

SRM VALLIAMMAI ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

SRM Nagar, Kattankulathur - 603 203.

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



UG - Curricula and Syllabi

B.E.– MECHANICAL ENGINEERING

REGULATION 2023

SRM VALLIAMMAI ENGINEERING COLLEGE

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

B.E. MECHANICAL ENGINEERING

REGULATIONS – 2023

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates of the Mechanical Engineering Programme will have the technical expertise, interpersonal skills, and moral principles necessary to succeed in their positions and provide solutions to societal, environmental, and engineering problems in the organizations.

PEO2: Successful graduates of the Mechanical Engineering Programme will pursue further studies.

PEO3: The Mechanical Engineering Programme graduates will emerge as employers to create jobs for talented and needy students.

2. PROGRAMME OUTCOMES (POs):

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

PO#	Graduate Attribute	Programme Outcomes
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

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

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Mechanical Engineering program the student will have following Program specific outcomes

PSO1: Apply multidisciplinary and mechanical expertise to analyze, design, and produce goods that will meet societal demands.

PSO2: Apply innovative technologies and techniques to create, and launch new systems, services, processes, and products.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
I	3	3	3	3	3	2			2		1		3	3
II							3	3	2	3	1		2	2
III	3	3		3	3	2				3	1	1	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

Year I	Sem I	Subject code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
		EN3111- Professional English – I	2.2	1.6	1	1.2	0.4	-	1	-	-	2.8	0.2	0.4	-	-	-	-
		MA3122- Matrices and Calculus	3	2	2	1								1				
		PH3123- Engineering Physics	2.8	1.4	1.4	1	1.25	1	1					1				
		CH3124- Engineering Chemistry	2.8	1.8	2.2	1.2	0.2	0.2	0.8	-	-	-	-	0.8	1	-	-	-
		GE3131- Basic Electrical & Electronics Engineering	2.8	2.8	1.7	1.6	3	2	2	2					1.8	1.5	2.5	2
		GE3111- தமிழர் மரபு /Heritage of Tamils																
		EN3119- English Language Learning Laboratory	1	1	0.4	0.8	0.4		0.8			2.2		1				
		GE3121 - Physics and Chemistry Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-	-
		GE3134- Engineering Practices Laboratory	0.6	2	1.4	1.2	1.2	0.2			0.2		0.2	0.4	0.6		1	0.4
Year I	Sem II	EN3211- Professional English – II	1.2	1.2	1.4	1.2	0.4					2.8	0.2	0.4				
		MA3222- Statistics and Numerical Methods	3	3											3			
		PH3225- Materials Science	2.6	2	1.3	1.2	1	1	1	-	-	-	-	1	-	-	-	-
		CH3225- Chemistry of Functional Materials	2.8	2.2	1.4	2	1.4	-	0.2	-	-	-	-	1	0.8	1.2	-	-
		GE3231- Problem solving and Python Programming	2.4	2.6	3	2.8	1.8						1.6	2	2.5		2	1
		GE3211- தமிழரும் தொழில் நுட்பமும் / Tamils and Technology																
		GE3233- Engineering Graphics and Design	2		3		1				1	3		2	2	1	1	1

		GE3221- Engineering Sciences Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-			-	-
		GE3232- Problem solving and Python Programming Laboratory	2.6	2.6	3.0	2.8	2.2						2.0	2.0	1.0	3.0		1.7	2.0
		GE3251- NSS/YRC/NSO/CLUB ACTIVITIES																	

		Subject code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		MA3321- Transforms and Partial Differential Equations	3	3			1							1		
		ME3332- Engineering Mechanics	3	3	3	3									3	3
		ME3363-Engineering Thermodynamics	3	3	2	1		0.4			1		0.6	2	1.8	0.8
		ME3364-Engineering Metallurgy And Material Testing	3	1	3	1	0.4	0.4	0.4	0.2				2	1.6	2
		ME3365-Manufacturing Processes	3		2		2	2	2	1	1			1	3	2
		ME3366-Fluid Mechanics and Machinery	3	2.8	3	0.6	1.6	0.4							3	3
		ME3367-Manufacturing Technology Laboratory-I	3						1		2			1		

		ME3338- Fluid Mechanics and Machinery Laboratory	3	3							3	1	2	3		1
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		ME3339- Computer Aided Drafting Laboratory	1.3		1.3	0.3	1	1.3			1.3	1			0.3	0.3
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Year II	Sem IV	Subject code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		MA3425- Applied Mathematics for Mechanical Engineering	2	2	1	1										
		ME3462- Manufacturing Technology	3	3	2.8	1	1	1	3			3		2	3	2.2
		ME3463-Strength of Materials	3	3	3	3	2	3	1	3			1	3	3	2
		ME3464-Theoryof Machines	3	2	2		2			1					2.8	
		ME3465-Unconventional Machining Processes	3		1		1		1		1	1		1	2	2
		ME3466-Thermal Engineering	2	2										1	2	1
		ME3451-NCC Credit Course Level – I														
		ME3467-Manufacturing Technology Laboratory-II	3						1		2			1	1	2

		ME3468-Strength of Materials Laboratory	3	2	1.2	3	2.8	1	1		3			1	1	0
		ME3469-Thermal Engineering Laboratory	3	3		3		2	2	1					3	3

Year III	Sem V	Subject code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		ME3561 Metrology and Measurements	2	1	2	1	2	1	1					1	2	
		ME3562 Mobility Engineering	2	1	2	1					1			1	1	2
		ME3563 Heat and Mass Transfer	3	3	3	2					1			1	3	2
		ME3564 Design of Machine Elements	2	2	3					1	1			2	3	1
		PMEXX Professional Elective – I	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PMEXX Professional Elective – II	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		CE3531 Environmental Studies														
		GE3551 NCC Credit Course Level – II*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		ME3566 Metrology and Measurements Laboratory	3				1							2	1	
		ME3567 Heat Transfer Laboratory	3	3		3		2	2	1					3	3
		ME3568 Dynamics Laboratory	3				1							2	2	

[illegible]

Year IV	Sem VII	Subject code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		ME3761 Process Planning and Cost Estimation	2	2							1	1		1	1	2
		ME3762 Mechatronics and Automation	3	2	3	2	1						1	3	3	2
		PMEXX Professional Elective – V	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PMEXX Professional Elective – VI	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BA3711 Human Values and Ethics	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		OXXXXX Open Elective	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MME20X Mandatory Course – II**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		ME3764 Mechatronics and Automation Laboratory	1	3							3			3	2	1
		ME3745 Simulation and Analysis Laboratory	2	3	3	2	3	-	-	1	1	1	-	1	3	1
		ME3746 Internship (2Weeks)	3	1	1		2			2	3	3		1	2	2
Year IV	Sem VIII	Subject code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		ME3841 Project Work	3	2	2	1	2	1	2	2	3	1	1	2	3	2

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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	GE3131	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3	
6	GE3111	தமிழர் மரபு/ Heritage of Tamils	HSMC	1	0	0	1	1	
PRACTICAL									
7	EN3119	English Language Learning Laboratory	HSMC	0	0	2	2	1	
8	GE3121	Physics and Chemistry Laboratory	BSC	0	0	4	4	2	
9	GE3134	Engineering Practices Laboratory	ESC	0	0	4	4	2	
Semester - II				Total	16	1	10	27	22
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	PH3225	Materials Science	BSC	3	0	0	3	3	
4	CH3225	Chemistry of Functional Materials	BSC	3	0	0	3	3	
5	GE3231	Problem Solving and Python Programming	ESC	3	0	0	3	3	
6	GE3211	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1	1	
THEORY CUM PRACTICAL									
7	GE3233	Engineering Graphics and Design	ESC	1	0	4	5	3	
PRACTICAL									
8	GE3221	Engineering Sciences Laboratory	BSC	0	0	4	4	2	
9	GE3232	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2	
10	GE3251	NSS / YRC / NSO / Club Activities [#]	PCD	0	0	0	0	0	
Total				17	1	12	31	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	ME3332	Engineering Mechanics	PCC	3	0	0	3	3
3	ME3363	Engineering Thermodynamics	PCC	3	0	0	3	3
4	ME3364	Engineering Metallurgy and Material Testing	PCC	3	0	0	3	3
5	ME3365	Manufacturing Processes	PCC	3	0	0	3	3
6	ME3336	Fluid Mechanics and Machinery	PCC	3	0	0	3	3
PRACTICAL								
7	ME3367	Manufacturing Technology Laboratory-I	PCC	0	0	3	3	2
8	ME3338	Fluid Mechanics and Machinery Laboratory	PCC	0	0	3	3	1.5
9	ME3339	Computer Aided Drafting Laboratory	PCC	0	0	3	3	1.5
Total				18	0	9	27	23

Semester - IV								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	MA3425	Applied Mathematics for Mechanical Engineering	BSC	2	0	0	2	2
2	ME3462	Manufacturing Technology	PCC	3	0	0	3	3
3	ME3463	Strength of Materials	PCC	3	0	0	3	3
4	ME3464	Theory of Machines	PCC	3	0	0	3	3
5	ME3465	Unconventional Machining Processes	PCC	3	0	0	3	3
6	ME3466	Thermal Engineering	PCC	3	0	0	3	3
7	GE3451	NCC Credit Course Level - I*	PCD	3	0	0	3	3
PRACTICAL								
8	ME3467	Manufacturing Technology Laboratory-II	PCC	0	0	3	3	2
9	ME3468	Strength of Materials Laboratory	PCC	0	0	3	3	1.5
10	ME3469	Thermal Engineering Laboratory	PCC	0	0	3	3	1.5
Total				17	0	9	26	22

* 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	ME3561	Metrology and Measurements	PCC	3	0	0	3	3
2	ME3562	Mobility Engineering	PCC	3	0	0	3	3
3	ME3563	Heat and Mass Transfer	PCC	3	0	0	3	3
4	ME3564	Design of Machine Elements	PCC	3	0	0	3	3
5	PMEXX	Professional Elective – I	PEC	3	0	0	3	3
6	PMEXX	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	ME3566	Metrology and Measurements Laboratory	PCC	0	0	3	3	1.5
10	ME3567	Heat Transfer Laboratory	PCC	0	0	3	3	1.5
11	ME3568	Dynamics 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	ME3661	Computer Integrated Manufacturing	PCC	3	0	0	3	3
2	ME3662	Design of Transmission System	PCC	3	0	0	3	3
3	ME3663	Power Plant Engineering	PCC	3	0	0	3	3
4	PMEXXX	Professional Elective-III	PEC	3	0	0	3	3
5	PMEXXX	Professional Elective-IV	PEC	3	0	0	3	3
6	MAN10X	Management Elective ^{\$}	HSMC	2	0	0	2	2
7	MME10X	Mandatory Course-I [%]	MC	3	0	0	3	0
PRACTICAL								
8	ME3664	Design and Fabrication Project	PCC	0	0	4	4	2
9	ME3665	CAD / CAM Laboratory	EEC	0	0	3	3	1.5
10	EN3649	Professional Communication Laboratory	EEC	0	0	2	2	1
Total				20	0	9	29	21.5

^{\$} Management Elective shall be chosen from the Management Elective Courses

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

Semester-VII								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	ME3761	Process Planning and Cost Estimation	PCC	3	0	0	3	3
2	ME3762	Mechatronics and Automation	PCC	3	0	0	3	3
3	PMEXX	Professional Elective – V	PEC	3	0	0	3	3
4	PMEXX	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	MME20X	Mandatory Course-II **	MC	3	0	0	3	0
PRACTICAL								
8	ME3764	Mechatronics and Automation Laboratory	PCC	0	0	3	3	1.5
9	ME3745	Simulation and Analysis Laboratory	EEC	0	0	3	3	1.5
10	ME3746	Internship (2 Weeks) ***	EEC	0	0	0	0	1
Total				20	0	6	26	21

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

**

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

*** Students should undergo Internship during vacation of VI Semester (Two weeks) and should submit a report and attend viva voce.

Semester-VIII								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
PRACTICAL								
1	ME3841	Project Work	EEC	0	0	20	20	10
Total				0	0	20	20	10

TCP-Total Contact Periods 215

Total Credits: 168

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
	Robotics And Automation	Modern Mobility Systems	Clean And Green Energy Technologies	Process Equipment And Piping Design	Computational Engineering	Product And Process Development
1	Sensors and Instrumentation	Automotive Materials, Components, Design and Testing	Bioenergy Conversion Technologies	Design of Pressure Vessels	Computational Solid Mechanics	Value Engineering
2	Electrical Drives and Actuators	Conventional and Futuristic Vehicle Technology	Carbon Footprint Estimation and Reduction Techniques	Failure Analysis and NDT Techniques	Computational Fluid Dynamics and Heat Transfer	Additive Manufacturing
3	Embedded Systems and Programming	Clean off - Highway Vehicle Technology	Energy Conservation in Industries	Material Handling and Solid Processing Equipment	Theory on Computation and Visualization	Design for X
4	Robotics	Vehicle Health Maintenance and Safety	Energy Storage Devices	Thermal and Fired Equipment design	Computational Bio-Mechanic	Ergonomics in Design
5	Smart Mobility and Intelligent Vehicles	CAE and CFD Approach in Future Mobility	Renewable Energy Technologies	Industrial Layout Design and Safety	Advanced Statistics and Data Analytics	New Product Development
6	Haptics and Immersive Technologies	EV and HV Technology and Thermal Management	Equipment for Pollution Control	Design Codes and Standards for Process Equipment	Machine Learning for Intelligent Systems	Product Life Cycle Management

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.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL - I: ROBOTICS AND AUTOMATION								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PME101	Sensors and Instrumentation	PEC	3	0	0	3	3
2	PME102	Electrical Drives and Actuators	PEC	3	0	0	3	3
3	PME103	Embedded Systems and Programming	PEC	3	0	0	3	3
4	PME104	Robotics	PEC	3	0	0	3	3
5	PME105	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
6	PME106	Haptics and Immersive Technologies	PEC	3	0	0	3	3

VERTICAL-II: MODERN MOBILITY SYSTEMS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PME201	Automotive Materials, Components, Design and Testing	PEC	3	0	0	3	3
2	PME202	Conventional and Futuristic Vehicle Technology	PEC	3	0	0	3	3
3	PME203	Clean off - Highway Vehicle Technology	PEC	3	0	0	3	3
4	PME204	Vehicle Health Maintenance and Safety	PEC	3	0	0	3	3
5	PME205	CAE and CFD Approach in Future Mobility	PEC	3	0	0	3	3
6	PME206	EV and HV Technology and Thermal Management	PEC	3	0	0	3	3

VERTICAL-III: CLEAN AND GREEN ENERGY TECHNOLOGIES								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PME301	Bioenergy Conversion Technologies	PEC	3	0	0	3	3
2	PME302	Carbon Footprint Estimation and Reduction Techniques	PEC	3	0	0	3	3
3	PME303	Energy Conservation in Industries	PEC	3	0	0	3	3
4	PME304	Energy Storage Devices	PEC	3	0	0	3	3
5	PME305	Renewable Energy Technologies	PEC	3	0	0	3	3
6	PME306	Equipment for Pollution Control	PEC	3	0	0	3	3

VERTICAL-IV: PROCESS EQUIPMENT AND PIPING DESIGN								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PME401	Design of Pressure Vessels	PEC	3	0	0	3	3
2	PME402	Failure Analysis and NDT Techniques	PEC	3	0	0	3	3
3	PME403	Material Handling and Solid Processing Equipment	PEC	3	0	0	3	3
4	PME404	Thermal and Fired Equipment design	PEC	3	0	0	3	3
5	PME405	Industrial Layout Design and Safety	PEC	3	0	0	3	3
6	PME406	Design Codes and Standards for Process Equipment	PEC	3	0	0	3	3

VERTICAL-V: COMPUTATIONAL ENGINEERING								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PME501	Computational Solid Mechanics	PEC	3	0	0	3	3
2	PME502	Computational Fluid Dynamics and Heat Transfer	PEC	3	0	0	3	3
3	PCS703	Theory on Computation and Visualization	PEC	3	0	0	3	3
4	PME504	Computational Bio-Mechanic	PEC	3	0	0	3	3
5	PME505	Advanced Statistics and Data Analytics	PEC	3	0	0	3	3
6	PCS704	Machine Learning for Intelligent Systems	PEC	3	0	0	3	3

VERTICAL-VI: PRODUCT AND PROCESS DEVELOPMENT								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PME601	Value Engineering	PEC	3	0	0	3	3
2	PME602	Additive Manufacturing	PEC	3	0	0	3	3
3	PME603	Design for X	PEC	3	0	0	3	3
4	PME604	Ergonomics in Design	PEC	3	0	0	3	3
5	PME605	New Product Development	PEC	3	0	0	3	3
6	PME606	Product Life Cycle Management	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	3	0	0	3
2	OAG102	Organic Farming for Sustainable Agricultural Production	Agri	3	3	0	0	3
3	OAG103	Sustainable Development through Indian Knowledge System	Agri	3	3	0	0	3
4	OCE101	Air and Noise Pollution Control Engineering	Civil	3	3	0	0	3
5	OCE102	Environmental Impact Assessment	Civil	3	3	0	0	3
6	OCE103	Green Building Design	Civil	3	3	0	0	3
7	OAD101	Foundation of Data Science	AIDS	3	3	0	0	3
8	OAD102	Open Source Software Tools	AIDS	3	3	0	0	3
9	OCS101	IoT and its Applications	CSE	3	3	0	0	3
10	OCS102	Machine Learning with R	CSE	3	3	0	0	3
11	OCS103	Tamil Computing	CSE	3	3	0	0	3
12	OCY101	Cyber Forensic and Investigation	CYB	3	3	0	0	3
13	OCY102	Social Media Security	CYB	3	3	0	0	3
14	OEC101	Introduction to 5G Communication Networks	ECE	3	3	0	0	3
15	OEC102	Introduction to Industrial IoT	ECE	3	3	0	0	3
16	OEC103	Arduino Programming and its Applications	ECE	3	3	0	0	3
17	OMD101	Introduction to Food Processing	MDE	3	3	0	0	3
18	OMD102	Introduction to Biomedical Instrumentation	MDE	3	3	0	0	3
19	OEE101	Renewable Energy Sources	EEE	3	3	0	0	3
20	OEE102	Energy Conservation and Management	EEE	3	3	0	0	3
21	OEE103	Electric and Hybrid Vehicles	EEE	3	3	0	0	3
22	OEI101	Fundamentals of Robotics	EIE	3	3	0	0	3
23	OEI102	Sensors for Engineering Applications	EIE	3	3	0	0	3
24	OIT101	Multimedia Technologies	IT	3	3	0	0	3
25	OIT102	3D Printing and Its Applications	IT	3	3	0	0	3
26	OIT103	Web Frameworks	IT	3	3	0	0	3
27	OCH101	Nanomaterials and Applications	CHE	3	3	0	0	3
28	OPH101	Advanced Functional Materials	PHY	3	3	0	0	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)

OTHER DEPARTMENT COURSES

OTHER DEPARTMENT COURSES								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	AG3432	Thermodynamics for Agricultural Engineering	PEC	3	0	0	3	3
2	AG3461	Tractors and Farm Engines	PEC	3	0	0	3	3
3	ME3366	Applied Fluid Dynamics and Thermodynamics	PEC	3	0	0	3	3
4	PME207	Foundation Skills In Integrated Product Development	PEC	3	0	0	3	3
5	PME208	Rapid Prototyping	PEC	3	0	0	3	3
OPEN ELECTIVE								
6	OME101	Refrigeration and Air conditioning	OEC	3	3	0	0	3
7	OME102	Advanced Manufacturing Processes	OEC	3	3	0	0	3
8	OME103	Material Testing and Characterization	OEC	3	3	0	0	3
9	OME104	Hazardous Waste Management	OEC	3	3	0	0	3
10	OME105	Automotive Engineering	OEC	3	3	0	0	3
MANDATORY COURSE								
1	MME201	Industrial Safety	MC	3	0	0	3	0

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	12	3	2					29
3	ESC	5	8	9		2				24
4	PCC			11	20	16.5	12.5	7.5		67.5
5	PEC					6	6	6		18
6	OEC							3		3
7	EEC						1	2.5	10	13.5
8	PCD		0							0
9	Mandatory Course (Non-credit)						0	0		0
Total		22	24	23	22	24.5	21.5	21	10	168

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

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

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

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

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

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

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

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

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

6	BAM406	Financial Analytics	PEC	3	0	0	3	3
VERTICAL V: ENVIRONMENT AND SUSTAINABILITY								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	AGM501	Sustainable infrastructure Development	PEC	3	0	0	3	3
2	AGM502	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3	AGM503	Sustainable Bio Materials	PEC	3	0	0	3	3
4	AGM504	Materials for Energy Sustainability	PEC	3	0	0	3	3
5	AGM505	Green Technology	PEC	3	0	0	3	3
6	AGM506	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3

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.

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:

- 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.

TEXTBOOKS:

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 Jeevani, Department of English, Anna University.
2. Technical Communication – Principles and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.

REFERENCE BOOKS:

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

CO - PO and CO - PSO MAPPING

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	1.6	1	1.2	0.4	-	1	-	-	2.8	0.2	0.4	-	-	-	-

OBJECTIVES:

1. To understand and apply matrix techniques for engineering applications.
2. To familiarize the student with basic calculus and traditions of 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 modeling 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

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 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 the vector differentiation and vector integration by using standard theorems.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt. Ltd., 2011.
2. James Stewart, "Calculus : Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015.
3. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2017.
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.

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	2	2	1								1				

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

1. To enhance the fundamental knowledge in crystalline materials and its applications.
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 fibre 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 diagram 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:**

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

1. To understand the properties of materials, crystalline material and growth techniques.
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.

TEXTBOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

4. Brijlal and Subramanyam, “Properties of Matter”, S .Chand publishing, 2002.
5. M.N.Avadhanulu & P.G.Kshirasagar, “A Text Book of Engineering Physics” – IX Edition, S.Chand Publications, 2014.
6. V.Rajendiran, Engineering Physics, Tata McGraw-Hill, New Delhi. 2011.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2010.
3. Shatendra Sharma & Jyotsna Sharma, “Engineering Physics”. Pearson, 2018

CO - PO and CO - PSO MAPPING

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	1.25	1	1					1				

(1-LOW, 2-MEDIUM, 3-HIGH)

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 nano materials.

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 students 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, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2021.

REFERENCE BOOKS:

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.

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	1	-	-	-
CO2	3	1	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	2	2	3	2	1	-	1	-	-	-	-	2	1	-	-	-
Average	2.8	1.8	2.2	1.2	0.2	0.2	0.8	-	-	-	-	0.8	1	-	-	-

(1–LOW, 2– MEDIUM, 3–HIGH)

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

COURSE OBJECTIVES

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

UNIT-I ELECTRICAL CIRCUITS 9

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

UNIT-II ELECTRICAL MACHINES 9

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

UNIT-III ANALOG ELECTRONICS 9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode –Characteristics

Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters.

UNIT-IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations – minimization using K maps (Simple Problems only).

UNIT-V MEASUREMENTS AND INSTRUMENTATION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to compute the electric circuit parameters for simple problems
2. Ability to explain the working principle and applications of electrical machines
3. Ability to analyze the characteristics of analog electronic devices
4. Ability to explain the basic concepts of digital electronics
5. Ability to explain the operating principles of measuring instruments

TEXTBOOKS

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

5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCE BOOKS

1. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
3. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

CO - PO and CO - PSO MAPPING

GE3131	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	2			3						2		2	
CO2	3	2				2		2					1	2		2
CO3	2	3	2	2									3			
CO4	3	3	1		3		2						1		3	
CO5	3	3	2	1			1						2	1		2
Average	2.8	2.8	1.7	1.6	3	2	2	2					1.8	1.5	2.5	2

(1–LOW, 2– MEDIUM, 3–HIGH)

GE3111

HERITAGE OF TAMILS

L T P C

1 0 0 1

UNIT I LANGUAGE AND LITERATURE

3

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

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

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 BOOK AND REFERENCE :

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கக.கக.பிள்ளை (வவளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – எவளக நதிக்களரையில் சங்ககால நகர நாகரிகம் (வதால்லியல் Fளற வவளியீடு)
4. வபாருளந – ஆற்றங்களர நாகரிகம். (வதால்லியல் Fளற வவளியீடு)
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.

அலகு I மொழி மற்றும் இலக்கியம்**3**

இந்திய வமாழிக் குடும்பங்கள் - திராவிட வமாழிகள்- தமிழ் ஒரு வசம்வமாழி- தமிழ் வசவ்விலக்கியங்கள்- சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் கமலாண்மைக் கருத்துகள்- தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண வபௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்- சிற்றிலக்கியங்கள்- தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியாரின் பங்களிப்பு

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

நடுகல் முதல் நவீன சிற்பங்கள் வளர் -ஐம்வபான் சிளகைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் ளகவிளனப் வபாருட்கள் , வபாம்ளமகள்- கதர் வசய்யும் களல - சுடுமண் சிற்பங்கள்

அலகு III நாட்டுப்புறக் கறலகள் மற்றும் வீர 3**விறளயொட்டுகள்**

நாட்டுப்புற களதகள், பாடல்கள்-வதருக்கூத், கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்- ஓயிலாட்டம், கதால்பாளவக் கூத், சிலம்பாட்டம்- வளரி, புலியாட்டம், தமிழர்களின் விளளயாட்டுகள்

அலகு IV: தமிழர்களின் திறைக் ககொட்பொடுகள்**3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - வதால்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் ககாட்பொடுகள்- தமிழர்கள் கபாற்றிய அறக்ககாட்பாடு -தமிழ் சங்கம்-சங்கம் வளர்த்த தமிழ்- சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்- சங்ககால நகரங்களும் Fளறமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் கசாழர்களின் வவற்றி

அலகு V: இந்திய கதசிய இயக்கம் மற்றும் இந்திய 3

பைப்பொட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலாபகபாரில் தமிழர்களின் பங்கு இந்தியா மற்றும் வவளிநாட்டின் பிற பகுதிகளின் தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமாரியாளத இயக்கம் – இந்திய மருத்வத்தில், சித்த மருத்வத்தின் பங்கு- கல்வவட்டுகள், ளகவயமுத்வப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு

TOTAL : 15 PERIODS

TEXT BOOKS & REFERENCE :

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கக.கக.பிள்ளை (வவளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முளனவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – ளவளக நதிக்களரயில் சங்ககால நகர நாகரிகம் (வதால்லியல் ள்ற வவளியீடு)
4. வபாருளந – ஆற்றங்களர நாகரிகம். (வதால்லியல் ள்ற வவளியீடு)
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.

EN3119	ENGLISH LANGUAGE LEARNING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

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: GROUP DISCUSSION 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: ADVANCED ENGINEERING MATERIALS 9

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 : 45 PERIODS

COURSE OUTCOMES:

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

1. Pronounce the words correctly.
2. Understand the nonverbal clues.
3. 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

CO - PO and CO - 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	1	0.4	0.8	0.4		0.8			2.2		1				

(1–LOW, 2– MEDIUM, 3–HIGH)

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

OBJECTIVES:

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving 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: PHYSICS LABORATORY (Any 5 Experiments)

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

TOTAL: 30 PERIODS

OUTCOMES:

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

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

REFERENCE

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

CO - PO and CO - PSO MAPPING

GE3121	PROGRAM OUTCOMES												PSOs			
	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	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-	-

(1–LOW, 2– MEDIUM, 3–HIGH)

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

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 familiarize 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

1. Determination of chloride content of water sample by Argentometric method.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
5. Determination of types and amount of alkalinity in water samples.
6. Estimation of available chlorine in bleaching powder solution.
7. Conductometric titration of barium chloride against sodium sulfate (Precipitation titration).
8. Estimation of sodium /potassium present in water using a flame photometer.
9. Estimation of TDS of a water sample by gravimetry.
10. Preparation of nanoparticles ($\text{Ag}/\text{Au}/\text{TiO}_2/\text{ZnO}/\text{CuO}$).
11. Pseudo first-order kinetics- ester hydrolysis.

TOTAL: 30 PERIODS

OUTCOMES

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

1. To infer the quality of water samples for alkalinity, hardness, DO, TDS, chloride, and chlorine.
2. To apply the knowledge on the estimation of metal ions, acidity and its precipitation nature towards their process.
3. To recognize the threshold limit for various characteristics of domestic water.
4. To identify the simple method of synthesis of nanoparticles.
5. To understand the pseudo first-order kinetics reaction from ester hydrolysis.

TEXTBOOKS

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

CO - PO and CO - PSO MAPPING

GE3121	PROGRAM OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	1	-	2	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	3	2.4	2.6	1	1.2	-	0.2	-	-	-	-	0.2	-	0.4	-	-

(1–LOW, 2– MEDIUM, 3–HIGH)

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.
3. To gain the skills for making fitting joints and assembling air conditioner.
4. To develop the skills for making simple electrical wiring connections using suitable tools.
5. To provide hands on experience for soldering and gain knowledge about the behavior of electronics components.

GROUP A (CIVIL & MECHANICAL)**I CIVIL ENGINEERING PRACTICE****15****Buildings:**

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

Plumbing Works:

- a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- b) Study of pipe connections requirements for pumps and turbines.
- c) Preparation of plumbing line sketches for water supply and sewage works.
- d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry works:

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

II MECHANICAL ENGINEERING PRACTICE**15****Welding:**

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

Basic Machining:

- a) Facing
- b) Simple Turning
- c) Step Turning

Sheet Metal Work:

- a) Forming & Bending
- b) Model making – Trays

Demonstration on:

- a) Smithy operations, upsetting, swaging, setting down and bending.
- b) Foundry operations like mould preparation for gear and step cone pulley.
- c) Assembly of centrifugal pump
- d) Assembly of air conditioner

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

15

1. 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.

IV ELECTRONICS ENGINEERING PRACTICE

15

1. Study of Electronic components and equipment – Resistor, colour coding measurement of AC
2. Signal parameter (peak-peak, RMS period, frequency) using CR.
3. Study of logic gates AND, OR, EX-OR and NOT.
4. Generation of Clock Signal.

5. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
6. Measurement of ripple factor of HWR and FWR.

COURSE OUTCOMES:

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

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

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

- | | |
|---|---------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets |
| 2. Carpentry vice (fitted to work bench) | 15 Nos. |
| 3. Standard woodworking tools | 15 Sets |

MECHANICAL

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

ELECTRICAL

1.	Assorted electrical components for house wiring	15 Sets
2.	Fluorescent Lamp	15 Sets
3.	Electrical measuring instruments	10 Sets
4.	Analog & Digital energy meter	5 Sets
5.	Megger	2
6.	Fan Regulator (Resistor & Electronic Type)	5
7.	Iron Box	2

ELECTRONICS

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

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GE3134	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3					1						1	2		3	
CO2		1	2		3						1				2	
CO3				3	2							1	1			2
CO4		2	3	1	2											
CO5		3	2	2					1							
Average	0.6	2	1.4	1.2	1.2	0.2			0.2		0.2	0.4	0.6		1	0.4

(1–LOW, 2– MEDIUM, 3–HIGH)

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, the students should be able

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.

TEXTBOOKS:

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

REFERENCE BOOKS:

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

CO - PO and CO - PSO MAPPING

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	1.2	1.2	1.4	1.2	0.4		0.			2.8	0.2	0.4				

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

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

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

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

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

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

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

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

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

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integrations using Trapezoidal, Simpson's rules.

UNIT-V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

9L+3T

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

TOTAL: 45L+15T PERIOD

OUTCOMES:

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:

6. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, 2015.
7. 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.

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

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

1. To understand about the interatomic bonding and deformation mechanism.
2. To understand the concept of various phase diagrams and their applications.
3. To facilitate the knowledge about Iron carbide system and its micro structures.
4. To enrich the idea of mechanical properties and Hardness measurements.
5. To enhance the advanced knowledge on ceramics, composites and nanomaterials

UNIT-I: INTERATOMIC FORCES AND IMPERFECTION IN SOLIDS 9

Introduction - forces between atoms - interatomic bonding - Ionic, covalent and metallic bonding - Intermolecular bonding - dispersion, dipole and hydrogen bonding. Imperfections - point, line, surface and volume - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods – Hall-petch relation- strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening

UNIT-II: PHASE DIAGRAMS 9

Solid solutions - Hume Rothery's rules - the phase rule - single component system - one- component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - free energy composition curves for binary systems - microstructural change during cooling.

UNIT-III: FERROUS ALLOYS 9

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - diffusion in solids - Fick's laws - phase transformations - TTT- diagram for eutectoid steel - pearlitic, bainitic and martensitic transformations - tempering of martensite - steels - stainless steels - cast irons.

UNIT-IV: MECHANICAL PROPERTIES 9

Tensile test - creep resistance - creep curves - mechanisms of creep - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and

UNIT – V: ADVANCED ENGINEERING MATERIALS

9

Metallic glasses: types - melt spinning process - properties and applications - Shape memory alloys - shape memory effect, pseudo elastic effect, properties of Ni-Ti alloy - applications: SMA blood clot filter - Ceramics - Super hard materials - Tungsten carbide and Boron nitrides
- Graphene - Applications - Superplastic forming - Bulk nanostructured materials by Severe Plastic Deformation (SPD) - Nanomaterials - properties - Nanoparticle thin film coating for self-cleaning applications

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. To acquire knowledge on the correlation of bonding and defects in various properties of materials.
2. To gain knowledge on the various phase diagrams and their applications
3. To acquire knowledge on Fe-Fe₃C phase diagram, various microstructures and alloys
4. To get knowledge on mechanical properties of materials and their measurement
5. To understand the basics of ceramics, composites and nanomaterials.

TEXTBOOKS:

1. O.P. Khanna – Materials Science & Metallurgy, Dhanpat Raj Publications, 2015.
2. Balasubramaniam, R. - Callister's Materials Science and Engineering. Wiley India Pvt.Ltd., 2014.
3. Raghavan, V. - Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
4. Raghavan, V. - Materials Science and Engineering: A First course. PHI Learning, 2015

REFERENCE BOOKS:

1. U.C. Jindal, Materials Science & Metallurgy, Pearson Publication, 2012.
2. Askeland, D. - Materials Science and Engineering. Brooks/Cole, 2010.
3. S.Mohan, V.Arjunan, Sujin P. Jose & M. Kanchana Mala, Principles of Materials Science, MJP Publishers, 2016.

4. Wahab, M.A. -Solid State Physics: Structure and Properties of Materials| Narosa Publishing House, 2009.

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PH3225	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	1	-	-	-	1	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	1	-	-	-	-	-	-	1	-	-	-	-
CO5	1	2	2	1	-	1	1	-	-	-	-	1	-	-	-	-
Average	2.6	2	1.3	1.2	1	1	1	-	-	-	-	1	-	-	-	-

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

1. To explain the basic concept of electrochemistry, and corrosion science to control corrosion.
2. To introduce the basic concepts and applications of phase rule and alloys.
3. To impart knowledge on the basis of engineering materials, preparatory methods, and their applications.
4. To apply the knowledge on fuels and combustion behaviors with their properties.
5. To identify the energy sources, operating principles, and applications of energy conversion and storage devices.

UNIT-I: ELECTROCHEMISTRY & 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-II: PHASE RULE AND ALLOYS**9**

Phase rule: introduction, the definition of terms with examples, one component system (water system) - reduced phase rule - construction of phase diagram by thermal analysis - simple eutectic systems, two-component systems (Zn-Mg system). Alloys: introduction - definition- properties of alloys - significance of alloying, functions, and effect of alloying elements- ferrous alloys - Nichrome and stainless steel - types (18/8) - heat treatment of steel, non- ferrous alloys – brass and bronze

UNIT-III: ENGINEERING MATERIALS**9**

Abrasives - natural abrasives, artificial abrasives. Refractories - properties-manufacture, common refractory bricks, insulating refractories, cermets, inorganic cermeting materials. Cement: manufacturing of cement, setting and hardening, types and uses- gypsum plaster. Engineering plastics: reinforced or filled plastics, polymer blends, and alloys

UNIT-IV: ENERGY SOURCES AND STORAGE DEVICES**9**

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

UNIT – V: FUELS AND COMBUSTION**9**

Fuels: Introduction - fossil fuels – alternate fuels - need for advanced fuels - manufacture of synthetic petrol (Bergius process), octane number, cetane number - characteristics and advantages of biodiesel, ethanol, hydrogen, propane and natural gas. Combustion: Introduction - Calorific value - higher and lower calorific values - ignition temperature, spontaneous ignition temperature, explosive range, emission characteristics - CO₂ emission and Footprint- essential requirement for complete combustion.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

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

1. To infer the importance of electrochemistry and corrosion.
2. To identify a strong foundational knowledge in phase rule systems and alloys.
3. To apply the knowledge of engineering materials for application requirements.
4. To recommend suitable fuels for engineering processes and applications.
5. To recognize the energy resources for suitable applications in energy storage sectors

TEXTBOOKS:

1. P. C. Jain and Monica Jain, “Engineering Chemistry”, 18th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2021.
2. S.S. Dara and S.S. Umare, “A Text Book of Engineering Chemistry”, 12th Edition, S. Chand & Company LTD, New Delhi, 2021.
3. B. Sivasankar, “Engineering Chemistry”, Tata McGraw-Hill Publishing Company LTD, 2023.

REFERENCE BOOKS:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath, and James Murday, “Textbook of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Shikha Agarwal, “Engineering Chemistry” - Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.

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CH3225	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	-	-	-	-	-	-	1	-	1	-	-
CO2	2	1	1	2	1	-	-	-	-	-	-	1	1	1	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	1	1	1	-	-
CO4	3	2	1	2	1	-	-	-	-	-	-	1	1	2	-	-
CO5	3	3	2	2	1	-	1	-	-	-	-	1	1	1	-	-
Average	2.8	2.2	1.4	2	1.4	-	0.2	-	-	-	-	1	0.8	1.2	-	-

(1–LOW, 2– MEDIUM, 3–HIGH)

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.

UNIT IV FILES, EXCEPTIONS, MODULES AND PACKAGES**9**

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

UNIT V CLASSES AND OBJECTS

9

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

TOTAL: 45 PERIODS

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.
4. 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.

TEXT BOOKS:

1. Reema Thareja, “Python Programming using Problem solving Approach”, Oxford Higher Education, 2018.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016 (<http://greenteapress.Com/wp/think-python/>)
3. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python” – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

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

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

WEB REFERENCES:

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

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GE3231	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1		3	4
1	3	3	3	3	2	-	-	-	-	-	2	2	2		-	1
2	3	3	3	3	2	-	-	-	-	-	2	2	-	-	3	-
3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	1	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	2	-
5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	1
Average	2.4	2.6	3	2.8	1.8						1.6	2	2.5		2	1

(1–LOW, 2– MEDIUM, 3–HIGH)

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 Period - 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 ofCoins – 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 Period, 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 BOOKS & REFERENCE :**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.)
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –

அலகு I நெசவு மற்றும் பீங்கான் நதாழில்நுட்பம்**3**

வநசவு மற்றும் பாளனத் வதாழில்நுட்பம்: சங்க காலத்தில் வநசவுத்வதாழில் - பாளனத் வதாழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் -பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமமப்பு மற்றும் கட்டுமான நதாழில்நுட்பம் 3

வடிவளமப்பு மற்றும் கட்டிடத் வதாழில்நுட்பம்: சங்க காலத்தில் வடிவளமப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுவபாருட்களில் வடிவளமப்பு-சங்க காலத்தில் கட்டுமான வபாருட்களும்நடுகல்லும் - சிலப்பதிகாரத்தில் கமளட அளமப்பு பற்றிய விவரங்கள் மாமல்லபுரச் சிற்பங்களும், ககாவில்களும் - கசாழர் காலத்Fவபருங்ககாயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக்ககாயில்கள் - மாதிரி கட்டளமப்புகள் பற்றி அறிதல், மFளர மீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமளல நாயக்கர் மஹால் - வசட்டிநாட்டு.வீடுகள் - பிரிட்டிஷ் காலத்தில் வசன்னையில் இங்கதா- சாகராவசனிக்கட்டிடக் களல.

அலகு III உற்பத்தி நதாழில்நுட்பம்**3**

உற்பத்தித் வதாழில் நுட்பம்: கப்பல் கட்டும் களல - உகலாகவியல் -இரும்புத் வதாழிற்சாளல - இரும்பு உருக்குதல், எஃகு - வரலாற்றுச்சான்றுகளாக வசம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள்அச்சடித்தல் - மணி உருவாக்கும் வதாழிற்சாளலகள் - கல்மணிகள்,கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்குமணிகள்-எலும்புத்Fண்டுகள்-வதால்லியல்சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வளககள்.

அலகு IV: விவசாயம் மற்றும் ெர்ப்பாசன நதாழில்நுட்பம் 3

குளங்கள், மதகு - கசாழர்காலக் குழுழித் தூம்பின் முக்கியத்Fவம் -கால்நளட பராமரிப்பு - கால்நளடகளுக்காக வடிவளமக்கப்பட்டகிணறுகள் - கவளாண்ளம மற்றும் கவளாண்ளமச் சார்ந்தவசயல்பாடுகள் - கடல்சார் அறிவு - மின்வளம் - முத்F மற்றும்முத்Fக்குளித்தல் - வபருங்கடல் குறித்த பண்ளடய அறிவு - அறிவுசார் சமூகம்

அலகு V: அறிவியல் தமிழ் & தமிழ் கணினி**3**

அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி -தமிழ் நூல்களள மின்பதிப்பு வசய்தல் - தமிழ்வமன்வபாருட்கள் உருவாக்கம் - தமிழ் இளணயக் கல்விக்கழகம் -தமிழ் மின் நூலகம் - ளணயத்தில் தமிழ் அகராதிகள் - வசாற்குளவத்திட்டம்.

TOTAL : 15 PERIODS

உமர புத்தகங்கள் & குறிப்பு புத்தகங்கள்:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கக.கக.பிள்ளை (வவளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முளனவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – எவளக நதிக்களரயில் சங்ககால நகர நாகரிகம் (வதால்லியல் Fளற வவளியீடு)
4. வபாருளந – ஆற்றங்களர நாகரிகம். (வதால்லியல் Fளற வவளியீடு)
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.

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

OBJECTIVES:

The main learning objective of this course is to impart knowledge

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

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT-I: PLANE CURVES AND SPECIAL CURVES 10

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

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

Orthographic projection- Principles-Principal planes - First angle projection-projection of points at 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 & 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. Natrajan 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 CO- 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	2	1	-	1
CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	1	-	1
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	1	-	1
CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	1	-	1
CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	1	-	1
Average	3	1	2	-	2	-	-	-	-	3	-	2	2	1	-	1

(1-LOW,2-MEDIUM,3-HIGH)

OBJECTIVES:

1. To gain practical knowledge and to co-relate 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 student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

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

TOTAL: 30 PERIODS**OUTCOMES:**

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

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

TEXTBOOKS:

1. Wilson J.D. and Hernandez C.A., —Physics Laboratory 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.

GE3221	PROGRAM OUTCOMES												PSOs			
	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	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-	-

(1–LOW, 2– MEDIUM, 3–HIGH)

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

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: CHEMISTRY LABORATORY

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

TOTAL: 30 PERIODS

OUTCOMES

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

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

TEXT BOOKS

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

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	-	-	-	-	-	-	-	-	2	-	-
CO3	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	1	1	2	2	2	-	-	-	-	-	-	-	-
CO5	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	2	1.4	1	1	1.2	0.4	0.6	0.4	-	-	-	-	-	0.4	-	-

(1–LOW, 2– MEDIUM, 3–HIGH)

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, 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.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL: 60 PERIODS

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 – PSO Mapping

GE3232	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	2	1	3	-	-
CO2	3	3	3	3	3	-	-	-	-	-	3	2	-	-	2	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	-	3	-	2
CO4	3	2	-	2	2	-	-	-	-	-	1	-	-	-	1	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	1	-	2	2
Average	2.6	2.6	3.0	2.8	2.2						2.0	2.0	1.0	3.0	1.7	2.0

(1–LOW, 2– MEDIUM, 3–HIGH)

GE3251- NSS/NSO/YRC/CLUB ACTIVITIES

Course Code and Title : NSS/NSO/YRC/Club Activities

OBJECTIVES:

Unit – 1 : NATIONAL SERVICE SCHEME (NSS)

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.

NSO/YRC & 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>

RESONANCE – SKILL BASED ACTIVITIES

OBJECTIVES:

1. To know the basics and general principles of Physics.
2. To provide knowledge of the current trends in Physics.
3. 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/NSO/YRC/CLUB ACTIVITIES

தமிழ்

மன்றம்பொடத்திட்டத்தின் கநாக்கங்கள்

1. மாணவர்களள சிறந்த கமளடப்கபச்சாளர்களாக உருவாக்குவF
2. தாய்வமாழியின் கமன்ளமளய பாFகாப்பF..

பயிற்சித்திட்டம்

1. கபச்சுக்களலப் பயிற்சி
2. கவிளத மற்றும் கட்டுளரகள் எழுFம் பயிற்சி
3. அறிவியல் வபாறியியல் வதாழில்நுட்பங்களளத் தமிழில் எழுFதல்.
4. பட்டிமன்ற கமளடகளில் கபசும் பயிற்சி.
5. நாட்டுப்புறப்பாடல்கள் பாடுதல் மற்றும் களதகள் எழுFம் பயிற்சி.

கற்றல் முடிவு

1. கபச்சுக்களலப் தேர்ச்சி
2. நாட்டுப்புறப்பாடல்கள் பற்றிய புரிதல்

கமற்ககொள்கள்

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

<https://poriyari.in/>

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.

Reference

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

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

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/>

CATALYSIS – SKILL-BASED ACTIVITIES

OBJECTIVES:

1. To inculcate a scientific attitude and temper.
2. To provide an opportunity to develop constructive, explorative & inventive ideas
3. among the students.
4. 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>
<https://www.indiabix.com/general-knowledge/chemistry>

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

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/>

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

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 6

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

UNIT-II: FOURIER SERIES 6

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

UNIT-III: LAPLACE TRANSFORMS 6

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

UNIT-IV: FOURIER TRANSFORMS 6

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

UNIT – V: Z – TRANSFORMS AND DIFFERENCE EQUATIONS 9

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

COURSE OUTCOMES:

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

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

REFERENCE BOOKS:

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, “Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.5. Ray Wylie. C and Barrett.L.C, “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.

5. 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	3			1							1				

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

The main learning objective of this course is to prepare the students to:

1. Learn the use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
2. Introduce the equilibrium of rigid bodies, vector methods and free body diagram.
3. Study and understand the distributed forces, surface, loading on beam and intensity.
4. Learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Develop basic dynamics concepts force, momentum, work and energy.

UNIT-I: BASICS OF PARTICLES**9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Action and Reaction.

UNIT-II: EQUILIBRIUM OF RIGID BODIES**9**

Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force - Couple system, Further Reduction of a System of Forces, Equilibrium in Two Dimensions - Reactions at Supports and Connections.

UNIT-III: DISTRIBUTED FORCES**9**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Centroid of a Volume, Composite Bodies. Moments of Inertia of Areas - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas.

UNIT-IV: FRICTION**9**

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT-V: DYNAMICS OF PARTICLES**9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL : 45 PERIODS**SKILL DEVELOPMENT ACTIVITIES**

(Group Seminar/Mini Project/Assignment/Content Preparation/ Quiz /Surprise Test/Solving GATE Questions/etc.)

5

1. Friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles.
2. Trusses and Frames
3. Kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular)
4. Energy formulations; Lagrange's equation
5. Familiarization of any one relevant software tool (Solid Works/SIM link/Adams/Equivalent open source software)

COURSE OUTCOMES:

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

1. Illustrate the vector and scalar representation of forces and moments.
2. Analyze the rigid body in equilibrium.
3. Evaluate the properties of distributed forces.
4. Determine the friction and the effects by the laws of friction.
5. Calculate dynamic forces exerted in rigid body.

TEXTBOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017.

2. Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.

REFERENCE BOOKS:

1. P Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
2. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5th Edition, McGraw Hill Higher Education, 2013.

E-RESOURCES:

1. https://swayam.gov.in/nc_details/NPTEL
2. <https://www.freecad.org/?lang=en>
3. <https://www.sculpteo.com/en/glossary/openscad-definition/>
4. <https://all3dp.com/2/best-open-source-cad-software/>
5. <https://gate.nptel.ac.in/>

CO - PO and CO - PSO MAPPING

ME3332	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3									3	3
CO2	3	3	3	3									3	3
CO3	3	3	3	3									3	3
CO4	3	3	3	3									3	3
CO5	3	3	3	3									3	3
Average	3	3	3	3									3	3

(1–LOW, 2– MEDIUM, 3–HIGH)

ME3363	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is to prepare the students to:

1. Understand the basic concepts of Engineering thermodynamics and application to the first law of thermodynamics.
2. Understand the second law of thermodynamics and its application to then thermodynamic systems and concepts of entropy and exergy.
3. Know the application of the second law of thermodynamics and understand the availability concepts.
4. Know the various thermodynamic properties and to understand the concept of steam power cycles and its application in the steam power plants.
5. Know the various properties of the ideal and real gas and the significance of compressibility factor in gas mixtures and the various property relations involved in thermodynamics.

(Use of steam tables and psychrometric chart is permitted)

UNIT-I: BASIC CONCEPTS AND FIRST LAW 9

Basic concepts - Thermodynamic systems, Properties and processes. Thermodynamic Equilibrium - Displacement work - P-V diagram. Heat and work transfer. Zeroth law – concept of temperature and temperature scales –First law of thermodynamics – application to closed and open systems – steady and unsteady flow processes.

UNIT-II: SECOND LAW AND ENTROPY 9

Heat Reservoir, source and sink. Heat Engine, Refrigerator, and Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance.

UNIT-III: AVAILABILITY AND APPLICATION OF II LAW 9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High - grade and low - grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency.

UNIT-IV: PROPERTIES OF PURE SUBSTANCE**9**

Steam - formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using of Steam Table and Mollier Chart.

UNIT-V: GAS MIXTURES AND THERMODYNAMIC RELATIONS**9**

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. VanderWaal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states – Generalized Compressibility Chart. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule Thomson Coefficient, Clausius Clapeyron equation.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

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

1. Apply the basic concepts of thermodynamic system, heat and work interaction and also can plot the PV and TS diagrams for all the processes.
2. Apply the second law of thermodynamics in analyzing the performance of thermal devices through energy and entropy calculations.
3. Apply the second law of thermodynamics to various applications and calculate the availability.
4. Evaluate the various properties of steam through steam tables and Mollier chart and understand the various properties relationship.
5. Solve the problems related to Gas Mixtures and the various property relations involved in thermodynamics.

TEXT BOOKS:

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics", 5th Edition, 2017.
2. Nag.P.K. "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 6th Edition 2017.

REFERENCE BOOKS:

1. Yunus A Cengel, Michael A Boles & Mehmet Kanoglu "Thermodynamics, An Engineering Approach", 9th edition 2019.
2. Borgnakke & Sonntag, "Fundamental of Thermodynamics", Wiley 9th Edition, 2016.

E RESOURCES

CO - PO and CO - PSO MAPPING

ME3363	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	1								2		
CO2	3	3	2	1								2		
CO3	3	3	2	1					1		1	2	3	
CO4	3	3	2	1		1			2		1	2	3	2
CO5	3	3	2	1		1			2		1	2	3	2
Average	3	3	2	1		0.4			1		0.6	2	1.8	0.8

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVE:

To impart knowledge on

1. The phase structure of metals/alloys.
2. The heat treatment process employed for various materials.
3. The classification of ferrous and nonferrous alloys.
4. Practical exposure towards microstructure of Engineering Materials.
5. 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 – normalising, 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 - carburising, 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 AND CHARACTERIZATION 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:

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

1. Know the phase reactions of various metals and alloys.
2. Have great exposure in the heat treatment processes and know their purpose in engineering applications.
3. Have knowledge in the classification, properties and applications of various ferrous alloys.
4. Know the classification and application of various non ferrous alloy materials.
5. Identify the various mechanical properties for the ferrous and non ferrous 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>

CO - PO and CO - PSO MAPPING

ME3364	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	3	2								2	1	2
CO2	3	1	3	1		2		1				2	1	2
CO3	3	1	3									2	2	2
CO4	3	1	3				2					2	2	2
CO5	3	1	3	2	2							2	2	2
Average	3	1	3	1	0.4	0.4	0.4	0.2				2	1.6	2

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVE:

1. To understand different manufacturing processes and select the best one out of the available methods.
2. To expose the concepts to the students in various metal casting, metal joining processes.
3. To learn and understand the working principle of bulk deformation processes.
4. To understand the working principles of sheet metal forming process
5. To Apply the working principle of plastics moulding.

UNIT-I: METAL CASTING**10**

Casting terminology, hand moulding, 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**10**

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: BULK DEFORMATION PROCESSES**9**

Hot working and cold working of metals - Forging processes - Open, impression and closed die forging - forging operations. Rolling of metals- Types of Rolling - Flat strip rolling - shape rolling operations - Defects in rolled parts. Principle of rod and wire drawing - Tube drawing - Principles of Extrusion - Types - Hot and Cold extrusion.

UNIT-IV: SHEET METAL PROCESSES 9

Sheet metal characteristics - shearing, bending and drawing operations - Stretch forming operations - Formability of sheet metal - Test methods -special forming processes-Working principle and applications - Hydroforming - Rubber pad forming - Metal spinning Introduction of Explosive forming, magnetic pulse forming, Super plastic forming - Micro forming.

UNIT-V: POWDER METALLURGY AND PLASTIC PROCESSING 7

Production of metal powder: Atomization, crushing; Blending; Compacting: Die pressing, iso-static pressing; Sintering: Principle, continuous sintering process; Plastic processing: Injection, Blow moulding, Rotational moulding, Film blowing and Thermoforming

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student gains knowledge about

1. Metal casting techniques
2. Various metal joining techniques
3. Various bulk deformation processes
4. Different sheet metal forming techniques
5. Manufacturing of plastic components by injection moulding, film blowing

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. Hajra Choudhury, “Elements of Workshop Technology, Vol. I”, Media Promoters Pvt Ltd., Mumbai, 2017.

E- RESOURCES:

1. <https://nptel.ac.in/courses/112107144>
2. <https://archive.nptel.ac.in/courses/112/107/112107219>

CO - PO and CO - PSO MAPPING

ME3365	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		2			2	3	1	1			1	3	2
CO2	3		2			2	3	1	1			1	3	2
CO3	3		2			2	2	1	1			1	3	2
CO4	3		2			2	2	1	1			1	3	2
CO5	3		2		2	2	2	1	1			1	3	2
Average	3		2		2	2	2	1	1			1	3	2

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

To impart knowledge to the students on the following topics of:

1. Mathematical concepts used to predict the effect of fluid properties on a flow system & the various pressure measuring devices.
2. Analysis of fluid kinematics and fluid dynamics using various mathematical equations.
3. Analysis and calculations of major and minor losses associated with pipe flow in piping networks.
4. Prediction of physical quantities.
5. Analysis of the performance of turbines and pumps.

UNIT-I FLUID PROPERTIES AND FLUID STATICS**9**

Fluid – definition, Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

UNIT-II FLUID KINEMATICS AND FLUID DYNAMICS**9**

Fluid Kinematics - types of flow - velocity field and acceleration - continuity equation - Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid Dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube

UNIT-III: FLOW THROUGH CIRCULAR CONDUITS**9**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor - Moody diagram - commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT-IV: DIMENSIONAL ANALYSIS**9**

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT-V: TURBINES AND PUMPS

9

Impact of jets – Hydro turbines: definition and classifications - Euler's equation for turbo machines. Turbines: definition and classifications - working principles - Impeller turbine - Reaction turbine - velocity triangles. Pumps: definition and classifications - Centrifugal pump - Reciprocating pump - velocity triangles, indicator diagram, specific speed, cavitations in pumps.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Ability to apply mathematical knowledge to predict the properties and pressure measurement.
2. Ability to analyze fluid kinematics and fluid dynamics using various mathematical equations.
3. Ability to analyze and calculate major and minor losses associated with pipe flow in piping networks.
4. Ability to predict the nature of physical quantities mathematically.
5. Ability to analyze the performance of turbines and pumps.

TEXTBOOKS:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2017.
2. Bansal R.K "A Text Book Fluid Mechanics and Hydraulic Machines", Laxmi Publications (p) Ltd, 10th Edition, 2018.

REFERENCE BOOKS:

1. Frank M White, Fluid Mechanics" Mc Graw hill Education, 9th Edition, 2017
2. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2013.

E-RESOURCES:

<https://nptel.ac.in/courses/112106175>
<https://nptel.ac.in/courses/112104117>
<https://nptel.ac.in/courses/112104118>

CO - PO and CO - PSO MAPPING

ME3336	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3		1								3	3
CO2	3	3	3	1	1	2							3	3
CO3	3	2	3	2	2								3	3
CO4	3	3	3		2								3	3
CO5	3	3	3		2								3	3
Average	3	2.8	3	0.6	1.6	0.4							3	3

(1–LOW, 2– MEDIUM, 3–HIGH)

ME3367

**MANUFACTURING TECHNOLOGY
LABORATORY -I**

L	T	P	C
0	0	3	2

OBJECTIVE:

To Study and practice the various operations that can be performed in lathe, shaper, milling machines etc. and to equip with the practical knowledge required in the core industries.

LIST OF EXPERIMENTS

Machining and Machining time estimations for:

1. Taper Turning operation and Machining time estimations for taper turning operation
2. External Thread cutting
3. Internal Thread Cutting
4. Eccentric Turning
5. Knurling operation and Machining time estimations for knurling operation
6. Square Head Shaping
7. Hexagonal Head Shaping
8. Fabrication of simple structural shapes using Gas Metal Arc Welding
9. Joining of plates and pipes using GMA / SAW welding
10. Preparation of green sand moulds
11. Manufacturing of simple sheet metal components using shearing and bending operations
12. Manufacturing of sheet metal components using metal spinning on a lathe

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Manufacture the work piece as per given shape and size using lathe
2. Demonstrate the safety precautions exercised in the mechanical workshop
3. Create the work piece as per given shape and size using machining processes such as shaping, drilling and milling
4. Make sheet metal components like tray and funnel
5. Formulate the moulding, sand moulds using tools, patterns.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. NO.	NAME OF THE EQUIPMENT	QTY
1.	Centre Lathes	7 Nos
2.	Horizontal Milling Machine	1 No
3.	Vertical Milling Machine	1 No
4.	Shaper.	1 No.
5.	Arc welding transformer with cables and holders	2 Nos
6.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	1 No
7.	Moulding table, Moulding equipment	2 Nos
8.	Sheet metal forming tools and equipment	2 Nos

CO - PO and CO - PSO MAPPING

ME3337	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3						1		2			1		
CO2	3						1		2			1		
CO3	3						1		2			1		
CO4	3						1		2			1		
CO5	3						1		2			1		
Average	3						1		2			1		

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

Upon Completion of this subject, the students can be able to:

1. Understand hands on experience in flow measurements using different devices.
2. Understand the working principle and performance of centrifugal and submergible pumps.
3. Know, how to calculate and draw characteristics curves for various experiments related to fluid mechanics.
4. Understand the energy flow pattern through the hydraulic turbines and pumps.
5. Explain his/her competency towards preventive maintenance of hydraulic turbines.

LIST OF EXPERIMENTS:

1. Determination of the Coefficient of discharge of given Orifice-meter.
2. Determination of the Coefficient of discharge of given Venturi-meter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

1. Ability to use the measurement equipment for flow measurement.
2. Ability to do performance test on different fluid machinery.

3. Conduct experiments on hydraulic turbines and pumps to draw characteristics.
4. Determine the energy flow pattern through the hydraulic turbines and pumps.
5. Exhibit his/her competency towards preventive maintenance of hydraulic turbines.

E-RESOURCES:

<https://archive.nptel.ac.in/courses/112/106/112106311/>

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.NO	NAME OF THE EQUIPMENT	QTY.
1	Orifice meter setup	1 no
2	Venturi meter setup	1 no
3	Rotameter setup	1 no
4	Pipe flow analysis setup	1 no
5	Centrifugal pump / Submersible pump setup	1 no
6	Reciprocating pump setup	1 no
7	Gear pump setup	1 no
8	Pelton wheel setup	1 no
9	Francis turbine setup	1 no
10	Kaplan turbine setup	1 no

CO - PO and CO - PSO MAPPING

ME3338	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3							3	1	2	3		1
CO2	3	3							3	1	2	3		1
CO3	3	3							3	1	2	3		1
CO4	3	3							3	1	2	3		1
CO5	3	3							3	1	2	3		1
Average	3	3							3	1	2	3		1

(1–LOW, 2– MEDIUM, 3–HIGH)

ME3339	COMPUTER AIDED DRAFTING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

1. To make the students understand and interpret drawings of Machine Components
2. To prepare assembly drawings both manually and using standard CAD packages
3. To familiarize the students with Indian Standards on drawing practices and standard components
4. To gain practical experience in handling 2D drafting and 3D modeling software systems.

UNIT-I: DRAWING STANDARDS & FITS AND TOLERANCES 9

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners–reference to handbook for the selection of standard components like bolts, nuts, screws, keys, etc. - Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning& tolerancing.

UNIT-II: INTRODUCTION TO 2D DRAFTING 12

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, and Detailed drawing. Bearings - Bush bearing, Plummer block, Valves – Safety and non- return valves.

UNIT-III: 3D GEOMETRIC MODELING AND ASSEMBLY 24

Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft – Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section – Assembly Couplings – Flange, Universal, Oldham's, Muff, Gear couplings Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch, Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, nozzle, ABS rotor, vane pump and gear pump.

PERIODS

Note: 25% of assembly drawings must be done manually and the remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Follow the drawing standards, Fits and Tolerances
2. Re-create part drawings and sectional views
3. Make assembly drawings as per standards

TEXTBOOKS:

1. Narayana K.L., "Machine Drawing", 6th Edition, New Age International Publishers 2019.
2. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers, 2013.

REFERENCES:

1. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata Mc GrawHill, 2006
2. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013

E-RESOURCES:

<https://nptel.ac.in/courses/112104031>

<https://eedocs.files.wordpress.com/2014/02/machinedrawing.pdf>

ME3339	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1		1	1	1	1			1	1				
CO2	2		1		1	2			2	1				
CO3	1		2		1	1			1	1			1	1
Average	1.3		1.3	0.3	1	1.3			1.3	1			0.3	0.3

(1–LOW, 2– MEDIUM, 3–HIGH)

MA3425	APPLIED MATHEMATICS FOR MECHANICAL	L	T	P	C
	ENGINEERING	2	0	0	2

OBJECTIVE:

1. To familiarize 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 introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems?
4. To acquaint the student with Fourier series techniques in solving one dimensional wave equations used in various situations.
5. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.

UNIT-I ORDINARY DIFFERENTIAL EQUATIONS 6

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

UNIT-II APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS - ONE DIMENSIONAL WAVE EQUATIONS 6

Classification of PDE - Solutions of one dimensional wave equation

UNIT-III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS - ONE DIMENSIONAL HEAT EQUATIONS

One dimensional equation of heat conduction- Zero to zero- Non zero to zero – Non zero to non zero boundary conditions

UNIT-IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS - TWO DIMENSIONAL HEAT EQUATIONS 6

Steady state solution of two dimensional equation of heat conduction in infinite plates (excluding insulated edges) and circular plates.

UNIT-V BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 6

One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods
– One dimensional wave equation by explicit method.

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. Appreciate the physical significance of Fourier series techniques in solving one dimensional wave equations.
4. Appreciate the physical significance of Fourier series techniques in solving one dimensional heat flow problems.
5. Appreciate the physical significance of Fourier series techniques in solving two dimensional heat flow problems.

TEXT BOOKS

1. Veerarajan. T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015

REFERENCE BOOKS:

1. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.

CO - PO and CO - PSO MAPPING

ME3425	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												
CO2	2	2	1	1												
CO3	2	2	1	1												
CO4	2	2	1	1												
CO5	2	2	1	1												
Average	2	2	1	1												

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

The main learning objective of this course is to prepare the students to:

1. Study the concepts and basic mechanics of metal cutting and the factors affecting machinability.
2. Learn working of basic and advanced turning machines.
3. Teach the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
4. Study the basic concepts of CNC of machine tools and constructional features of CNC.
5. Learn the basics of CNC programming concepts to develop the part programme for CNC Machining.

UNIT-I: FUNDAMENTALS OF MACHINING 9

Introduction: Material removal processes, types of machine tools; Metal cutting fundamentals: Theory of chip formation, types of chips, Piispanen model of chip analogy, orthogonal cutting and oblique cutting; Nomenclature of single point cutting tools; Mechanics of metal cutting: Machining forces and Merchant's Circle Diagram (MCD) – simple calculations, cutting tool materials, tool wear, tool life, surface finish, cutting fluids; Overview of high speed machining.

UNIT-II: CENTRE LATHE AND SPECIAL PURPOSE LATHES 9

Centre lathe, constructional features, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – Automats – Single spindle, Swiss type, multi spindle - Turret Indexing mechanism, Bar feed mechanism.

UNIT-III: MACHINE TOOLS FOR NON-CIRCULAR COMPONENTS AND HOLE MAKING 9

Reciprocating machine tools: shaper, planer, slotter (Construction details only). Milling machines: Horizontal milling m/c and Vertical milling m/c: specifications, parts, milling cutters, work holding devices, operations. Hole making: Drilling, reaming, boring, tapping -sawing machine: hack saw, band saw, circular saw; broaching machines: Push, pull, surface and continuous broaching machines – broach construction

UNIT-IV: GEAR MANUFACTURING AND SURFACE FINISHING PROCESSES

9

Gear machining: Forming, Gear generating process – Gear shaping, Gear hobbing. Surface finishing- Abrasive processes: Types of grinding process –cylindrical grinding, surface grinding, centre less grinding – grinding wheel specifications and selection. Fine finishing processes – Honing, lapping, super finishing, polishing and buffing, power brushing-Tumbling - Metal spraying –Metallization

UNIT-V: CNC MACHINE TOOLS AND PART PROGRAMMING

9

Numerical control (NC) machine tools - CNC: types, constructional details, special features – Design considerations of CNC machines for improving machining accuracy (Structural members, Slide ways, Linear bearings, Ball screws, Spindle drives and feed drives)- Part programming fundamentals – Manual programming – Basic NC programs (introductory programs only) - Post processors

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Gain an understanding of the fundamentals of metal cutting.
2. Distinguish the process capabilities of different types of lathes.
3. Appreciate different types of reciprocating machine tools and hole-making operations.
4. Familiarize with gear manufacturing and surface finishing processes.
5. Understand the basic concepts of the Computer Numerical Control machine tool and CNC programming.

TEXTBOOKS:

1. Rao, P.N. “Manufacturing Technology”, Metal Cutting and Machine Tools, 3rd Edition Tata McGraw– Hill, New Delhi, 2018.
2. Raghuvanshi. B.S, “A course in Workshop Technology – Vol II”. 10th Revised Edition, Dhanpat Rai & Co., 2018.

REFERENCE BOOKS:

1. Hajra Choudry, “Elements of Workshop Technology: Machine Tools (Volume - 2)”, Media Promoters, 2010.
2. P.C. Sharma, “A text book of Production Technology (Manufacturing Processes) 7th Edition”, S. Chand and Company, 2009.

E-RESOURCES :

<https://nptel.ac.in/courses/112105127>

CO - PO and CO - PSO MAPPING

ME3462	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	1	1	1	3			3		2	3	3
CO2	3	3	3	1	1	1	3			3		2	3	2
CO3	3	3	3	1	1	1	3			3		2	3	2
CO4	3	3	2	1	1	1	3			3		2	3	2
CO5	3	3	3	1	1	1	3			3		2	3	2
Average	3	3	2.8	1	1	1	3			3		2	3	2.2

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

The main learning objective of this course is to prepare the students to:

1. Understand and analyze the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.
2. Analyze the transverse loading on beams and stresses in beams for various engineering applications.
3. Analyze the torsion principle for shafts and springs for various engineering applications.
4. Analyze the deflection of beams using various methods.
5. Analyze thick and thin shells.

UNIT-I: STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and strains and principal planes – Mohr's circle of stress.

UNIT-II: TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types of beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT-III: TORSION 9

Torsion formulation stresses and deformation in circular and hollow shafts – Stepped shafts – Deflection in shafts fixed at both ends – Stresses in helical springs – Deflection of helical springs, carriage springs – Strain energy.

UNIT-IV: DEFLECTION OF BEAMS**9**

Double Integration method – Macaulay’s method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell’s reciprocal theorems.

UNIT-V: THIN CYLINDERS, SPHERES AND THICK CYLINDERS**9**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé’s theorem.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

At the end of the course, the students would be able to

1. Develop an understanding of the concepts of stress and strain and their use in the analysis of machine members.
2. Explain the concepts and procedures used in the analysis of loaded beams and shafts with various support conditions.
3. Develop an understanding of material behaviour under the condition of pure torsion (twisting moment) on circular shafts.
4. Compute slopes and deflections in determinate beams subjected to loading using various methods.
5. Analyze the stresses and deformations induced in thick and thin Shells.

TEXTBOOKS:

1. Bansal, R.K., “Strength of Materials”, Laxmi Publications (P) Ltd., 2017.
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009.

REFERENCE BOOKS:

1. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2002.
2. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2018.

E-RESOURCES :

<https://nptel.ac.in/courses/112106141>

CO - PO and CO - PSO MAPPING

ME3463	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	2	3	1	3			1	3	3	2
CO2	3	3	3	3	2	3	1	3			1	3	3	2
CO3	3	3	3	3	2	3	1	3			1	3	3	2
CO4	3	3	3	3	2	3	1	3			1	3	3	2
CO5	3	3	3	3	2	3	1	3			1	3	3	2
Average	3	3	3	3	2	3	1	3			1	3	3	2

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

1. Applying the basic components of mechanisms
2. Designing cam mechanisms for specified output motions.
3. Applying the basic concepts of toothed gearing and kinematics of gear trains
4. Understanding the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
5. Understanding the undesirable effects of unbalances resulting from prescribed motions in the mechanism.

UNIT-I: BASICS OF MECHANISMS**9**

Classification of mechanisms–Basic kinematic concepts and definitions–Degree of freedom, Mobility–Kutzbach criterion, Gruebler’s criterion–Grashof’s Law–Kinematic inversions of four-bar chain and slider crank chains.

UNIT-II: KINEMATICS OF CAM MECHANISMS**9**

Classification of cams and followers–Terminology and definitions–Displacement diagrams–Uniform velocity, parabolic, simple harmonic and cycloidal motions– follower motions–Layout of plate cam profiles–Specified contour cams–Circular arc and tangent cams.

UNIT-III: GEARS AND GEAR TRAINS**9**

Law of toothed gearing – Involute and cycloidal tooth profiles – definitions–Gear tooth action–contact ratio–Interference and under cutting. Gear trains– Speed ratio, train value – Parallel axis gear trains–Epicyclic Gear Trains–Compound gear trains–reverted gear trains–cyclometer-differential gear.

UNIT-IV: FORCE ANALYSIS**9**

Dynamic force analysis – Inertia force and Inertia torque– D Alembert’s principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads –Crank shaft torque – Turning moment diagrams –Fly Wheels.

UNIT-V: BALANCING**9**

Balancing of rotating masses – Balancing of several masses rotating in same plane - Balancing of several masses rotating in different planes. Balancing of reciprocating masses – Swaying couple - Hammer blow – Partial balancing of unbalanced primary force in a reciprocating engine

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

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

1. Familiar with the basic components of mechanisms and implement them.
2. Create customized cam mechanisms for required particular output motions.
3. Understand the basic concept soft toothed gearing and kinematics of gear trains and bring into practicable form the concepts learned.
4. Calculate static and dynamic forces of mechanisms.
5. Work out the amount of balancing masses required and their locations of reciprocating and rotating masses.

TEXTBOOKS:

1. Dr.Khurmi R S, “Theory of Machines”, 14th edition, S Chand publications, 2020.
2. Rattan, S.S, “Theory of Machines”, 5th Edition, Tata McGraw-Hill, 2019.

REFERENCE BOOKS:

1. Cleghorn.W.L, “Mechanisms of Machines”, Oxford University Press, 2014
2. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines”, 3rd Edition Affiliated East-West Pvt.Ltd., New Delhi, 2006.

E-RESOURCES:

<https://archive.nptel.ac.in/courses/112/104/112104121/>

CO - PO and CO - PSO MAPPING

ME3464	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		2			1					2	
CO2	3	2	2		2			1					3	
CO3	3	2	2		2			1					3	
CO4	3	2	2		2			1					3	
CO5	3	2	2		2			1					3	
Average	3	2	2		2			1					2.8	

(1–LOW, 2– MEDIUM, 3–HIGH)

ME3465	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is to prepare the students to:

1. Classify the unconventional machining processes and describe the mechanical processes.
2. Describe the thermal and electrical based process.
3. Identify the chemical and electrochemical based process parameters and their influence on performance and their applications.
4. Learn the advanced Nano finishing process.
5. Know the latest trends microfabrication technology.

UNIT-I: INTRODUCTION AND 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-II: 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-III: 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.

UNIT-IV: ADVANCED NANO FINISHING PROCESSES**9**

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magnetorheological abrasive flow finishing their working principles, equipment, the effect of process parameters, applications, advantages and limitations.

UNIT-V: MICROFABRICATION TECHNOLOGY**9**

Rapid prototyping- classification of rapid prototyping techniques-steps of rapid prototyping -Stereolithography (SLA), Selective laser sintering (SLS)-Fused Deposition Modelling (FDM)- processes, working principles, advantages, disadvantages, applications, limitations.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

At the end of the course, the students would be able to

1. Apply the different UCMP for real time applications.
2. Analyze the various thermal energy and electrical energy based UCMP.
3. Integrate the chemical and electro-chemical energy based UCMP.
4. Apply the various nano abrasives based UCMP in industries.
5. Create the devices involved in microfabrication and recent technology.

TEXTBOOKS:

1. Adithan. M., “Unconventional Machining Processes”, Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458.
2. Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCE BOOKS:

1. Benedict. G.F. “Non-traditional Manufacturing Processes”, Marcel Dekker Inc., New York, 2010.
2. Paul DeGarmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., 8th Edition, New Delhi, 2012.

E- RESOURCES:

<https://www.digimat.in/nptel/courses/video/112104195/L01.html>

CO - PO and CO - PSO MAPPING

ME3465	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		1		1		1		1	1		1	2	2
CO2	3		1		1		1		1	1		1	2	2
CO3	3		1		1		1		1	1		1	2	2
CO4	3		1		1		1		1	1		1	2	2
CO5	3		1		1		1		1	1		1	2	2
Average	3		1		1		1		1	1		1	2	2

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

The main learning objective of this course is to impart knowledge on

1. Steam power cycles and their application in steam power plants.
2. Concepts of thermodynamics in different air standard cycles and to solve problems.
3. Functions and features of IC engines and to calculate the performance parameters of IC Engines.
4. Concepts of steam nozzles and turbines and to solve problems.
5. Psychrometrics and Refrigeration to solve problems.

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

UNIT-I BASIC STEAM POWER CYCLES 9

Carnot Cycle - Rankine Cycle- Modified Rankine Cycle- Regenerative Cycle - Reheat Cycle.

UNIT-II GAS POWER CYCLES 9

Air Standard Cycles - Otto, Diesel and Dual – Calculation of mean effective pressure, and air standard efficiency Comparison of cycles

UNIT-III INTERNAL COMBUSTION ENGINES AND PERFORMANCE 9

IC engine – Classification and application IC engine - Theoretical and actual Valve timing diagrams - Port time diagram - Theoretical and actual p-V diagrams of a four- stroke Otto and Diesel cycle engine. Performance parameters and calculations.

UNIT-IV STEAM NOZZLES AND STEAM TURBINES 9

Introduction – Steam flow through nozzles – Nozzle efficiency – Classification of the steam turbine – Advantages of the steam turbine over steam engines – Methods of reducing wheel – Impulse turbine – Turbine Efficiency.

UNIT-V PSYCHROMETRICS AND REFRIGERATION**9**

Concept of Psychrometry and Psychrometrics - Definitions - Psychrometric Charts
- Psychrometric Processes - Fundamentals of refrigeration – Air refrigeration system
– Simple vapour compression system – Vapour absorption system.

TOTA : 45 PERIODS**COURSE OUTCOMES:**

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

1. Solve problems on Steam power cycles.
2. Execute thermodynamic concepts to different air standard cycles and solve problems.
3. Report the functioning and features of IC engines and performance parameters of IC Engines.
4. Solve problems in steam nozzles and turbines.
5. Solve problems in psychrometrics and Refrigeration concepts.

TEXTBOOKS:

1. Kothandaraman, C.P., “A Course in Thermal Engineering”, Fifth Edition,” Dhanpat Rai and Co, 2004.
2. Rajput, R.K., “Thermal Engineering” Tenth Edition, Laxmi Publication (P) LTD, 2017.

REFERENCE BOOKS:

1. Ganesan, V. "Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill 2012.
2. Ballaney, P.L. "Thermal Engineering", Khanna publishers, 24th Edition 2012.

E-RESOURCE

https://onlinecourses.nptel.ac.in/noc23_me31/preview

CO - PO and CO - PSO MAPPING

ME3466	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2										1	2	1
CO2	2	2										1	2	1
CO3	2	2										1	2	1
CO4	2	2										1	2	1
CO5	2	2										1	2	1
Average	2	2										1	2	1

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

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 II 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 MANAGERMENTS 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

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

COURSE OUTCOME:

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

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

TEXT BOOKS

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

REFERENCE BOOK:

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

ME3467	MANUFACTURING TECHNOLOGY LABORATORY-II	L	T	P	C
		0	0	3	2

OBJECTIVES:

To study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry

LIST OF EXPERIMENTS:

- 1.** Contour milling using vertical milling machine
- 2.** Spur gear cutting in milling machine
- 3.** Helical Gear Cutting in milling machine
- 4.** Gear generation in hobbing machine
- 5.** Gear generation in gear shaping machine
- 6.** Plain Surface grinding
- 7.** Cylindrical grinding
- 8.** Tool angle grinding with tool and Cutter Grinder
- 9.** Measurement of cutting forces in Milling / Turning Process
- 10.** CNC Part Programming

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Prepare the work piece as per the given shape and size using machining processes such as surface grinding, tool grinding cylindrical grinding.
2. Create the work piece as per the given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.
3. Manufacture the gears using gear making machines and analyze the defects in the cast and machined components.

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Turret and Capstan Lathes	1No each
2	Horizontal Milling Machine	2Nos.
3	Vertical Milling Machine	1No
4	Surface Grinding Machine	1No
5	Cylindrical Grinding Machine	1No
6	Radial Drilling Machine	1No
7	Lathe Tool Dynamometer	1No
8	Milling Tool Dynamometer	1No
9	Gear Hobbing Machine	1No
10	Tool Makers Microscope	1No
11	CNC Lathe	1No
12	CNC Milling machine	1No
13	Gear Shaping machine	1No
14	Centerless grinding machine	1No
15	Tool and cutter grinder	1No

CO - PO and CO - PSO MAPPING

ME3467	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3						1		2			1	1	2
CO2	3						1		2			1	1	2
CO3	3						1		2			1	1	2
Average	3						1		2			1	1	2

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

1. Performing various destructive testing on metal samples.
2. Analyzing the effect of torsion on metal rods.
3. Performing various hardness tests
4. Understanding the effects of hardening on metal specimens.
5. Analyzing the effects of tempering on metal specimens.

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminum rods
3. Torsion test on a mild steel rod
4. Impact test on a metal specimen
5. Hardness test on metals - Brinnell and Rockwell Nos.
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical Properties Comparison
 - Unhardened specimen
 - Quenched Specimen
 - Quenched and tempered specimen
11. Microscopic examination of hardened samples
 - Hardened and tempered samples.

COURSE OUTCOMES:

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

1. Ability to perform various destructive testing on metal samples.
2. Analyze the effect of torsion on metal rods.
3. Ability to perform various hardness tests.
4. Ability to understand the effects of hardening on metal specimens.
5. Analyze the effects of tempering on metal specimens.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Quantity
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Metallurgical Microscopes	3
8	Muffle Furnace (800 ⁰ C)	1

CO - PO and CO - PSO MAPPING

ME3468	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	3	3	1	1		3			2	1	
CO2	3	2	1	3	3	1	1		3			2		
CO3	3	2	2	3	2	1	1		3			2		
CO4	3	2	1	3	3	1	1		3			2		
CO5	3	2	1	3	3	1	1		3			2		
Average	3	2	1.2	3	2.8	1	1		3			2	1	

(1–LOW, 2– MEDIUM, 3–HIGH)

COURSE OUTCOMES:

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

1. Recognize the components and conduct the performance test on internal combustion engines.
2. Study the performance of heat pump and exhaust gas analyzer.
3. Understanding the concepts involving in steam nozzles and steam turbines.
4. Compare the working and performance of petrol and diesel engines.
5. Estimate the various properties of lubrication oils.

LIST OF EXPERIMENTS**Engine Lab**

1. Valve Timing and Port Timing Diagrams.
2. Actual p-v diagrams of IC engines
3. Performance Test on 4-stroke Diesel Engine.
4. Heat Balance Test on 4-stroke Diesel Engine.
5. Morse Test on Multicylinder Petrol Engine.
6. Retardation Test to find Frictional Power of a Diesel Engine.
7. Determination of Flash Point and Fire Point of various fuels / lubricants.
8. Determination of Viscosity – using Red Wood Viscometer.

Steam Lab

9. Study and demo of Steam Generators and Turbines.

Computerized Thermal Lab

10. Experimental analysis of Heat pump refrigeration test rig using LAB VIEW software.
11. Experimental analysis of Exhaust Emissions for Diesel Engines and Boilers using LAB VIEW software.

45 PERIODS

LIST OF EQUIPMENT

(For a batch of 30 students)

- | | |
|---|-------|
| 1. I.C Engine – 2 stroke and 4 stroke model. | 1 set |
| 2. Red Wood Viscometer. | 1 No. |
| 3. Apparatus for Flash and Fire Point. | 1 No. |
| 4. 4-stroke Diesel Engine with mechanical loading. | 1 No. |
| 5. 4-stroke Diesel Engine with hydraulic loading. | 1 No. |
| 6. 4-stroke Diesel Engine with electrical loading. | 1 No. |
| 7. Multi-cylinder Petrol Engine. | 1 No. |
| 8. Data Acquisition system with any one of the above engines. | 1 No. |
| 9. Steam Boiler with turbine setup. | 1 No. |
| 10. Heat pump refrigeration test rig. | 1 No. |
| 11. Exhaust gas analyzer. | 1 No. |

CO - PO and CO - PSO MAPPING

ME3469	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3		3		2	2	1					3	3
CO2	3	3		3		2	2	1					3	3
CO3	3	3		3		2	2	1					3	3
CO4	3	3		3		2	2	1					3	3
CO5	3	3		3		2	2	1					3	3
Average	3	3		3		2	2	1					3	3

OBJECTIVES:

1. To teach basic concepts of the metrology and importance of measurements.
2. To teach measurement of linear and angular dimensions
3. To teach the tolerance analysis in manufacturing.
4. To develop the fundamentals of form measurements and surface metrology
5. To provide the knowledge of the advanced measurements for quality control in manufacturing industries

UNIT I BASICS OF METROLOGY**9**

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards. Calibration of measuring instruments, Principle of air gauging ISO standards.

UNIT II LINEAR AND ANGULAR MEASUREMENTS

Linear Measuring Instruments: Evolution, types, classification, Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Optomechanical measurements using measuring microscope and Profile projector Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads Single element measurements

UNIT III TOLERANCE ANALYSIS**9**

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT IV FORM MEASUREMENT**9**

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V ADVANCES IN METROLOGY**9**

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers

interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM– Constructional features – Probes – Accessories – Software – Applications
– Basic concepts of Machine Vision System – Element – Applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Describe the concepts of measurements to apply in various metrological instruments
2. Study the principles of linear and angular measurement tools used for industrial applications
3. Apply the tolerance symbols and tolerance analysis for industrial applications.
4. Apply the principles and methods of form and surface metrology.
5. Apply the advances in measurements for quality control in manufacturing Industries.

TEXTBOOKS:

1. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2018.
2. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2022.

REFERENCES:

1. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2020.
2. Raghavendra, Krishnamurthy “Engineering Metrology & Measurements”, Oxford Univ. Press, 2013.

ME3561	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2			1		2	2					1	2	
CO2	2		3			1						1	2	
CO3	2	2	2	2	2	1						1	2	
CO4	2	2			2	1						1	2	
CO5	2		2		2	1						1	2	
Average	2	1	2	1	2	1	1					1	2	

(1-LOW, 2-MEDIUM, 3-HIGH)

ME3562	MOBILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 1 .To study the construction and working principle of various parts of an automobile.
- 2 .To study the practice for assembling and dismantling of engine parts and transmission system
- 3 .To study various transmission systems of automobile.
- 4 .To study about steering, brakes and suspension systems
- 5 .To study alternative energy sources

UNIT-I: VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).

UNIT-II: ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT-III: TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT-IV: STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT – V: ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Electric and Hybrid Vehicles, Fuel Cell.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Recognize the various parts of the automobile and their functions and materials.
2. Discuss the engine auxiliary systems and engine emission control.
3. Distinguish the working of different types of transmission systems.
4. Explain the Steering, Brakes and Suspension Systems.

5. Predict possible alternate sources of energy for IC Engines.

TEXTBOOKS:

1. Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.
2. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014.

REFERENCE BOOKS:

1. Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.

E-Resources:

1. <https://archive.nptel.ac.in/courses/107/106/107106088/>
2. https://onlinecourses.nptel.ac.in/noc20_de06/preview
3. https://onlinecourses.nptel.ac.in/noc21_de02/preview

CO - PO and CO - PSO MAPPING

ME3562	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	2	1					1			1	1	2
CO2	2	1	2	1					1			1	1	2
CO3	2	1	2	1					1			1	1	2
CO4	2	1	2	1					1			1	1	2
CO5	2	1	2	1					1			1	1	2
Average	2	1	2	1					1			1	1	2

OBJECTIVES:

1. To Learn the principal mechanism of heat transfer under steady state and transient conditions.
2. To learn the fundamental concept and principles in convective heat transfer.
3. To learn the theory of phase change heat transfer and design of heat exchangers.
4. To study the fundamental concept and principles in radiation heat transfer.
5. To develop the basic concept and diffusion, convective di mass transfer.

UNIT I CONDUCTION**12**

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts – Methods of enhanced thermal conduction.

UNIT II CONVECTION**12**

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications.

UNIT IV RADIATION**12**

Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields.

Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state and Transient Diffusion - Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
2. Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
3. Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.
4. Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
5. Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

TEXTBOOKS:

1. R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2009.
2. Yunus A. Cengel, “Heat Transfer A Practical Approach” – Tata McGraw Hill, 5th Edition – 2013.

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley & Sons, 7th Edition, 2014.
- Holman, J.P., “Heat and Mass Transfer”, Tata McGraw Hill, 2010.

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

(1-LOW, 2-MEDIUM, 3-HIGH)

(Use of P S G Design Data Book is Permitted)

1. To know the steps involved in design. Familiarize engineering materials and their selection for a particular application. To know the various standards, tolerances, and different types of loading, stresses, factors of safety, and design of components subjected to variable loading
2. To know the design of shafts subjected to bending and torsional loads based on strength and rigidity. To select keys and find out the stresses acting on them and to design different types of rigid and flexible couplings.
3. To study the design of rivet joints for structural and vessels and to design weld structures subjected to direct, eccentric, and cyclic loadings.
4. To design the close coil helical spring, leaf spring, torsion, and disc springs subjected to direct and eccentric loading. The students can design hydrodynamic journal bearings. The students can study and derive the properties of the lubricants and bearings.
5. The students can design new products. To study and understand the design thinking concepts.

Design process-factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers– Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and ‘C’ frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

Design of solid and hollow shafts based on strength, and rigidity–Rigid and flexible couplings.

Bolted joints with eccentric loading, Knuckle joints, Cotter joints – Welded joints, Stress in weld joint, Transverse and Longitudinal weld joint-riveted joints, Lab joint and Butt joint.

Design of helical springs - Leaf springs - Sliding contact and rolling contact bearings - Hydrodynamic journal bearings- Selection of Rolling Contact bearings

UNIT V PRODUCT ENGINEERING AND DESIGN THINKING**8**

Introduction to Product design, product engineering, and design thinking; Product Design Specification and Planning- Integrating the Fuzzy Front End of complex product development aligned to Design Thinking Models.

TOTAL: 45 PERIODS**OUTCOMES:**

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

1. Explain the design of machine members subjected to static and variable loads.
2. Apply the concepts to design a shaft, keys, and couplings.
3. Apply design concepts to bolted, Knuckle, Cotter, and riveted joints.
4. Apply the concept of design helical, leaf springs, ball bearings, and journal bearings.
5. Apply the concepts of designing a new product and select design thinking principles.

TEXTBOOKS:

1. Bhandari V B, "Design of Machine Elements", 5th Edition, Tata McGraw-Hill Book Co, 2020
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2015.

REFERENCES:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
2. NPTEL :: Mechanical Engineering - NOC:Product Engineering and Design Thinking

ME 3564	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3					1	1			2	3	1
CO2	2	2	3					1	1			2	3	1
CO3	2	2	3					1	1			2	3	1
CO4	2	2	3					1	1			2	3	1
CO5	2	2	3					1	1			2	3	1
Average	2	2	3					1	1			2	3	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

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

UNIT- I ENVIRONMENT AND BIODIVERSITY 6

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

UNIT- II ENVIRONMENTAL POLLUTION 6

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

UNIT- III RENEWABLE SOURCES OF ENERGY 6

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

GE3551

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

L T P C
3 0 0 3

Objective:

1. To know the basic principles of adventure program and creating awareness for social
2. To improve the cadet's knowledge in firefighting and their health's
3. To create an interest in handling the weapons and read the map
4. To know the handling the situation on ground in army battle
5. To know 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 Abhiyan, 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 \(s3waas.gov.in\)](https://redbook26-5-2017.pmd@s3waas.gov.in))
2. Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, by RPH Editorial Board, Kindle Edition.

OBJECTIVES:

1. Demonstrate the calibration of simple linear measuring instruments used in manufacturing industries.
2. Demonstrate the important linear measurements carried out in manufacturing industries.
3. Demonstrate the important angular measurements carried out in manufacturing industries.
4. Demonstrate the important Form measurements carried out in manufacturing industries.
5. Demonstrate the measurement of prismatic components using contact and noncontact methods and surface metrology.

LIST OF EXPERIMENTS:

1. Calibration of vernier caliper using gauge blocks and measurement of given samples.
2. Calibration of micrometer using gauge blocks and measurement of given samples using micrometer.
3. Calibration of dial gauge using given gauge blocks.
4. Calibration of vernier height gauge using gauge blocks and measurement of given sample using vernier height gauge.
5. Calibration of vernier depth gauge using gauge blocks and measurement of given sample using vernier depth gauge.
6. Measurement of bore diameter of given samples using Bore gauge.
7. Measurement of bore diameter of given samples using telescopic gauge
8. Measurement of linear dimensions of given sample using Comparator.
9. Measurement of angles using sine bar.
10. Measurement of gear parameters using gear tooth vernier.
11. Noncontact (Optical) measurement using Profile projector.
12. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

TOTAL: 45 PERIODS**OUTCOMES:**

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

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge, dial gauge and depth gauge– using gauge blocks
2. Measurement of linear dimensions using Mechanical Comparators
3. Measurement of angular dimensions using Sine bar

4. Measurement of screw thread parameters using gear tooth vernier caliper
5. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments Noncontact (Optical) measurement using Profile projector

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

SL. NO	NAME OF EQUIPMENTS	QUANTITY
1	Micrometer	5 Nos.
2	Vernier Caliper	5 Nos.
3	Vernier Height Gauge	2 Nos.
4	Vernier depth Gauge	2 Nos.
5	Slip Gauge Set	1 No.
6	Gear Tooth Vernier	1 No.
7	Sine Bar	1 No.
8	Profile Projector	1 No.
9	Mechanical Comparator	1 No.
10	Dial Gauge	2 Nos.
11	Bore Gauge	1 No.
12	Telescopic Gauge	1 No.

ME3566	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2										2	1	
CO2	3											2	1	
CO3	3											2	1	
CO4	3				2							2	1	
CO5	3				2							2	1	
Average	3				1							2	1	

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To study the heat transfer phenomena to predict the relevant coefficient using implementation
2. To expose the mechanisms of free and forced convection
3. To demonstrate the phase change heat transfer and calculate the performance of heat exchanging devices
4. To explain diffusion and convective mass transfer
5. To study the performance of refrigeration cycle / components with software knowledge.

LIST OF EXPERIMENTS**HEAT TRANSFER LAB**

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Determination of Thermal conductivity of composite wall.
6. Determination of Thermal conductivity of insulating powder.
7. Heat transfer from pin-fin apparatus (forced convection modes)
8. Determination of Stefan – Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Effectiveness of Parallel / counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING LAB

11. Determination of COP of a refrigeration system
12. Experiments on Psychometric processes
13. Performance test on a reciprocating air compressor
14. Performance test in a fluidized Bed Cooling Tower

COMPUTERIZED HEAT TRANSFER LAB

15. Experimental analysis of Thermal conductivity for various cross section of Iron Rod using LAB VIEW software.

TOTAL: 45 PERIODS

(For a batch of 30 students)

SL.No.	LIST OF EQUIPMENTS	QUANTITY
1	Guarded plate apparatus	1 No.
2	Lagged pipe apparatus	1 No.
3	Natural convection-vertical cylinder apparatus	1 No.
4	Forced convection inside tube apparatus	1 No.
5	Composite wall apparatus	1 No.
6	Thermal conductivity of insulating powder apparatus	1 No.
7	Pin-fin apparatus	1 No.
8	Stefan-Boltzmann apparatus	1 No.
9	Emissivity measurement apparatus	1 No.
10	Parallel/counter flow heat exchanger apparatus	1 No.
11	Single/two stage reciprocating air compressor	1 No.
12	Fluidized bed cooling tower apparatus	1 No.
13	Refrigeration test rig	1 No.
14	Air-conditioning test rig	1 No.
15	Thermal Conduction System	1 No.

COURSE OUTCOMES:

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

1. Conduct tests on heat conduction apparatus and evaluate thermal conductivity of materials.
2. Identify the correlation to find the heat transfer rate in free and forced convection.
3. Analyze the performance of parallel/counter flow heat exchanger.
4. Integrate the concepts of radiative heat transfer apparatus and evaluate Stefan Boltzmann constant and emissivity.
5. Conduct tests to evaluate the performance of refrigeration and air conditioning test rigs.

ME3567	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3		3		2	2	1					3	3
CO2	3	3		3		2	2	1					3	3
CO3	3	3		3		2	2	1					3	3
CO4	3	3		3		2	2	1					3	3
CO5	3	3		3		2	2	1					3	3
Average	3	3		3		2	2	1					3	3

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. Apply the principles of kinematics in the measurement of various kinematic parameters
2. Apply the principles of kinematics and dynamics in the measurement of vibration parameters in various experiments.
3. To Demonstrate the how speed is governed by using various governor
4. To Demonstrate how the concept of the gyroscope working
5. Apply the principles of kinematics and dynamics in the torsional natural frequency of single and Double Rotor systems

LIST OF EXPERIMENTS:

1. Study of gear parameter.
2. Kinematic models to study various mechanisms.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus
5. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
6. Transverse vibration of Free beam – with and without concentrated masses.
7. Determination of torsional natural frequency of single and Double Rotor systems. Undamped and Damped Natural frequencies.
8. Dynamic analysis of cam mechanism.
9. Experiment of Watt Governor.
10. Experiment of Porter Governor.
11. Experiment of motorized gyroscope.
12. Determination of critical speed of shaft.

TOTAL: 45 PERIODS**OUTCOMES:**

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

1. Determine the measurement of various kinematic parameters.
2. Found the vibration parameters in various experiments.
3. Determine the how speed is governed by using various governor
4. Determine the principle of the gyroscope working
5. Found the torsional natural frequency of single and Double Rotor systems

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

SL. NO	NAME OF EQUIPMENTS	QUANTITY
1	Cam follower setup.	1 No.
2	Motorized gyroscope.	1 No.
3	Governor apparatus Watt, Porter, Proell and Hartnell governors.	1 No.
4	Whirling of shaft apparatus.	1 No.
5	Two rotor vibration setup.	1 No.
6	Spring mass vibration system.	1 No.
7	Torsional Vibration of single rotor system setup	1 No.
8	Gear Models	1 No.

ME3566	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2										2	2	
CO2	3											2	2	
CO3	3											2	2	
CO4	3				2							2	2	
CO5	3				2							2	2	
Average	3				1							2	2	

(1-LOW, 2-MEDIUM, 3-HIGH)

ME 3661	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To provide the overview of evolution of automation, CIM and its principles.
2. To learn the various Automation tools, include various material handling system.
3. To train students to apply group technology and FMS.
4. To familiarize the computer aided process planning in manufacturing.
5. To introduce to basics of data transaction, information integration and control of CIM.

UNIT I INTRODUCTION 9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software– Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM

UNIT II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipment – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types & applications – Vehicle guidance technology – Vehicle management and safety.

UNIT III GROUP TECHNOLOGY AND FMS 9

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS – FMS applications, Benefits

UNIT IV PROCESS PLANNING

9

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes –Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.

UNIT V PROCESS CONTROL AND DATAANALYSIS

9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control-Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discuss the basics of computer aided engineering
2. Choose appropriate automotive tools and material handling systems
3. Discuss the overview of group technology, FMS and automation identification methods.
4. Design using computer aided process planning for manufacturing of various components
5. Acquire knowledge in computer process control techniques.

TEXTBOOKS:

1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2020.
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer.

REFERENCES:

1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing, PHI Learning Pvt. Ltd., New Delhi, 2020.
2. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing, Pearson Education, Asia,3rd Edition,2019

ME 3661	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	2	1	2				1			1	2	1
CO2	3	2	2	1	2				1			1	2	1
CO3	3	2	2	1	2				1			1	2	1
CO4	3	2	2	1	2				1			1	2	1
CO5	3	2	2	1	2				1			1	2	1
Average	3	2	2	1	2				1			1	2	1

(1-LOW, 2-MEDIUM, 3-HIGH)

ME3662	DESIGN OF TRANSMISSION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
2. To understand the standard procedure available for Design of Transmission of Mechanical elements spur gears and parallel axis helical gears.
3. To learn the design bevel, worm and cross helical gears of Transmission system.
4. To learn the concepts of design multi and variable speed gear box for machine tool applications.
5. To learn the concepts of design to cams, brakes and clutches

(Use of P S G Design Data Book permitted)

UNIT-I: DESIGN OF FLEXIBLE ELEMENTS 9

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT-II: SPUR GEARS 9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur gear.

UNIT-III: PARALLEL AXIS HELICAL GEARS 9

Helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.

UNIT-IV: BEVEL AND WORM GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT – V: GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Apply the concepts of design to belts, chains and rope drives.
2. Apply the concepts of design to spur gear.
3. Apply the concepts of design to helical gear.
4. Apply the concepts of design to worm and bevel gears.
5. Apply the concepts of design to gear boxes.

TEXTBOOKS:

1. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, 2008.

REFERENCE BOOKS:

1. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
2. Sundararamamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_me71/preview
2. <https://archive.nptel.ac.in/courses/112/105/112105234/>
3. <https://archive.nptel.ac.in/courses/108/106/108106160/>

CO - PO and CO - PSO MAPPING

ME3662	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	1					1			1	2	3
CO2	3	2	3	1					1			1	2	3
CO3	3	2	3	1					1			1	2	3
CO4	3	2	3	1					1			1	2	3
CO5	3	2	3	1					1			1	2	3
Average	3	2	3	1					1			1	2	3

OBJECTIVES

The main learning objective of this course is to prepare the students:

1. To understand the construction and working of the components inside a thermal power plant.
2. To improvise knowledge on working of the components inside a Diesel, Gas and Combined cycle power plants.
3. To study about the construction and working of the components of nuclear power plants.
4. To comprehend about the working of the components inside Renewable energy power plants.
5. To be familiar with the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

UNIT I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS**OUTCOMES**

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

1. Explain the layout, construction and working of the components inside a thermal power plant.
2. Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
3. Explain the layout, construction and working of the components inside nuclear power plants.
4. Explain the layout, construction and working of the components inside Renewable energy power plants.
5. Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Ltd., 2008.
2. Er. R. K. Rajput, "A Text Book of Power Plant Engineering", 5th Edition, Laxmi Publication Pvt. Ltd., 2014.

REFERENCE BOOKS:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

ME3663	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	1	1	1		1	3			1		1	2	2
CO 2	3	1	1	1		1	3			1		1	2	2
CO 3	3	1	1	1		1	3			1		1	2	2
CO 4	3	1	1	1		1	3			1		1	2	2
CO 5	3	1	1	1		1	3			1		1	2	2
Average	3	1	1	1		1	3			1		1	2	2

(1 – LOW, 2-MEDIUM, 3-HIGH)

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.
5. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 6th edition 2017.

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

(1 – LOW, 2-MEDIUM, 3-HIGH)

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 Mangement"10 th Edition, Cengage, Phillippine Edition, 2019.
2. Ray Tricker, Quality Management Systems: A Practical Guide to Standards Implementation, Routledge; 1st edition, 2019
3. Poornima M. Charantimath, Total Quality Management, Pearson Education, 2 nd Edition, 2017.

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

(1 – LOW, 2-MEDIUM, 3-HIGH)

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				
		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				
	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

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

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

OBJECTIVE

1. To make the students aware of the finer sensibilities of human existence through an art form
2. To enable students to appreciate different forms of literature
3. To help students understand that literature is an expression of life's experience.
4. To improve the aesthetic sense of the students by exposing them to various forms of literature
5. To improve the creative abilities of students by giving them opportunities to review forms of literature

UNIT – I: Introduction to Elements of Literature**9**

- Reading, thinking, discussing and writing skills
- Finer sensibility for better human relationship
- Understanding of the problem of humanity without bias
- Space to reconcile and get a cathartic effect

Assessment- Declamation /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 secret law, determination of trade secret status, liability for misappropriations of trade secrets, protection for submission, trade secret litigations.

TOTAL HOURS: 45

OUTCOMES:

1. Student will be able to define need and importance of intellectual property rights.
2. Rules and process for IPR registration.
3. Patent Searching, Patent Drafting, filing, Protection and duration of a patent in India and abroad.
4. Legal concepts in Science, Engineering, Technology and Creative Design.
5. Clarity on the influence of Geographical Indications on Trade Secrets.

REFERENCES:

1. Watal, Jayashree, Intellectual Property Rights In The WTO And Developing Countries, Oxford University Press
2. R. Anita Rao & Bhanoji Rao, Intellectual Property Rights- A Primer, Eastern Book Co.
3. Shiv Sahai Singh, The Law Of Intellectual Property Rights, Eastern Book Co.
4. Deepa Goeland Shomini Parashar, IPR, Biosafety and Bioethics, Pearson publisher
5. Pandey, Neeraj, Dharni, Khushdeep, Intellectual Property Rights, PHI, 2020.
6. Sople, Vinod V. Managing Intellectual Property: The Strategic Imperative, PHI, 2020.

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

Defining Work Groups and Teams - Types of Teams and Team Processes - Group Decision- Making and Effectiveness - Diversity and Multiculturalism in Teams - Organizational Culture and Development - Social Dynamics and Change Management.

TOTAL HOURS: 45

COURSE OUTCOMES

1. Students will be able to understand Industrial Psychology by practicing Management theories in solving Industrial relations problems.
2. Students can apply critical thinking with regard to human attitudes and behavior for better decision making.
3. The managerial competencies among students can be enhanced by employing human factor with suitable ergonomics in workplace.
4. To inculcate value based leadership abilities amongst students in achieving individual as well as organizational goals.
5. Students can withhold cultural diversity in globalized business and engage in lifelong learning.

REFERENCES

1. Aamodt, M. G. (2016). Industrial/Organizational Psychology: An Applied Approach (6th Edition), Cengage Learning.
2. Landy, F. J., & Conte, J. M. (2016). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology (4th Edition), Wiley.
3. Riggio, R. E. (2017). Introduction to Industrial and Organizational Psychology (6th Edition), Routledge.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3			1				1
CO2		3	2		1		1	
CO3	1					1		
CO4	2		2		1		1	
CO5				3				2
	2	3	2	2	1	1	1	2

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 Given 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 – 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.

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. Prentice Hall India, New Delhi.
2. Goel, S. K. (2012). *An introduction to The constitution of India*. Sage Publications.
3. R.C.Agarwal (1997). Indian Political System. SChand and Company, New Delhi.
4. Bakshi, P. (1993). *The Constitution of India*. Prentice Hall Publications.
5. Sen, S. (2011). *The Constitution of India: Popular Sovereignty and Democratic Transformations*. Prentice Hall India, New Delhi.

PO-CO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2			1				1
CO2	2		3	2	3	3	1	1
CO3	2	3	2	1		1		
CO4	2		2	1		1		
CO5	2		2	1	2	1	1	
Avg.	2	3	1.8	1.2	2.5	1.5	1	1

ME3664	DESIGN AND FABRICATION PROJECT	L	T	P	C
		0	0	4	2

OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Discovering potential research areas in the field of Mechanical Engineering.
2. Comparing and contrasting the several existing solutions for the problem identified.
3. Formulating and proposing a plan for creating a solution for the research plan identified.
4. Conducting the experiments as a team and interpreting the results.
5. Reporting and presenting the findings of the work conducted.

A project topic must be selected by the students in consultation with their guides. The ultimate aim of the project work is to deepen comprehension of mechanical principles by applying them to a new problem which may be the design and fabrication of a device for a specific application. Design team-Team formation, Conceptualization: Visual thinking, Sketching/Drawing, new concept thinking, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies. Patents and Intellectual Property.

TOTAL: 60 PERIODS

COURSE OUTCOME:

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

1. Discover potential research areas in the field of Mechanical Engineering.
2. Compare and contrast the several existing solutions for the problems identified.
3. Formulate and propose a plan for creating a solution for the research plan identified.
4. Conduct the experiments as a team and interpret the results.
5. Report and present the findings of the work conducted.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. <https://archive.nptel.ac.in/courses/110/104/110104073/>
3. https://onlinecourses.nptel.ac.in/noc23_mg107/preview

CO - PO and CO - PSO MAPPING

ME3664	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO2	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO3	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO4	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO5	3	2	2	1	2	1	2	2	3	1	1	2	3	2
Average	3	2	2	1	2	1	2	2	3	1	1	2	3	2
Low (1) ; Medium (2) ; High (3)														

OBJECTIVES:

1. To educate practical experience in handling 2D drafting and 3D modelling software systems
2. To help design 3 Dimensional geometric model of parts
3. To educate design sub-assemblies and assemblies
4. To tutor about exporting the 3 Dimensional geometric parts and assemblies to drawing
5. To educate about G & M Code programming and simulate the CNC program

LIST OF EXPERIMENTS:**3D GEOMETRIC MODELLING**

1. CAD Introduction

Sketch: Line, Polyline, Circle, Ellipse, Arc, Polygon

Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.

Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.

Feature manipulation: Copy, Edit, Pattern, Suppress, History operations.

Assembly: Constraints, Exploded Views, Interference check

Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting

2. Creation of 3D assembly model of following machine elements using 3D Modelling software

Flange Coupling

Plummer Block

Screw Jack

Stuffing box

Universal Joint

Lathe Tailstock

*Students may also be trained in manual drawing of some of the above components (specify the number – progressive arrangement of 3D)

MANUAL PART PROGRAMMING

1. CNC Machining Centre

i) Linear Cutting.

ii) Circular cutting.

iii) Cutter Radius Compensation.

iv) Canned Cycle Operations.

2. CNC Turning Centre

- i) Straight, Taper and Radial Turning.
- ii) Thread Cutting.
- iii) Rough and Finish Turning Cycle.
- iv) Drilling and Tapping Cycle.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Design experience in handling 2D drafting and 3D modelling software systems.
2. Design 3 Dimensional geometric model of parts.
3. Design sub-assemblies and assemblies.
4. Export the 3 Dimensional geometric parts and assemblies to drawing.
5. Demonstrate manual part programming and simulate the CNC program.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

SL. NO	NAME OF EQUIPMENTS	QUANTITY
1	Computer Work Station	15 Nos.
2	Color Desk Jet Printer	1 No.
3	Analysis Software (AutoCAD / FreeCAD / LibreCAD)	Student version / Open source

ME3566	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	-	1	-	-	1	1	1	-	1	3	1
CO2	2	3	3	-	1	-	-	1	1	1	-	1	3	1
CO3	2	3	3	-	1	-	-	1	1	1	-	1	3	1
CO4	2	3	3	-	1	-	-	1	1	1	-	1	3	1
CO5	2	3	3	-	1	-	-	1	1	1	-	1	3	1
Average	2	3	3	-	1	-	-	1	1	1	-	1	3	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES

The course aims to

1. Enhance the Employability and Career Skills of students.
2. Orient the students towards grooming as a professional.
3. To learn how to speak in Group Discussions
4. Make them employable Graduates and help them attend interviews successfully.
5. 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:

1. Make effective presentations and participate confidently in Group Discussions
2. Attend job interviews and interacting in different situations.

3. Able to write business reports, proposals and related correspondence.
4. 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)

ME3761	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is:

1. To introduce the process planning concepts to make cost estimation for various products after process planning.
2. To demonstrate the concept of process planning activities and preparation of set of documents.
3. To teach the concept of cost estimation methods.
4. To demonstrate the concept of production cost estimation.
5. To comprehend machine time calculations.

UNIT-I: INTRODUCTION TO PROCESS PLANNING 9

Introduction - methods of process planning-Drawing Interpretation - Material evaluation - steps in process selection - Production equipment and tooling selection.

UNIT-II: PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes - Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning - Economics of process planning.

UNIT-III: INTRODUCTION TO COST ESTIMATION 9

Importance of Costing and Estimation – Methods of costing - Elements of Cost Estimation – Types of Estimates – Estimating procedure - Estimation Labor Cost, Material Cost - Allocation of Overhead Charges.

UNIT-IV: PRODUCTION COST ESTIMATION 9

Estimation of different types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

UNIT-V: MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Select the process, equipment, and tools for various industrial products.
2. Prepare process planning activity chart
3. Explain the concept of cost estimation.
4. Compute the job order cost for different type of shop floor.
5. Calculate the machining time for various machining operations.

TEXTBOOKS:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2003.
2. Sinha B.P, "Mechanical estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCE BOOKS:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.

E- RESOURCES:

<https://archive.nptel.ac.in/courses/112/107/112107209>

<https://archive.nptel.ac.in/courses/112/107/112107238>

ME3761 1	PROGRAM OUTCOMES												PSOs	
		2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1							1	1		1	1	2
CO2	2	1							1	1		1	1	2
CO3	2	1							1	1		1	1	2
CO4	2	1							1	1		1	1	2
CO5	2	1							1	1		1	1	2
Average	2	2							1	1		1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
2. To make the students describe mechatronic components and systems using the basic building blocks of various systems mathematically, along with different modes of controller.
3. To utilize the architectures of Microprocessor, Microcontroller and Programmable Peripheral Interface 8255, Pin Diagram, Addressing Modes, Programming and interfacing circuits of Microprocessor.
4. To learn how to apply the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of mechatronic engineering.
5. To design and develop a mechatronic system using the knowledge and skills acquired through the course and also from the given case studies.

UNIT I INTRODUCTION 9

Introduction to Mechatronics – Concepts of Mechatronics approach – Need for Mechatronics-
Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static
and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges
– Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors – Actuators –
Classification – Stepper motor – Servo motor - Industry 4.0, Robotics, AI, ML, Embedded System,
AR, Haptics, EVs, Semiconductors

UNIT II SYSTEM MODELS AND CONTROLLERS 9

Systems – Classification - Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Translational Systems, Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control.

UNIT III MICROPROCESSOR AND MICROCONTROLLER 9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes – Instruction set of 8085 – Concepts of 8051 microcontroller – Block diagram – Architecture of 8255 - Stepper Motor Control – Traffic Control interface, Introduction to Arduino processor.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS

9

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Selection of a PLC.

UNIT V MECHATRONIC SYSTEM DESIGN

9

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Case studies of Mechatronics systems- Pick and place Robot- Engine Management system- Automatic car park barrier.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Describe the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems, actuators and sensor and technology.
2. Describe Mechatronic components and systems using the basic building blocks of various systems mathematically, along with different modes of controller.
3. Describe the architecture of Microprocessor, Microcontroller and Programmable Peripheral Interface 8255, Pin Diagram, Addressing Modes, Programming and interfacing circuits of Microprocessor.
4. Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering
5. Describe a Mechatronic system using the knowledge and skills acquired through the course and also from the given case studies.

TEXTBOOKS:

1. Bolton, “Mechatronics”, Prentice Hall,2013
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall,2013.

REFERENCES:

1. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print,2013
2. Devadas Shetty and Richard A.Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.

ME3762	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	1						1	3	3	2
CO2	3	2	3	2	1						1	3	3	2
CO3	3	2	3	2	1						1	3	3	2
CO4	3	2	3	2	1						1	3	3	2
CO5	3	2	3	2	1						1	3	3	2
Average	3	2	3	2	1						1	3	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

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. Nagarazan, ‘A Textbook on Professional Ethics and Human Values’ New Age International Publishers, 2015.
8. World Community Service Centre, “Value Education”, Vethathiri publications, Erode, 2011.
9. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
10. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press, 2003.
11. Suresh Jayshree, 2003, Human Values and Professional Ethics, ,S. Chand Publishing, Third Revised Edition.

E-BOOK :

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

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

OBJECTIVES:

1. To study the concept of Mechatronics to design, modeling, and analysis of basic pneumatic, electrical, and hydraulic systems.
2. To provide the hands on-training in the control of linear actuators.
3. To study the concepts of speed controller models
4. To study the concepts of 8051 programming
5. To study the concepts and fundamentals of IoT, sensors, actuators and IoT boards

MECHATRONICS LIST OF EXPERIMENTS:

1. Measurement of Linear/Angular of Position, Direction and Speed using Transducers.
2. Speed and Direction control of DC Servomotor.
3. Addition, Subtraction and Multiplication Programming in 8051.
4. Programming and Interfacing of Stepper motor and DC motor using 8051
5. Sequencing of Pneumatic Circuits.
6. Sequencing of Hydraulic, Pneumatic, and Electro-pneumatic circuits using Software.

AUTOMATION (IoT) LIST OF EXPERIMENTS

1. Familiarization with the concept of IoT and its open-source microcontroller/SBC.
2. Write a program to turn the ON/OFF motor using a microcontroller/SBC through the internet.
3. Write a program to interface sensors to display the data on the screen through the internet.
4. Interface the sensors with the microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through the internet when sensor data is detected.
5. To interface sensor with microcontroller/SBC and write a program to turn ON/OFF Linear/Rotary Actuator through IoT when sensor data is detected.
6. To interface Bluetooth/Wifi with microcontroller/SBC and write a program to send sensor data to a smartphone using Bluetooth/wifi.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Demonstrate the functioning of Mechatronics systems with various pneumatic, hydraulic, and electrical systems
2. Demonstrate the microcontroller and PLC as controllers in automation systems by executing proper interfacing of I/O devices and programming
3. Demonstrate the speed controller models
4. Demonstrate the 8051 programming
5. Demonstrate the sensing and actuation of mechatronics elements using IoT.

ME 3764	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3							3			3	2	1
CO2	1	3							3			3	2	1
CO3	1	3							3			3	2	1
CO4	1	3							3			3	2	1
CO5	1	3							3			3	2	1
Average	1	3							3			3	2	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To give exposure to software tools needed to analyze engineering problems related to Truss.
2. To give exposure to software tools needed to analyze engineering problems related to Beams.
3. To expose the students to different applications of simulation tools.
4. To expose the students to different applications of analysis tools.
5. To help learners understand mode shape analysis of beams.

LIST OF EXPERIMENTS:**SIMULATION AND ANALYSIS**

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.

TOTAL: 45 PERIODS**OUTCOMES:****Upon the completion of this course the students will be able to**

1. simulate the stress induced in link elements of Truss, cables.
2. analyze the stresses and strains induced in plates.
3. analyze the stresses and strains induced in brackets and beams.
4. analyze the stresses and strains induced in heat transfer problems.
5. calculate the natural frequency and mode shape analysis of 2D components and beams.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

SL. NO	NAME OF EQUIPMENTS	QUANTITY
1	Computer Work Station	15
2	Printer	01
3	Multibody Dynamic Software suitable for Mechanism simulation and analysis (Ansys / FreeCAD / Chrono)	Student version / Open source

ME3745	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	3	-	-	1	1	1	-	1	3	1
CO2	2	3	3	2	3	-	-	1	1	1	-	1	3	1
CO3	2	3	3	2	3	-	-	1	1	1	-	1	3	1
CO4	2	3	3	2	3	-	-	1	1	1	-	1	3	1
CO5	2	3	3	2	3	-	-	1	1	1	-	1	3	1
Average	2	3	3	2	3	-	-	1	1	1	-	1	3	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To improve the practical knowledge.
2. To get hands-on experience in an industry.
3. To demonstrate team building to achieve success in the production and service activities

GUIDELINES:

1. A Student must undergo an internship in a reputed industry for a period of 15days minimum.
2. He can attend such internship in any of summer vacations in his previous semesters and submit the relevant certificate in the seventh semester for getting one credit

Presentation	Viva-voce	Certificate from Industry and report	Total Mark
25	25	50	100

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

- 1.Practice engineering concepts in real time.
- 2.Develop work habits and attitudes necessary for job success.
- 3.Build teams to achieve the production and service outputs.

ME3746	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1		2			2	3	3		1	2	2
CO2	3	1	1		2			2	3	3		1	2	2
CO3	3	1	1		2			2	3	3		1	2	2
Average	3	1	1		2			2	3	3		1	2	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

The objective of this course is to help the students to develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same, and to train the students in preparing project reports and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. Design team-Team formation, Conceptualization: Visual thinking, Sketching/Drawing, new concept thinking, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies. Patents and Intellectual Property.

TOTAL: 300 PERIODS**COURSE OUTCOME:**

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

1. Take up any challenging practical problems and find solutions by formulating proper methodology.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. <https://archive.nptel.ac.in/courses/110/104/110104073/>
3. https://onlinecourses.nptel.ac.in/noc23_mg107/preview

CO - PO and CO - PSO MAPPING

ME3841	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO2	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO3	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO4	3	2	2	1	2	1	2	2	3	1	1	2	3	2
CO5	3	2	2	1	2	1	2	2	3	1	1	2	3	2
Average	3	2	2	1	2	1	2	2	3	1	1	2	3	2

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health
- To adopt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost-effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE**4+ 2**

Health: Importance of maintaining health- prevention than treatment - Ten types of health - Physical - Mental - Social – Financial - Emotional - Spiritual - Intellectual - Relationship – Environmental and Occupational/Professional health.

Present health status - The life expectancy- present status - mortality rate - dreadful diseases - Non- communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time.

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age)- Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI-Importance and actions to be taken.

UNIT II DIET**6+ 4**

Role of diet in maintaining health - energy one needs to keep active throughout the day – nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong. **Balanced Diet and its 7 Components** - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions.

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes. Different cooking methods, merits and demerits of each method.

UNIT III ROLE OF AYURVEDA AND SIDDHA SYSTEMS IN MAINTAINING HEALTH

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 (Tri-Dosha Theory) - Udal Thathukkal.

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS

3+ 4

Emotional health - Definition and types - Three key elements: the subjective experience – the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances – Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity.

UNIT V YOGA

2+ 12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for Individuals according to the Age - The Eight Limbs of Yoga - Simple yoga asanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL: 45 PERIODS (Lecture 19 + Practice 26)

COURSE OUTCOMES:

After completing the course, the students will be able to:

1. Learn the importance of different components of health
2. Gain confidence to lead a healthy life
3. Learn new techniques to prevent lifestyle health disorders
4. Understand the importance of diet and workouts in maintaining health
5. Understand the practice of yoga

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA, 2016.
2. Yoga for Beginners: 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California.
3. Yoga and Empowerment, WCSC-VISION for Wisdom, 3rd Edition 2018, Vethathiri Publications, Erode
4. SIDDHA MEDICINE HANDBOOK OF TRADITIONAL REMEDIES Kindle Edition by Paul Joseph Thottam (Author) 2012.
5. The Ayurvedic Pharmacopoeia of India Part-I Volume-VII First Edition [Minerals & Metals] by Central Council for Research in Ayurveda and Siddha, 2008

REFERENCES:

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

COURSE OBJECTIVE:

- To know the contributions of the scientists for the development of society over a period of time.
- To understand the Science and Technological developments that lead to human welfare.
- To appreciate the Science and Technological contributions for the development of various sectors of the country.
- To identify the technical transfer versus economic progress of the countries.
- To know the students get a holistic view of the development of science and technology as a historical and cultural phenomenon.

UNIT I HISTORICAL PERSPECTIVE OF SCIENCE AND TECHNOLOGY 9

The nature of science and technology, Roots of science and technology in India, Science and society, Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Indian contribution to science and technology (from Ancient to Modern). Aryabhata, Charaka, Bhaskara II, Sushruta, J C Bose, C V Raman, Homi J Bhaba, Dr APJ Abdul kalam

UNIT II SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Scientific and Technological Developments in Medieval India; Influence of the Islamic world and Europe; The role of 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. Kohli, 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– Cyber crime and informationSecurity– Cyber criminals– Classification of Cyber crimes.

UNIT II LEGAL PERSPECTIVES**9**

Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and theLegal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India.

UNIT 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 lawscase studies, General law and Cyber Law–a Swift Analysis.

TOTAL: 45 PERIODS**Course Outcomes**

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

- **CO1** - Understand key terms and concepts in cyber security and cyber law, intellectual propertyandcyber– 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 personaldata,securing simple computer networks, and safe Internet usage
- **CO5** – Incorporate approaches for incident analysis and response.

Text Books

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

Reference Books

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

COs/POs/PSOs Mapping

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	1			
2		2		2		2									2	2
3								2					1			
4		3	2					2				2			2	1
5	2					2								2		
av g	2	2.5	2	2		2		2				2	1	2	2	1.5

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.

MME201	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		1			2			1			2	1	
CO2		1		2				2			1		1	
CO3	2			2			1			2		2	1	
CO4	2		3			2			2		1		1	
CO5		2			2			1				1	1	
Average	3	1	1	1	1	1		1	1	1	1	1	1	

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To understand the concepts of measurement technology.
2. To learn about the various sensors used to measure various physical parameters.
3. To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.
4. To learn about the optical, pressure and temperature sensor.
5. To understand the signal conditioning and DAQ systems.

UNIT I INTRODUCTION**9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS**9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)-Application of proximity sensor in automated guided vehicle (AGV)-position and proximity sensors in modern industries.

UNIT III FORCE, MAGNETIC AND HEADING SENSORS**8**

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set of 8085 – Concepts of 8051 microcontroller – Block diagram –Architecture of 8255 - Stepper Motor Control – Traffic Control interface, Introduction to Arduino processor.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS**10**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS**9**

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Case studies

of Mechatronics systems- Pick and place Robot- Engine Management system- Automatic car park barrier.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Recognize with various calibration techniques and signal types for sensors.
2. Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors, and transducers.
3. Apply the various sensors and transducers in various applications
4. Select the appropriate sensor for temperature and pressure applications.
5. Acquire the signals from different sensors using Data acquisition systems.

TEXTBOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013.

REFERENCES:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.
2. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

PME101	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	2	2	1						1	2	3
CO2	3	2	1	2	2	1						1	2	3
CO3	3	2	1	1	2	1						1	2	3
CO4	3	2	1	3	2	1						1	2	3
CO5	3	2	1	3	2	1						1	2	3
Average	3	2	1	2.2	2	1						1	2	3

(1-LOW, 2-MEDIUM, 3-HIGH)

PME102	ELECTRICAL DRIVES AND ACTUATORS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To familiarize are lay and power semiconductor devices
2. To teach a knowledge on drive characteristics
3. To demonstrate the knowledge on DC motors and drives.
4. To demonstrate the knowledge on AC motors and drives.
5. To demonstrate the knowledge on Stepper and Servo motor.

UNIT I RELAY AND POWER SEMI-CONDUCTOR DEVICES 9

Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit- Introduction to Driver and snubber circuits.

UNIT II DRIVE CHARACTERISTICS 9

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

UNIT III DC MOTORS AND DRIVES 9

DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT IV AC MOTORS AND DRIVES 9

Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control– Static rotor resistance control – Slip power recovery control.

UNIT V STEPPER AND SERVO MOTOR 9

Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation- Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Recognize the principles and working of relays, drives and motors.
2. Study the working and characteristics of various drives and motors.
3. Learn the solid state switching circuits to operate various types of Motors and Drivers
4. Interpret the performance of Motors and Drives.
5. Describe the Motors and Drivers for given applications.

TEXTBOOKS:

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2016.

REFERENCES:

1. Gopal K.Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
1. Theraja B.L. & Theraja A.K., "A Text Book of Electrical Technology", S.Chand & Co. Ltd., New Delhi, 2023.

PME102	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	2	1							1	1	1
CO2	3	1	2	2	1							1	1	1
CO3	3	1	2	2	1							1	1	1
CO4	3	1	1	2	2							1	1	1
CO5	3	1	1	2	2							1	1	1
Average	3	1	1	2	1							1	1	1

(1-LOW, 2-MEDIUM, 3-HIGH)

PME 103	EMBEDDED SYSTEMS AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To introduce the Building Blocks of an embedded System and Software Tools.
2. To emphasize the role of Input/output interfacing with Bus Communication protocol
3. To illustrate the ISR and scheduling for the multitasking process.
4. To explain the basics of a Real-time operating system.
5. To expose the students to the fundamentals of embedded Programming

UNIT-I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA — Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

UNIT-II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS485 – CAN Bus- Serial Peripheral Interface (SPI) – InterIntegrated Circuits (I2C).

UNIT-III INTERRUPTS THE SERVICE MECHANISM AND DEVICE DRIVER 9

Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers.

UNIT-IV RTOS-BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication- shared memory, message passing- Interprocess Communication- Introduction to process synchronization using semaphores.

UNIT-V 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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. The hardware functionals and software strategies required to develop various Embedded systems
2. The basic differences between various Bus communication standards
3. The incorporation of the interface as Interrupt services.
4. The various scheduling algorithms through a Real-time operating system.
5. Deliver insight into embedded C programming and its salient features for embedded systems.

TEXT BOOKS:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design, McGraw-Hill Edu, 3rd edition 2017
2. Peckol, "Embedded system Design", John Wiley & Sons, 2010.

REFERENCE BOOKS:

1. Shibu. K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2nd edition 2017.
2. Lya B.Das," Embedded Systems" ,Pearson Education, 1st edition 2012.

PME 103	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	1	1								2	1
CO2	2	2	3	1	1								2	1
CO3	2	2	3	1	1								2	1
CO4	2	2	3	1	1								2	1
CO5	2	2	3	1	1								2	1
Average	2	2	3	1	1								2	1

(1–LOW, 2– MEDIUM, 3–HIGH)

OBJECTIVES:

1. To learn about basics of robots and their classifications
2. To understand the robot kinematics in various planar mechanisms
3. To learn about the concepts in robot dynamics
4. To understand the concepts in trajectory planning and programming
5. To know about the various applications of robots

UNIT I	BASICS OF ROBOTICS	8
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Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution –repeatability of robot- Robot Maintenance - Robot Safety systems.

UNIT II	ROBOT KINMEATICS
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Robot kinematics: Introduction- Matrix representation- rigid motion and homogeneous Transformation-D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms.

UNIT III	ROBOT DYNAMICS	9
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Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation.

UNIT IV	TRAJECTORY, PATH PLANNING AND PROGRAMMING	8
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Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS.

UNIT V	ROBOT APPLICATIONS	9
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Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives. Robot end effectors and Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.

OUTCOMES:

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

1. Demonstrate the basic concepts, terminologies safety system of robots.
2. Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots.
3. Derive the Forward and Inverse Kinematics, Dynamics for Various Robots.
4. Apply the various programming techniques in industrial applications.
5. Analyse the use of various types of robots in different applications.

TEXTBOOKS:

1. John.J. Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.

REFERENCES:

1. M.P. Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata, McGraw-Hill Education Pvt Limited 2nd Edition, 2012.
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2nd Edition, 2010.

PME104	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	1	2							1	1	3
CO2	3	2	3	1	2							1	2	3
CO3	3	2	3	1	2							1	2	3
CO4	3	2	3	1	2							1	2	3
CO5	3	2	3	1	3							1	2	3
Average	3	2	3	1	2.2							1	2	3

(1-LOW, 2-MEDIUM, 3-HIGH)

PME105	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To learn about various technologies and systems used to implement smart mobility and intelligent vehicles.
2. To learn basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
3. To learn basic Control System Theory applied to Autonomous Automobiles.
4. To impart overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task.
5. To learn about the connectivity fundamentals, Navigation and other applications for autonomous vehicle.

UNIT I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES 9

Concept of Automotive Electronics, History and Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Advanced driving assistance technology. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT II SENSOR TECHNOLOGY FOR SMART MOBILITY 9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems.

UNIT III CONNECTED AUTONOMOUS VEHICLE 9

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy.

UNIT IV VEHICLE WIRELESS TECHNOLOGY AND NETWORKING 9

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the

Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks.

UNIT V CONNECTED CAR AND AUTONOMOUS VEHICLE TECHNOLOGY 9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles -Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles
2. Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing
3. Familiar with the concept of fully autonomous vehicles
4. Apply the basic concepts of wireless communications and wireless data networks
5. Analyse the concept of the connected vehicle and its role in automated vehicles

TEXTBOOKS:

1. “Intelligent Transportation Systems and Connected and Automated Vehicles”, 2016, Transportation Research Board
2. Radovan Miucic, “Connected Vehicles: Intelligent Transportation Systems”, 2019, Springer.

REFERENCES:

1. Tom Denton, “Automobile Electrical and Electronic systems, Routledge”, Taylor & Francis Group, 5th Edition, 2018.
2. Tom Denton, Automobile Electrical and Electronic Systems, 3rd Edition Elsevier Publications 2004.

PME105	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1								2	3	3
CO2	3	2	1	1								2	3	3
CO3	3	2	1	1								2	3	3
CO4	3	2	1	1								2	3	3
CO5	3	2	1	1								2	3	3
Average	3	2	1	1								2	3	3

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To learn various immersive technologies of VR, AR and MR.
2. To learn software related to immersive technologies.
3. To learn the concepts of developing AR applications.
4. To learn the concepts of developing VR and unreal engine.
5. To study the haptic perception and extended reality.

UNIT I INTRODUCTION TO IMMERSIVE TECHNOLOGIES 9

Introduction on Virtual reality – Augmented reality – Mixed reality – Extended reality – VR Devices – AR Devices – Applications.

UNIT II SOFTWARE TOOLS 9

Intro to Unity – Unity editor workspace – Intro to C# and visual studio - Programming in Unity – Intro to Unreal Engine – UE4 Editor workspace – Intro to Blueprint programming – Programming in Ue4 .

UNIT III BUILDING AR APPLICATION WITH UNITY 9

AR SDKs for unity and unreal engine – Working with SDKs for unity – Developing AR application in unity - Building AR application.

UNIT IV BUILDING VR APPLICATION WITH UNREAL ENGINE 9

VR SDKs for unity and unreal engine – Developing VR application in Ue4 – Building VR application.

UNIT V HAPTIC PERCEPTION AND EXTENDED REALITY 9

Extended Reality - Introduction to Haptics – Devices and possibilities – Custom Device development – Device Integration.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Apply detailed knowledge about immersive technology.
2. Gaining the knowledge of different types of Tools and Devices .
3. Acquiring the knowledge about Unity and Unreal Engine.
4. Explain the developing application in immersive technologies.
5. Discuss about haptics in immersive technologies.

TEXTBOOKS:

1. Immersive Multimodal Interactive Presence, by Angelika Peer (Editor), Christos D. Giachritsis (Editor), Springer; 2012th edition (13 April 2014), ISBN-10 : 1447162137.
2. XR Haptics, Implementation & Design Guidelines, by Eric Vezzoli , Chris Ullrich , Gijs den Butter , Rafal Pijewski, March 13, 2022.

REFERENCES:

1. Practical Augmented Reality, by Steve Aukstakalnis, Addison-Wesley Professional; 1st edition (8 September 2016)
2. Augmented Reality - Theory, Design and Development, by Chetankumar G Shetty.

PME106	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2		2				1			1	1	2
CO2	2	2	2		2				1			1	1	2
CO3	2	2	2		2				1			1	1	2
CO4	2	2	2		2				1			1	1	2
CO5	2	2	2		2				1			1	1	2
Average	2	2	2		2				1			1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To study the functional requirements of engine components and suitable materials
2. To learn to design of cylinder and piston components
3. To learn to design of connecting rod and crankshaft
4. To learn to design of flywheel and valve train
5. To study the Engine Testing cycles, Emission measurement technologies

UNIT-I: FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS

9

Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.

UNIT-II: DESIGN OF CYLINDER AND PISTON COMPONENTS

9

Design of cylinder, cylinder head, piston, piston rings and piston pin – more details in necessary.

UNIT-III: DESIGN OF CONNECTING ROD AND CRANK SHAFT

9

Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.

UNIT-IV: DESIGN OF FLYWHEEL AND VALVE TRAIN

9

Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub - arm.

UNIT – V: ENGINE TESTING

9

Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO₂ - HC.-Particle counter.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

1. Discuss the requirements of engine components and select suitable materials.
2. Apply the concept of design to cylinder and piston components and solve problems.
3. Apply the concept of design to Connecting rod and crank shaft and solve problems.
4. Apply the concept of design to flywheel and valve train and solve problems.
5. Discuss engine test cycles, dynamometer and emission measurement technologies and instruments.

TEXTBOOKS:

1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
2. The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello | 24 December 2019.

REFERENCE BOOKS:

1. Hiroshima Yamagata, "The science and technology of materials in automotive engines", Woodhead Publishing Limited, Cambridge, England
2. Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005.

E-Resources:

1. <https://archive.nptel.ac.in/courses/107/106/107106088/>
2. <https://archive.nptel.ac.in/courses/112/107/112107217/>
3. https://onlinecourses.nptel.ac.in/noc22_mm34/preview

CO - PO and CO - PSO MAPPING

PME201	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	2				1			1	3	3
CO2	3	2	3	2	2				1			1	3	3
CO3	3	2	3	2	2				1			1	3	3
CO4	3	2	3	2	2				1			1	3	3
CO5	3	2	3	2	2				1			1	3	3
Average	3	2	3	2	2				1			1	3	3
Low (1) ; Medium (2) ; High (3)														

OBJECTIVES:

- 1 To study the advanced engine technologies
- 2 To learn various advanced combustion technologies and its benefits
- 3 To learn the methods of using low-carbon fuels and their significance
- 4 To learn and understand the hybrid and electric vehicle configurations
- 5 To study the application of fuel cell technology in automotive

UNIT I ADVANCED ENGINE TECHNOLOGY 9

Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.

UNIT II COMBUSTION TECHNOLOGY 9

Spark Ignition combustion, Modern Spark Ignition system (Digital Twin Spark Ignition System Digital Twin Spark-Swirl Induction, Digital Twin Spark-Fuel Injection System), Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.

UNIT III LOW CARBON FUEL TECHNOLOGY 9

Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward.

UNIT IV HYBRID AND ELECTRIC VEHICLE (BATTERY POWERED) 9

Conventional Hybrids(Conventional ICE + Battery),Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward.

UNIT V FUEL CELL TECHNOLOGY 9

Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.

OUTCOMES:

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

1. Discuss the latest trends in engine technology
2. Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment.
3. Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals.
4. Discuss the working and energy flow in various hybrid and electric configurations.
5. Analyzing the need for fuel cell technology in automotive applications.

TEXTBOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Gregor Hoogers, "Fuel Cell Technology Handbook", .CRC Press, 2019.

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2012.

E-RESOURCES:

<https://nptel.ac.in/courses/108106170>

PME202	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	2				1	3		1	2	3
CO2	3				2				1	3		1	2	3
CO3	3	2	2	2	2				1	3		1	2	3
CO4	3	2	2	2	2				1	3		1	2	3
CO5	3	2	2	2	2				1	3		1	2	3
Average	3	2	2	2	2				1	3		1	2	3

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To study the low and zero carbon fuels suitability and methods of use in off-road vehicles.
2. To learn and understand the green energy production methodologies and its use in off-road vehicle categories.
3. To learn various fuel cell types and its suitability in off-highway vehicles applications
4. To illustrate the impact of in-cylinder technologies on engine out emissions control.
5. To study the existing after-treatment technologies used in off-highway vehicle applications.

UNIT I LOW AND ZERO CARBON FUELS POWERED OFF-HIGHWAY 9
VEHICLES

Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE), Ammonia and Hydrogen Fuels suitability, methods, and Role of vehicle software.

UNIT II GREEN ENERGY POWERED OFF-HIGHWAY VEHICLES 9

Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, green hydrogen.

UNIT III FUEL CELL POWERED OFF-HIGHWAY VEHICLES 9

Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications.

UNIT IV IN-CYLINDER TREATMENT TECHNOLOGIES 9

Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies.

UNIT V AFTER TREATMENT TECHNOLOGIES 9

Diesel Oxidation Catalyst, Diesel Particulate Filter, lean NO_x trap, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO₂ absorption techniques, Waste Heat Recovery

and Organic Rankine Cycle.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Evaluate the availability, suitability, and its role in off-road vehicle categories in reducing the carbon footprint on the environment.
2. Gain the knowledge on various green energy production methods and its impact on meeting energy demand of off-road vehicle applications.
3. Develop the working of fuel cell, various fuel cell types, and its design for off-road vehicle applications.
4. Gain the knowledge on various in-cylinder low temperature combustion technologies and its key role in controlling the engine-out emissions.
5. Develop the working of various existing after treatment systems in controlling the engine out emissions.

TEXTBOOKS:

1. John Twidell, and Tony Weir. Renewable Energy Sources – 3rd Edition 2015,
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines.

REFERENCES:

1. Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers Technology & Engineering, 2001.
2. W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control, 2006.

PME203	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1				1			1	3	1
CO2	3	2	1	1	1				1			1	3	1
CO3	3	2	1	1	1				1			1	3	1
CO4	3	2	1	1	1				1			1	3	1
CO5	3	2	1	1	1				1			1	3	1
Average	3	2	1	1	1				1			1	3	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES

1. To enable the student to understand the principles, functions and practices adapted in maintenance activities of vehicles.
2. To study the powertrain maintenance, fault diagnosis, maintenance of Batteries.
3. To develop vehicle system maintenance and service of clutch, brake.
4. To study the concepts of vehicle safety and regulations.
5. To study and understand the simulation of safety concepts.

UNIT – I INTRODUCTION**9**

Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services – service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools.

UNIT – II POWERTRAIN MAINTENANCE**9**

Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical -Fault Diagnosis Using Scan Tools.

UNIT – III VEHICLE SYSTEM MAINTENANCE**9**

Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering.

UNIT – IV VEHICLE SAFETY**9**

Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers.

UNIT – V SIMULATION OF SAFETY CONCEPTS**9**

Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions.

TOTAL:45 PERIODS**OUTCOMES:**

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

- 1.The students have the knowledge of vehicle health monitoring, maintenance and safety.
- 2.The students able to maintenance of powertrain.
- 3.The students can ability to maintenance of Vehicle system.
- 4.Explain and awareness of vehicle safety.
- 5.Explain the simulation of safety concepts.

TEXT BOOKS:

- 1.5th Edition, “Advanced Automotive Fault Diagnosis Automotive Technology: Vehicle Maintenance and Repair” By Tom Denton.
- 2.Safety Management System and Documentation Training Programme Handbook by S. V. Paul
ISBN: 9788123923444

REFERENCES:

- 1.Ed May, "Automotive Mechanics Volume One" and Two, Mc Graw Hill Publications, Tenth edition, 2018.
- 2.Bosch Automotive Handbook, Tenth Edition, 2018.

PME204	PROGRAM OUTCOMES											PSO's	
	1	2				6	7	8	9		12		
CO1	3	2							1		1		
CO2	3	2	2	1	1				1		1	3	2
CO3	3	2	2	1	1				1		1	3	2
CO4	3	2	2	1	1				1		1	3	2
CO5	3	2	2	1	1				1		1	3	2
Average	3	2	2	1	1				1		1	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

PME205	CAE AND CFD APPROACH IN FUTURE MOBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 1.To study the use of computer in mobility software or mobility.
- 2.To study the concepts computer aided design and rapid prototyping
- 3.To introduce the basic concepts of the finite elements methods.
- 4.To introduce basics and fundamental of the computational fluid dynamics
- 5.To introduce Turbulence Modelling and various simulation techniques.

UNIT – I INTRODUCTION TO CAE /CFD 9

Introduction to use of computer in Mobility Product Life Cycle, Software for mobility. Introduction to design process and role of computers in the design process, use of modern computational tools used for design and analysis, Concept of modelling and simulation. CFD as a design and research tool, Applications of CFD in mobility engineering.

UNIT – II CAD AND RAPID PROTOTYPING 9

Curves and Surfaces: Geometric modelling curves and surfaces, Wire frame models, Parametric representations, Parametric curves and surfaces, Solid modelling: Fundamentals of solid modelling, Different solid representation schemes, Boundary representation (B-rep), Constructive solid geometry (CSG). Mechanism design and assembly. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards. CAD Data and Programming Techniques for RP: Transformations, Solid modelling for RP, Surface modelling, STL file generation, Defects in STL files and repairing algorithms, Interface formats.

UNIT – III INTRODUCTION TO FEA 9

Basic Concept of Finite Element Method, Ritz and Rayleigh Ritz methods, Method of weighed residuals, Galerkin method. Governing differential equations of one- and two dimensional problems, One Dimensional Second Order Equations – Discretization – Linear and Higher order Elements – Interpolation and shape functions, Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of static problems and case studies in stress analysis of mechanical components using 2D and 3D elements.

CFD vs. experimentation; continuity, navier-stokes and energy equations; modelling and discretization techniques; basic steps in CFD computation Various simplifications, Dimensionless equations and parameters, Incompressible inviscid flows, Source panel method, and Vortex panel method Conservation form of the equations, shock fitting and shock capturing, Time marching and space marching. 3-D structured and unstructured grid generation, mesh smoothing and sensitivity checks.

UNIT – V PROBLEM SOLVING USING CFD**9**

Turbulence Modelling, different turbulent modelling scheme. Incompressible Viscous Flows: Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; Simulation of Ahmed and Windsor bodies; Vorticity based grid-free simulation technique; simulation in climatic and acoustic wind tunnels; velocity vector and pressure contour simulation.

TOTAL :45 PERIODS**OUTCOMES:**

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

1. Discuss the basic concept of the CAE /CFD
2. Develop the computer aided design and rapid prototyping.
3. Discuss the basic concept of Finite Element methods.
4. Discuss the concepts of computational fluid dynamics
5. Solving the problem and simulation using computational fluid dynamics.

TEXT BOOKS:

1. Computational Fluid Dynamics: A Practical Approach by Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu.
2. Applied Computational Fluid Dynamics by S. C. Gupta.

REFERENCES:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007.
2. Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008

PME205	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	2		1		2			3	3	2
CO2	3	3	2	2	2		1		2			3	3	2
CO3	3	3	2	2	2		1		2			3	3	2
CO4	3	3	2	2	2		1		2			3	3	2
CO5	3	3	2	2	2		1		2			3	3	2
Average	3	3	2	2	2		1		2			3	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To describe about working principle of electric vehicles.
2. To explain the construction and working principle of Hybrid electric vehicles.
3. To understand about working principle layout of electric and hybrid vehicles.
4. To impart knowledge on thermal management of batteries.
5. To illustrate the working principles of thermal management of fuel cells.

UNIT I ELECTRIC VEHICLES 9

Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.

UNIT II HYBRID VEHICLES 9

Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components. Regenerative Braking, Economy, Vibration and Noise reduction. Hybrid Electric Vehicles System – Analysis and its Types, Controls.

UNIT III VEHICLE LAYOUT 9

Electric vehicle layout, specifications, system components, electronic control system, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, energy consumption, safety and challenges in electric vehicles.

UNIT IV THERMAL MANAGEMENT FOR BATTERIES 9

Introduction - Thermal control in vehicular battery systems: battery performance degradation at low and high temperatures - Passive, active, liquid, air thermal control system configurations for HEV and EV applications - Battery Heat Transfer.

UNIT V THERMAL MANAGEMENT IN FUEL CELLS 9

Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy

balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand and describe the importance of electric vehicle.
2. Discuss the importance and working principle of hybrid electric vehicle.
3. Design the different types of electric and hybrid vehicle layouts.
4. Understand the basic knowledge about the thermal management system in batteries.
5. Illustrated the concepts of thermal management system in fuel cells.

TEXTBOOKS:

1. Jack Erjavec and Jeff Arias, “Hybrid, Electric and Fuel Cell Vehicles”, Cengage Learning, Pvt. Ltd., New Delhi, 2012.
2. Jack Erjavec and Jeff Arias, “Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles”, Cengage Learning Pvt. Ltd., New Delhi, 2007.

REFERENCES:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017.

PME206	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		3		2				2	1			2	1
CO2	2		3		2				2	1			2	1
CO3	2		3		2				2	1			2	1
CO4	2		3		2				2	1			2	1
CO5	2		3		2				2	1			2	1
Average	2		3		2				2	1			2	1

(1-LOW, 2-MEDIUM, 3-HIGH)

PME301	BIOENERGY CONVERSION TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To elucidate on biomass, types, availability, and characteristics.
2. To study the bio-methanation process.
3. To impart knowledge on combustion of biofuels
4. To describe on the significance of equivalence ratio on thermochemical conversion of biomass
5. To provide insight to the possibilities of producing liquid fuels from biomass.

UNIT I INTRODUCTION 9

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario carbon neutrality – biomass assessment studies – typical conversion mechanisms densification technologies.

UNIT II BIOMETHANATION 9

Biomethanation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

UNIT III COMBUSTION 9

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels- equivalence ratio – fixed Bed and fluid Bed combustion.

UNIT IV GASIFICATION, PYROLYSIS AND CARBONISATION 9

Chemistry of gasification types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonization.

UNIT V LIQUIFIED BIOFUELS 9

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae Process and chemistry Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications;

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Estimate the surplus biomass availability of any given area.
2. Design a biogas plant for a variety of biofuels.
3. Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.
4. Analyse the influence of process governing parameters in thermochemical conversion of biomass.
5. Synthesize liquid biofuels for power generation from biomass.

TEXTBOOKS:

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, CRC Press; ISBN-10: 0367745550- Springer-2022.
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel Shiromani, Solomon U. Oranusi, Springer- 2022.

REFERENCES:

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.
2. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication, 1997.

PME301	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2				2		3		1			2	1	2
CO2	2	2	3			2	2				2	2	1	2
CO3	2	2	3	2			1				2	2	1	2
CO4	2	2	3	2			1				2	2	1	2
CO5	2	2	3	2			1				2	2	1	2
Average	2	2	3	2	2	2	2		1		2	2	1	2
Low (1) Medium (2) High (3)														

PME 302	CARBON FOOTPRINT ESTIMATION AND	L	T	P	C
	REDUCTION TECHNIQUES	3	0	0	3

OBJECTIVES:

1. To introduce climate change and carbon footprint
2. To study the principle of product life cycle and Green House Gas emissions accounting
3. To study the Methodology for Carbon Footprint Calculation
4. To learn emission mitigation and carbon sink
5. To study the case study of carbon footprint.

UNIT-I CLIMATE CHANGE AND CARBON FOOTPRINT 9

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic Implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon Footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations

UNIT-II PRODUCT LIFE CYCLE AND GHG EMISSIONS 9

Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality Allocation and Assessing Uncertainty

UNIT-III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT 9

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes

UNIT-IV EMISSION MITIGATION AND CARBON SINK 9

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of

mitigation –Policies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing.

UNIT-V CASE STUDIES

9

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation - Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Explain the climate change and carbon footprint
2. Discuss the principle of product life cycle and Green House Gas emissions accounting
3. Explain the Methodology for Carbon Footprint Calculation
4. Discuss emission mitigation and carbon sink
5. Explain the case study of carbon footprint.

TEXT BOOKS:

1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10 : 9811011737
2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10 : 9814585742

PME 302	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	2				3		1					1
CO2	1	1	2				3		1					1
CO3	1	1	2				3		1					1
CO4	1	1	2				3		1					1
CO5	1	1	2				3		1					1
Average	1	1	2				3		1					1

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

- 1 To learn Quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally benign
- 2 To Analyzing factors behind energy billing and applying the concept of demand side management for lowering energy costs
- 3 To learn computing the stoichiometric air requirement for any given fuel and quantifying the energy losses associated with thermal utilities of industries
- 4 To diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency
- 5 To Applying CUSUM and other financial evaluation techniques to estimating the accruable energy savings/monetary benefits for any energy efficiency project

UNIT – I INTRODUCTION**9**

Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

UNIT – II ELECTRICAL SUPPLY SYSTEMS**9**

Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics.

UNIT – III ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES**9**

Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.

UNIT – IV ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES**9**

Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems.

UNIT – V ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS**9**

Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme

TOTAL: 45 PERIODS**OUTCOMES: At the end of the course the students would be able to**

1. Discuss Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign
2. Analyze factors behind energy billing and apply the concept of demand side management for lowering energy costs

3. Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries
4. Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency
5. Apply CUSUM and other financial evaluation techniques to estimate the accruable energy savings/monetary benefits for any energy efficiency project

TEXTBOOKS:

1. Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4 Volumes). Available at <http://www.em-ea.org/gbook1.asp>. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.
2. K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers & Dist, 2007.

REFERENCE BOOKS:

1. Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
2. Albert Thumann and Paul Mehta D, “Handbook of Energy Engineering”, 7th Edition, The Fairmont Press, 2013.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc20_mm20/preview
2. <https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-me44/>
3. <https://archive.nptel.ac.in/courses/112/105/112105221/>

CO - PO and CO - PSO MAPPING

PME303	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	-	-	-	3	-	1	-	-	1	2	2
CO2	2	2	1	-	-	-	3	-	1	-	-	1	2	2
CO3	2	2	1	-	-	-	3	-	1	-	-	1	2	2
CO4	2	2	1	-	-	-	3	-	1	-		1	2	2
CO5	2	2	1	-	-	-	3	-	1	-		1	2	2
Average	2	2	1	-	-	-	3	-	1	-		1	2	2
Low (1) ; Medium (2) ; High (3)														

OBJECTIVES:

1. To teach the various types of energy storage devices and technologies and their comparison.
2. To discuss the techniques of various energy storage devices and their performances.
3. To discuss the basics of batteries and hybrid systems for EVs and other mobile applications.
4. To teach about the renewable energy storage systems and management systems.
5. To have an insight in to other energy storage devices, hydrogen and fuel cells.

UNIT I INTRODUCTION TO ENERGY STORAGE 9

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical–Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.

UNIT II ENERGY STORAGE SYSTEMS 9

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types- Charging and Discharging – Battery testing and performance.

UNIT III MOBILE AND HYBRID ENERGY STORAGE SYSTEMS 9

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS

UNIT IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT 9

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management

UNIT V OTHER ENERGY DEVICES 9

Superconducting Magnetic Energy Storage (SMES), Super capacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC, MCFC and Biofuel Cells – Biogas Storage.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Study the need and identify the suitable energy storage devices for applications.
2. Learn the working of various energy storage devices and their importance.
3. Learn the basic characteristics of batteries for mobile and hybrid systems.
4. Discuss the storage of renewable energies and management systems.
5. Study the need for other energy devices and their scope for applications.

TEXTBOOKS:

1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", 2nd Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001

REFERENCES:

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, 2016.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley& amp; Sons, 2010.

PME304	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1		2						1	2
CO2	3	2	1	1	1		2						1	2
CO3	3	2	1	1	1		2						1	2
CO4	3	2	1	1	1		2						1	2
CO5	3	2	1	1	1		2						1	2
Average	3	2	1	1	1		2						1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To educate about the Indian and global energy scenario
2. To teach about the various solar energy technologies and its applications.
3. To educate about the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To teach about the ocean and geothermal technologies.

UNIT I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT IV BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion- mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration -- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations –

Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discuss the Indian and global energy scenario.
2. Describe the various solar energy technologies and its applications.
3. Explain the various wind energy technologies.
4. Explore the various bio-energy technologies.
5. Discuss the ocean and geothermal technologies.

TEXTBOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.

PME305	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	1	-	1	-	3	-	-	-	-	3	2	1
CO2	3	2	2	-	1	-	3	-	-	-	-	3	2	1
CO3	3	2	3	-	2	-	3	-	-	-	-	3	2	1
CO4	2	2	2	-	2	-	3	-	-	-	-	3	2	1
CO5	2	1	2	-	2	-	3	-	-	-	-	3	2	1
Average	2.2	1.6	2	-	1.6	-	3	-	-	-	-	3	2	1

(1-LOW, 2-MEDIUM, 3-HIGH)

PME306	EQUIPMENT FOR POLLUTION CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To study the pollution control regulation and standards.
2. To study the equipment for various water pollution.
3. To study the equipment for air pollution control.
4. To study the equipment for solid waste processing.
5. To study the pollution monitoring equipment.

UNIT I POLLUTION CONTROL REGULATIONS AND STANDARDS 9

Pollutants in water and wastewater –sources and impacts- Characteristics and impacts of solid and hazardous wastes -Indian Constitution and Environmental Protection Legislations - Environmental Standards under different Environmental legislations - Water Act (1974), Air Act (1981), Environmental Protection Act (1986) and major Notifications, Municipal solid Wastes (Management and Handling) Rules -Bio Medical Wastes (Management and Handling) Rules - Hazardous Wastes (Management and Handling Rules),Environment Impact Assessment Notifications - Unit operations and unit processes in Pollution Control- - Selection criteria for Pollution Control Equipment.

UNIT II EQUIPMENT FOR WATER POLLUTION CONTROL 9

Operational principles and Design criteria of Flash mixers, Flocculators, Clarifiers, Sand Filters, Adsorption Columns, Aerators, Air blowers, Distillation units, Centrifugal and Reciprocating Pumps, Chemical dosing systems, Motors, Pipes, valves and Fittings.- Filed visit to a wastewater treatment plant.

UNIT III EQUIPMENT FOR AIR POLLUTION CONTROL 9

Operational principle and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electro static precipitators, Bio filters –Filed visittoan industry with air pollution control system.

UNIT IV EQUIPMENT FOR SOLID WASTE PROCESSING 9

Operational principles and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electrostatic precipitators, Biofilters - Filed visit to an industry with air pollution control systems

UNIT V POLLUTION MONITORING EQUIPMENT**9**

Equipment's for sampling of water, solids and air- Sample preservation Equipment – incubators – Cold Storage systems- equipment for analysis of water and air samples- Ambient air and flue gas sampling and monitoring equipment.

TOTAL: 45 PERIODS**OUTCOMES:**

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

1. Discuss the pollution control regulations and standards.
2. Design equipment for water pollution control.
3. Design equipment for air pollution control.
4. Design equipment for solid waste processing.
5. Discuss the Conduct performance assessment of pollution control equipment.

TEXTBOOKS:

1. Noel de Nevers, "Air Pollution Control Engg", Mc Graw Hill, New York, 2016.
2. Rao. C.S (2006)., "Environmental Pollution and Control Engineering", 2nd Edition, Revised, Wiley Eastern Limited, India.

REFERENCES:

1. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford, 2001
2. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, TataMcGraw-Hill Publishing Company Limited, New Delhi, 2014.

PME306	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1				3		1			1	1	2
CO2	2	1	1				3		1			1	1	2
CO3	2	1	1				3		1			1	1	2
CO4	2	1	1				3		1			1	1	2
CO5	2	1	1				3		1			1	1	2
Average	2	1	1				3		1			1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To introduce the Mathematical knowledge to design pressure vessels and piping.
2. To learn the ability to carry of stress analysis in pressure vessels and piping
3. To study the design of vessels and theory of reinforcement.
4. To study buckling and fracture analysis in vessels.
5. To learn piping layout and flow diagram.

UNIT I	INTRODUCTION	9
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Methods for determining stresses – Terminology and Ligament Efficiency – Applications

UNIT II	STRESSES IN PRESSURE VESSELS	9
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Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

UNIT III	DESIGN OF VESSELS	9
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Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

UNIT IV	BUCKLING AND FRACTURE ANALYSIS IN VESSELS	9
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Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V	PIPING	9
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Piping components - bends, tees, bellows, and valves-types of piping supports. Flow diagram – piping layout and piping stress Analysis- Introduction to piping codes and Standards.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications.

2. Analyse stress in pressure vessels.
3. Design and analysis of pressure vessels.
4. Analysis of buckling and fracture analysis in vessels.
5. Design and analysis of piping layout and piping codes.

TEXTBOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors, 1987.
2. Theory And Design of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001

REFERENCES:

1. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
2. Theory and design of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001.

PME401	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	3
CO2	3	2		1	1				1			1	2	3
CO3	3	2		1	1				1			1	2	3
CO4	3	2		1	1				1			1	2	3
CO5	3	2		1	1				1			1	2	3
Average	3	2		1	1				1			1	2	3

(1-LOW, 2-MEDIUM, 3-HIGH)

PME402	FAILURE ANALYSIS AND NDT TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To introduce need and scope of failure analysis and fundamental sources of failures.
2. To learn about non-destructive testing and basic principles of visual inspection.
3. To study about the magnetic testing and techniques
4. To learn the principle of radiography testing and its inspection techniques and methods.
5. To study the acoustics testing and principle and instrumentation.

UNIT I INTRODUCTION 9

Introduction and need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing and assembly. Tree diagram and FMEA.

UNIT II VISUAL INSPECTION 9

Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Sensitivity, Applications, Limitations and Standards.

UNIT III MAGNETIC TESTING 9

Magnetic Particle Testing, Eddy Current Testing: Magnetism-basic definitions and principle of magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Sensitivity Advanced Eddy Current Test Methods, Applications, Limitations.

UNIT IV RADIOGRAPHY TESTING 9

Radiography, Ultrasonic Testing: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Ultrasonic Testing: Basic properties of sound beam, Ultrasonic

transducers, Inspection methods, Techniques for Normal Beam Inspection, Techniques for Angle Beam Inspection, Flaw characterization techniques, Ultrasonic flaw detection equipment, Modes of Display, Immersion Testing, Applications of Ultrasonic Testing, Advantages, Limitations.

UNIT V ACOUSTIC TESTING

9

Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications, Standards. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Codes and Standards. In Situ Metallographic Examination: Approach to the Selection of Site for Metallographic examination, Replication process, Significance of Microstructure observation, Decision making, Applications, Codes and Standards. (digital signal process)

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discuss the need and scope of failure analysis and fundamental sources of failures.
2. Describe about non-destructive testing and basic principles of visual inspection.
3. Explain about magnetic testing and principles, techniques.
4. Explain the principle of radiography testing and its inspection techniques and methods.
5. Describe the acoustic testing principle and technique and instrumentation.

TEXTBOOKS:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.
2. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010

REFERENCES:

1. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).

PME402	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	2	2				1			1	2	3
CO2	2	2	1	2	2				1			1	2	3
CO3	2	2	1	2	2				1			1	2	3
CO4	2	2	1	2	2				1			1	2	3
CO5	2	2	1	2	2				1			1	2	3
Average	2	2	1	2	2				1			1	2	3
Low (1); Medium (2); High (3)														

PME403	MATERIAL HANDLING AND SOLID PROCESSING	L	T	P	C
	EQUIPMENT	3	0	0	3

OBJECTIVES:

1. To provide knowledge on materials handling equipment.
2. To provide knowledge on Industrial Vehicles
3. To provide knowledge on conveyor equipment.
4. To provide knowledge on Auxiliary Equipment and Hoisting Equipment.
5. To provide knowledge on Bulk Handling Equipment and Systems

UNIT I INTRODUCTION TO MATERIALS HANDLING 9

Basic principles & objectives in material handling and its benefits - Classification of material handling equipment - selection of material handling equipments - guidelines for effective utilisation of material handling equipments -unit load concept.

UNIT II INDUSTRIAL VEHICLES 9

Introduction and types - Hand trucks - Two wheel Hand Trucks - Multiple wheel Hand Trucks - Hand Lift Trucks - Power Trucks - Fixed Platform Truck - Platform Lift Truck - Pallet Lift Truck - Walkie Truck - Straddle Carrier - Fork Lift Trucks - Specifications of FLT - FLT Attachments - Tractors – Industrial Tractor-Trailer-Self-propelled trucks and fork trucks - Automated guided vehicles Theory.

UNIT III CONVEYORS 9

Classification of conveyors- Definition - Description - General Characteristics - types and uses of belt Conveyors - Roller conveyors - Haulage Conveyors - Screw Conveyors - Bucket Conveyors – Chain Conveyors - Cable Conveyors - Pneumatic and Hydraulic conveyors - Computer controlled conveyor system.

UNIT IV AUXILIARY EQUIPMENT AND HOISTING EQUIPMENT 9

Hoppers - Gates- Feeders- Chutes-positioners- Ball Table- Weighing and Control Equipment- Pallet loaders and unloaders -applications and advancements. - Hoisting Equipment - parts of hoisting equipment - Description and uses of hoists - Description and uses of ropes - description and purpose of crane hooks - Elevators - Cranes - Derricks - and its types

UNIT V BULK HANDLING EQUIPMENT AND SYSTEMS**9**

Storage of bulk solids - bulk handling equipment - Robotic handling - Materials handling at the workplace - Robots and their classification - Major components of a robot - classification of Robotic manipulators - Robotic handling applications

TOTAL: 45 PERIODS**OUTCOMES:**

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

1. Discuss the basic concepts of material handling equipment.
2. Explain the basic working principles of various industrial Vehicles.
3. Develop the basic working principles of various conveyors.
4. Elaborate the basic working principles of various Auxiliary Equipment and Hoisting Equipment.
5. Explain the basic working principles of various Bulk Handling Equipment and Systems.

TEXTBOOKS:

1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors, Pvt Ltd, 2019.
2. Siddharta Ray, Introduction to Materials Handling, New Age International Publishers, 2008

REFERENCES:

1. Peter Hilgraf, „Design and Selection of Bulk Material Handling Equipment and Systems” Wide Publishing, 2016.
2. Kulwiec, “Materials Handling Handbook” - Vol. 1 & 2, Wiley india Pvt. Ltd, 2009.

E-RESOURCES:

https://onlinecourses.nptel.ac.in/noc22_mm20/preview

PME403	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1	1	1				1			1	2	2
CO2	2	1	1	1	1				1			1	2	2
CO3	2	1	1	1	1				1			1	2	2
CO4	2	1	1	1	1				1			1	2	2
CO5	2	1	1	1	1				1			1	2	2
Average	2	1	1	1	1				1			1	2	2

(1-LOW, 2-MEDIUM, 3-HIGH)

COURSE OBJECTIVES

1. To introduce the concepts of thermal and fired equipment.
2. To study the basis, design and construction of boilers.
3. To study of typical fuel firing systems in the boiler.
4. To study of materials requirements for pressure parts.
5. To study of various boiler auxiliaries system.

UNIT – I INTRODUCTION**9**

Principal equipment in Thermal Power Plant, Historical developments of Boiler, Utility, Industrial boilers, Modern trends in boiler design, Basic knowledge of different types of Thermal Fired Equipment, sub critical and super critical boilers - Coal, Oil, Gas, Pulverised fuel cyclone, FBC, CFBC, MSW, and Stoker firing, Boiler efficiency, auxiliary power consumption, Performance data, Performance Correction Curves

UNIT – II BASIS OF BOILERS AND DESIGN**9**

Codes- Design and Construction, IBR, ISO, ASME, BS, Heat balance diagram, Boiler parameters, Fuel analysis and variations, Site conditions, Furnace heat loadings, FOT, Plan area loading, Volumetric loading Balanced Draft and Pressurised Furnace, Natural / Controlled Circulation, Constant and Sliding Pressure, Boiler heat transfer surfaces, Flue gas velocities, boiler auxiliaries, Boiler schemes, Boiler Layouts.

UNIT – III FIRING SYSTEM- FUEL AND MILLING**9**

Coal / Oil / Natural Gas in any combination, Lignite, Blast Furnace Gas / Coke Oven Gas / Corex Gas Carbon Monoxide / Tail gas, Asphalt, Black Liquor, Bagasse, Rice Husk, Washery Rejects, Wheat / Rice straw MSW, wind box, Burner, Type of Stokers, Pulverisers - Bowl mill, Tube mill, Direct firing, Indirect firing, Wall firing (Turbulent / Vortex Burners), Tangential firing (Jet Burners), Fire Ball.

UNIT – IV PRESSURE PARTS AND DESIGN AND MATERIALS**9**

Economiser, Drums, Water Walls, Headers, Links, Super Heater, Super Heaters, Reheaters, Tubes, Spiral Tubes, Surface area, Free Gas Area, Metal temperature, LMTD, Acid Dew Point Temperature, Carbon steel, Low alloy steel, Titanium alloy steel.

Air preheaters (APH) – bi sector APH , Tri sector APH, Cold PA System, Hot PA System, Tubular APH, Steam coil Air preheater , FANS – Axial, Radial, Performance curves, MILLS-Tube , Vertical mills , Air quality Control systems ,Dust Collection System - Mechanical Precipitator, Electrostatic Precipitator, FGD , SCR , SNCR.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Explain the concepts of thermal and fired equipment.
2. Discuss the basis, design and construction of boilers.
3. Describe of typical fuel firing systems in the boiler.
4. Discuss the materials requirements for pressure parts.
5. Discuss of various boiler auxiliaries system.

TEXT BOOKS:

1. A Course in Power Plant Engineering; Dhanapat Rai and Sons - Domkundwar
2. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar

REFERENCES:

1. Elwakil M, Power Plant Technology, McGraw Hill, New York, 1964
2. Steam Generators and Waste Heat Boilers: For Process and Plant Engineers (Mechanical Engineering) by V. Ganapathy
3. Steam Generators: Description and Design by Donatello Annaratone
4. An Introduction to Coal and Wood Firing Steam Generators (Power Plants Engineering) by J Paul Guyer
5. Advances in Power Boilers (JSME Series in Thermal and Nuclear Power Generation) by Mamoru Ozawa and Hitoshi Asano | 28 January 2021

PME404	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	1	3	1					1			1	2	3
CO 2	2	1	3	1					1			1	2	3
CO 3	2	1	3	1					1			1	2	3
CO 4	2	1	3	1					1			1	2	3
CO 5	2	1	3	1					1			1	2	3
Average	2	1	3	1					1			1	2	3

(1 – LOW, 2-MEDIUM, 3-HIGH)

PME405	INDUSTRIAL LAYOUT DESIGN AND SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
2. To learn the facilities layout design algorithms and selecting appropriate software.
3. To study the facilities layout problem modelling tools and algorithms for production, warehouse, and material handling.
4. To learn the safety planning and management principles in industries.
5. To learn the various safety management approaches in industries.

UNIT I INTRODUCTION 9

Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.

UNIT II FACILITIES LAYOUT DESIGN & ALGORITHMS 9

Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP-PLANOPT, Factory CAD, Factory FLOW, Plant Simulation)

UNIT III FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS 9

Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material-Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.

UNIT IV SAFETY PLANNING & MANAGEMENT 9

Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an

Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety.

UNIT V APPROACHES IN SAFETY MANAGEMENT

9

Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Explain the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
2. Discuss the facilities layout design algorithms and selecting appropriate software.
3. Describe the facilities layout problem modeling tools and algorithms for production, warehouse, and material handling.
4. Explain the safety planning and management principles in industries.
5. Illustrate the various safety management approaches in industries.

TEXTBOOKS:

1. Sunderesh S. Heragu, “Facilities Design”, 3rd Edition, CRC Press Taylor & Francis Group, 2008.
2. L. M. Deshmukh, “Industrial Safety Management: Hazard Identification and Risk Control”, Tata McGraw-Hill Publishing Co. Ltd., 2005.

REFERENCES:

1. Eric Teicholz, “Facility Design and Management Handbook”, Tata McGraw-Hill Publishing Co. Ltd., 2001.
2. James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, “Facilities Planning”, 4th Edition, John Wiley & Sons, 2010.

PME405	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	2	2	1				2	1	1		2	2
CO2	1	2	2	2	1				2	1	1		2	2
CO3	1	2	2	2	1				2	1	1		2	2
CO4	1	2	2	2	1				2	1	1		2	2
CO5	1	2	2	2	1				2	1	1		2	2
Average	1	2	2	2	1				2	1	1		2	2

(1-LOW, 2-MEDIUM, 3-HIGH)

PME406	DESIGN CODES AND STANDARDS FOR PROCESS	L	T	P	C
	EQUIPMENT	3	0	0	3

OBJECTIVES:

1. To study the Codes and Standards and Need for them in the industry.
2. To know the different sources and the bodies that publish Codes and Standards.
3. To familiarize the Government Regulations and its applicability.
4. To familiarize with different codes used in Different Industry.
5. To familiarize the Codes and Standards used in Process industry

UNIT I INTRODUCTION 9

Introduction to Codes and Standards- Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices.

UNIT II CODES 9

Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes.

UNIT III STANDARDS 9

Sources of Codes and Standards. Who publishes Codes and Standards- International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes.

UNIT IV REGULATION 9

Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers.

UNIT V DESIGN CODES 9

Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE.

OUTCOMES:

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

- 1.Explain the need for codes and Standards in Industry.
- 2.Discuss the different codes and standards used in different industry.
- 3.Discuss the sources of different codes and standards and the societies that publish them and how these are evolved
- 4.Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International
- 5.Discuss knowledge of codes and standards used in Process equipment design for Oil and Gas Industry.

TEXTBOOKS:

- 1.Mechanical Engineering. Handbook. ASME. ASTM.API
- 2.Perrys Chemical Engineering Handbook

REFERENCES:

- 1.ASME, ISRO, IBR, OISD
- 2.API, AWS, ISHRAE

PME406	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	3						1			1	1	2
CO2	2	1	3						1			1	1	2
CO3	2	1	3						1			1	1	2
CO4	2	1	3						1			1	1	2
CO5	2	1	3						1			1	1	2
Average	2	1	3						1			1		2

(1-LOW, 2-MEDIUM, 3-HIGH)

COURSE OBJECTIVES :

1. To study the definition and basics on theory of elasticity.
2. To learn finite element method and procedure for static linear elasticity.
3. To study the Non Linear and History depend problems.
4. To study time dependent and dynamic problems of Small and large strain visco-plasticity.
5. To study Structural Elements & Interfaces and contact using penalty method.

UNIT I BASIC ON THEORY OF ELASTICITY 9

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium. Strain – displacement relations, Stress – strain relations, Lamé's constant –cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle.

UNIT II FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY 9

Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.

UNIT III NON LINEAR AND HISTORY DEPEND PROBLEMS 9

Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity - Large strain visco-plasticity.

UNIT IV TIME DEPENDENT AND DYNAMIC PROBLEMS 9

First-order systems - the diffusion equation - Explicit time integration – the Newmark method - Implicit time integration - Modal analysis and modal time integration.

UNIT V STRUCTURAL ELEMENTS & INTERFACES AND CONTACT 9

Continuum Beams – Shells – Cohesive Zones - Enforcing constraints using penalty methods and Lagrange Multipliers - Contact elements (in two dimensions).

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discuss the definition and basics on theory of elasticity
2. Derive the finite element method for static linear elasticity, solve problems.
3. Discuss the Non Linear and History depend problems, Solve problems.
4. Discuss time dependent and dynamic problems, solve problems.
5. Discuss Structural Elements & Interfaces and contact, solve problems.

TEXTBOOKS:

1. J.N.Reddy, Introduction To Finite Element Method, 4th Edition 2020. (939038527 X · 9789390385270).
2. G.Ramamurty, Applied Finite Element Analysis, I.K. International Publishing House Pvt. Limited, 2018. (9789380578453- 9380578458).

REFERENCES:

1. The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution (Computational Fluid and Solid Mechanics) by Miguel Luiz Bicalem and Klaus-Bathe 25 February 2020.
2. The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics) by Dominique Chapelle and Klaus-Jurgen Bathe 27 January 2019.

PME501	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	1					1			1	1	1
CO2	3	3	2	1					1			1	1	1
CO3	3	3	2	1					1			1	1	1
CO4	3	3	2	1					1			1	1	1
CO5	3	3	2	1					1			1	1	1
Average	3	3	2	1					1			1	1	1

(1-LOW, 2-MEDIUM, 3-HIGH)

COURSE OBJECTIVES:

1. To study the fluid flow simulation techniques and their mathematical behavior.
2. To learn the Discretize 1D and 2D systems using finite difference and finite volume techniques.
3. To Formulate diffusion–convection problems using the finite volume method.
4. To study the flow field for different types of grids.
5. To learn the need for turbulence models and their types.

UNIT I INTRODUCTION 9

Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow – Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretization and Numerical errors.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations– General Methods for first and second-order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of the solution, optimum step-size, Euler, Crank-Nickolson, and pure implicit methods, stability of schemes.

UNIT III FINITE VOLUME METHOD FOR CONVECTION-DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis.

UNIT IV FLOW FIELD ANALYSIS 9

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer.

UNIT V TURBULENCE MODELLING

9

Turbulence model requirement and types, mixing length model, Two equation (k- ϵ) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques- software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Apply the fundamentals of CFD, and develop case-specific governing equations.
2. Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems.
3. Implement various mathematical schemes under the finite volume method for convention diffusion.
4. Solve complex problems in the field of fluid flow and heat transfer with the support of high- speed computers.
5. Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXTBOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2020.
2. Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2021.

REFERENCES:

1. John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, 2018.
2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 2019.

PME502	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1			1	3	2
CO2	3	2	2	1					1			1	3	2
CO3	3	2	2	1					1			1	3	2
CO4	3	2	2	1					1			1	3	2
CO5	3	2	2	1					1			1	3	2
Average	3	2	2	1					1			1	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

PCS703	THEORY ON COMPUTATION AND VISUALIZATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study the concepts and techniques of discrete mathematics for theoretical computer science.
2. To learn different formal languages and their relationship.
3. To classify and construct grammars for different languages and vice-versa.
4. To study Visualization, Graphical and Quantitative Information.
5. To learn Visualization design and data Ink.

UNIT I REVIEW OF MATHEMATICAL THEORY 9

Sets, Functions, Logical statements, Proofs, Relations, Languages, Principal of Mathematical Induction, Strong Principle, Recursive Definitions, Structural Induction.

UNIT II REGULAR LANGUAGES AND FINITE AUTOMATA 9

Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output – Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, union- intersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA - Non Deterministic Finite Automata, Conversion of NFA- Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.

UNIT III CONTEXT FREE GRAMMAR (CFG) AND PUSHDOWN AUTOMATA 9

Definitions and Examples, Unions Concatenations And Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity, Unambiguous CFG and Algebraic Expressions, BackusNaurForm (BNF), Normal Form – CNF. Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.

UNIT IV VALUE OF VISUALIZATION 9

Information Visualization, In Readings in Information Visualization, Graphical Excellence, Graphical Integrity, Sources of Graphical Integrity In The Visual Display of Quantitative Information

The Power of Representation, Data-Ink and Graphical Redesign, Data-Ink Maximization and Graphical Design, Data Density and Small Multiples

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discussing the concepts and techniques of discrete mathematics for theoretical computer science.
2. Explain the different formal languages and their relationship.
3. Discussing to classify and construct grammars for different languages and vice-versa.
4. Explaining the Visualization, Graphical and Quantitative Information.
5. Applying the Visualization design and data Ink.

TEXTBOOKS:

1. Introduction to the Theory of Computation by Michael Sipser.
2. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman.

REFERENCES:

1. Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill
2. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria& Sons.

PME503	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1					1			1	3	2
CO2	3	2	1	1					1			1	3	2
CO3	3	2	1	1					1			1	3	2
CO4	3	2	1	1					1			1	3	2
CO5	3	2	1	1					1			1	3	2
Average	3	2	1	1					1			1	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

COURSE OBJECTIVES:

1. To Introduction of principles and concepts of bio-mechanics.
2. Focuses on the studies of tissues and structure of musculoskeletal system.
3. To study the mechanics of joints and human motion.
4. To explain the computational approaches in biomechanics.
5. To learn the quantification of forces and motion.

UNIT I INTRODUCTION TO BIOMECHANICS 9

Perspective of biomechanics, Terminologies, Kinematic and kinetic concepts for analyzing human motion, Kinetic concepts for analyzing human motion, Linear kinetics of human movement, Equilibrium, Angular kinetics of human Movement, Mechanical properties of soft tissues, bones, and muscles

UNIT II BIOMECHANICS OF TISSUES AND STRUCTURES OF THE MUSCULOSKELETAL SYSTEM 9

Biomechanics of Bone, Biomechanics of Articular Cartilage, Tendons and Ligaments, Peripheral Nerves and Spinal Nerve Roots, Skeletal Muscle

UNIT III BIOMECHANICS OF JOINTS AND HUMAN MOTION 9

Knee, Hip, Foot and Ankle, Lumbar Spine, Cervical Spine, Shoulder, Elbow Wrist, and Hand, Linear kinematic and kinetic aspects of human movement, angular kinematic and kinetic aspects of human movement, equilibrium and human moment.

UNIT IV COMPUTATIONAL APPROACHES IN BIOMECHANICS 9

Finite Element Analysis in Biomechanics, Computational modelling of Vancouver Periprosthetic Fracture in Femur, Scaffolds, artificial hip and knee joints, Aortic Valve.

UNIT V GAIT ANALYSIS 9

Exoskeleton design, Ergonomics, Sports mechanics, Performance Analysis, Biomechanical analysis, 3D printing.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discuss the principles of mechanics.
2. Elaborate the tissues and structures of the musculoskeletal system
3. Discuss of joint mechanics and human motion.
4. Create Examples of computational mathematical modelling applied in biomechanics.
5. Describe the analysis of human motion.

TEXTBOOKS:

1. Susan J Hall, —Basic Biomechanics, 6th Edition, The McGraw-Hill Companies Inc., 2020.
2. Jay D Humphrey and Sherry L Delange, —An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, 1st edition, Springer-Verlag, 2019.

REFERENCES:

1. Margareta Nordin and Victor H Frankel, —Basic Biomechanics of the Musculoskeletal System, 3rd Edition, Lippincott Williams and Wilkins, 2019.
2. Pritam Pain, Sreerup Banerjee, Goutam Kumar Bose , Advances in Computational Approaches in Biomechanics, 2022.

PME 504	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1			1	3	2
CO2	3	2	2	1					1			1	3	2
CO3	3	2	2	1					1			1	3	2
CO4	3	2	2	1					1			1	3	2
CO5	3	2	2	1					1			1	3	2
Average	3	2	2	1					1			1	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

PME505	ADVANCED STATISTICS AND DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To introduce the basic concepts of linear regression and multiple regression.
2. To introduce exploratory data analysis.
3. To study logistic regression models for classification.
4. To develop the forecasting techniques for the predictions.
5. To introduce the time series analysis for the prediction of future behavior.

UNIT I REGRESSION 9

Introduction – Linear regression - Correlation analysis -Limitations, errors, and caveats of using regression and correlation analyses - Multiple regression and correlation analysis - Inferences about population parameters – Modeling techniques. - Coefficient of determination, Interpretation of regression coefficients, Categorical variables, heteroscedasticity, Multi-collinearity outliers, Ridge regression.

UNIT II EXPLORATORY DATA ANALYSIS 9

Rise of statistics, Data Wrangling, Data Quality. Visual encoding – Mapping Data to Visual Variables, Encoding Effectiveness, Scales & Axes, Aspect Ratio, Regression Lines, Multidimensional Data, Parallel Coordinates, Dimensionality Reduction.

UNIT III LOGISTIC AND MULTINOMIAL REGRESSION 9

Logistic function, Estimation of probability using Logistic regression, Variance, Wald Test, Hosmer Lemeshow Test, Classification Table, Gini Co-efficient.

UNIT IV FORECASTING AND CAUSAL MODELS 9

Moving average, Exponential Smoothing, Casual Models.

UNIT V TIME SERIES ANALYSIS 9

Auto regression (AR), Moving Average(MA) Models, ARMA, ARIMA models , Multivariate Models.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Develop how to do regression fit for the given data.
2. Visualize the data through explanatory data analysis.
3. Classify the given data through logistic regression.
4. Analyzing forecasting techniques and causal inferences.
5. Utilize the effective time series analysis to predict/forecast the future behavior of data.

TEXTBOOKS:

1. Douglas C Montgomery and George C Runger, “Applied Statistics and Probability for Engineers”, John Wiley & Sons, 2018.
2. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulachi, “Introduction to Time Series Analysis and Forecasting”, Wiley, 2020.

REFERENCES:

1. David Forsyth, ‘Probability and Statistics for Computer Science’, Springer; 2018.
2. Daniel T. Larose, Chantal D. Larose “Data Mining and Predictive Analytics”, Wiley, 2019

PME505	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	1	2	1				1			1	3	1
CO2	3	3	1	2	1				1			1	3	1
CO3	3	3	1	2	1				1			1	3	1
CO4	3	3	1	2	1				1			1	3	1
CO5	3	3	1	2	1				1			1	3	1
Average	3	3	1	2	1				1			1	3	1

(1-LOW, 2-MEDIUM, 3-HIGH)

PCS704	MACHINE LEARNING FOR INTELLIGENT	L	T	P	C
	SYSTEMS	3	0	0	3

OBJECTIVES:

1. To introduce basic machine learning techniques such as regression, classification
2. To learn about introduction of clustering, types and segmentation methods
3. To learn about fuzzy logic, fuzzification and defuzzification
4. To learn about basics of neural networks and neuro fuzzy networks.
5. To learn about Recurrent neural networks and Reinforcement learning.

UNIT I 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT II 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT III 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application

UNIT IV 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics

UNIT V 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent

networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand basic machine learning techniques such as regression, classification.
2. Understand about clustering and segmentation
3. Model a fuzzy logic system with fuzzification and defuzzification
4. Understand the concepts of neural networks and neuro fuzzy networks.
5. Gain knowledge on Reinforcement learning.

TEXTBOOKS:

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addison Wesley, England, 2011
2. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2016 2nd Edition, Springer

REFERENCES:

1. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, delhi 2016.
2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, Chichester, 2011, Sussex Wiley.

PME506	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	1						1	3	3	2
CO2	3	2	3	2	1						1	3	3	2
CO3	3	2	3	2	1						1	3	3	2
CO4	3	2	3	2	1						1	3	3	2
CO5	3	2	3	2	1						1	3	3	2
Average	3	2	3	2	1						1	3	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To study the value engineering process and able to identify its functions within the process.
2. To determine the appropriate value engineering methodology for a given project and propose appropriate training to centralized and decentralized modes.
3. To learn various decision-making processes and cost evaluation models and apply them in appropriately in the product development life-cycle.
4. To explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing.
5. To demonstrate to implement value engineering solutions and propose to perfect them.

UNIT I	VALUE ENGINEERING BASICS	9
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Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis.

UNIT II VALUE ENGINEERING JOB PLAN AND PROCESS 9

Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering.

UNIT III VALUE ENGINEERING TECHNIQUES 9

Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC)

UNIT IV WORKSHEETS AND GUIDELINES 9

Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal -

Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.

UNIT V VERSATILITY OF VALUE ENGINEERING

9

Value engineering operation in maintenance and repair activities - value engineering in non-hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.
2. Discuss the product and articulate it in various phases of value engineering
3. Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training
4. Apply querying theory and FAST to prefect a value engineering project implementation.
5. Develop various case studies related to value engineering project implementation.

TEXTBOOKS:

1. Iyer. S.S., “Value Engineering”, New Age International (P) Limited, 9th Edition, 2009.
2. Anil Kumar. and Mukhopadhyaya., “Value Engineering: Concepts Techniques and applications”, SAGE Publications, 1st Edition, 2003.

REFERENCES:

1. Lawrence D. Miles., “Techniques of Value Analysis and Engineering”, Lawrence D. Miles Value Foundation, 3rd Edition, 2015.
2. Del L. Younker., “Value Engineering: analysis and methodology”, CRC Press, 2003.

PME601	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			1			1	2	1		3	1	1	2
CO2	1			1			1	2	1		3	1	1	2
CO3	1			1			1	2	1		3	1	1	2
CO4	1			1			1	2	1		3	1	1	2
CO5	1			1			1	2	1		3	1	1	2
Average	1			1			1	2	1		3	1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
2. To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
3. To be acquainted with vat polymerization and direct energy deposition processes
4. To be familiar with powder bed fusion and material extrusion processes.
5. To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes

UNIT I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DfAM) 9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom-up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications. Additive friction stir deposition process: principle, parameters, applications, , Case studies.

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism -

Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 9

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
2. Acquire knowledge on process of transforming a concept into the final product in AM technology.
3. Elaborate the vat polymerization and direct energy deposition processes and its applications.
4. Acquire knowledge on process and applications of powder bed fusion and material extrusion.
5. Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXTBOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-
2. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990- 582-1.

REFERENCES:

1. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
2. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.

E-RESOURCES:

<https://archive.nptel.ac.in/courses/112/103/112103306/>

PME602	PROGRAM OUTCOMES												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	1	1				1			1	2	3
CO2	2	2	3	1	1				1			1	2	3
CO3	2	2	3	1	1				1			1	2	3
CO4	2	2	3	1	1				1			1	2	3
CO5	2	2	3	1	1				1			1	2	3
Average	2	2	3	1	1				1			1	2	3

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
2. To learn the design consideration principles of forming in the design of extruded, stamped, and forged products
3. To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
4. To learn design consideration principles of welding in the design of welded products.
5. To learn design consideration principles in additive manufacturing

UNIT-I INTRODUCTION 9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.

UNIT-II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings.

UNIT-III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly.

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, and redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

TOTAL : 45 PERIODS

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

1. Elaborate the design principles for manufacturability
2. Discuss the factors influencing form design
3. Apply the component design features of various machines.
4. Discuss the design consideration principles of welding in the design of welded products.
5. Discuss the design consideration principles of additive manufacturing.

1. James G. Bralla, “Design for Manufacturability Handbook”, McGraw Hill Professional, 1998.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

1. CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.

2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.

PME 603	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	1	1				1				3	1
CO2	2	2	3	1	1				1				3	1
CO3	2	2	3	1	1				1				3	1
CO4	2	2	3	1	1				1				3	1
CO5	2	2	3	1	1				1				3	1
Average	2	2	3	1	1				1				3	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To introduce to industrial design based on ergonomics.
2. To consider ergonomics concept in manufacturing
3. To apply ergonomics in design of controls and display.
4. To apply environmental factors in ergonomics design.
5. To develop aesthetics applicable to manufacturing and product

UNIT I INTRODUCTION 9

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

UNIT II **ERGONOMICS AND PRODUCTION** **9**

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

UNIT III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools

UNIT IV ENVIRONMENTAL FACTORS 9

Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsell colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects,

colour and machine form, colour and style

UNIT V AESTHETIC CONCEPTS

9

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Appreciate ergonomics need in the industrial design.
2. Apply ergonomics in creation of manufacturing system
3. Discuss on design of controls and display.
4. Consider environmental factors in ergonomics design.
5. Report on importance of aesthetics to manufacturing system and pro

TEXTBOOKS:

1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares , Francisco Rebelo
2. Ergonomics in Product Design by Sendpoints Publishing Co. Ltd.

REFERENCES:

1. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006
2. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7thEdition, 2002

PME604	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	1						1	3	3	2
CO2	3	2	3	2	1						1	3	3	2
CO3	3	2	3	2	1						1	3	3	2
CO4	3	2	3	2	1						1	3	3	2
CO5	3	2	3	2	1						1	3	3	2
Average	3	2	3	2	1						1	3	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To introduce the fundamental concepts of the new product development
2. To develop material specifications, analysis and process.
3. To Learn the Feasibility Studies & reporting of new product development.
4. To study the New product qualification and Market Survey on similar products of new product development
5. To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT I FUNDAMENTALS OF NPD 9

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD.

UNIT II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III ESSENTIALS OF NPD 9

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

UNIT IV CRITERIONS OF NPD

9

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT V REPORTING & FORWARD-THINKING OF NPD

9

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXTBOOKS:

1. Product Development – Sten Jonsson, 2015
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger, 2020

REFERENCES:

1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark, 2006
2. Toyota Product Development System – James Morgan & Jeffrey K. Liker, 2018

PME605	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	3	1				1	1			1	1	3
CO2	1	1	3	1				1	1			1	1	3
CO3	1	1	3	1				1	1			1	1	3
CO4	1	1	3	1				1	1			1	1	3
CO5	1	1	3	1				1	1			1	1	3
Average	1	1	3	1				1	1			1	1	3

(1-LOW, 2-MEDIUM, 3-HIGH)

OBJECTIVES:

1. To study about the history, concepts and terminology in PLM
2. To learn the functions and features of PLM/PDM
3. To develop different modules offered in commercial PLM/PDM tools
4. To demonstrate PLM/PDM approaches for industrial applications
5. To use PLM/PDM with legacy data bases, Coax& ERP systems

UNIT I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM**9**

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT II PLM/PDM FUNCTIONS AND FEATURES**9**

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT III DETAILS OF MODULES IN A PDM/PLM SOFTWARE**9**

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software-selection criterion of software for particular application - Brand name to be removed

UNIT IV ROLE OF PLM IN INDUSTRIES**9**

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance-process compliance and process automation

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Summarize the history, concepts and terminology of PLM
2. Develop the functions and features of PLM/PDM
3. Discuss different modules offered in commercial PLM/PDM tools.
4. Interpret the implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAX& ERP systems

TEXTBOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10 : 3662516330
2. Product LifeCycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10 : 0899303196

REFERENCES:

1. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
2. AnttiSaaksvuori and AnselmiImmonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition)

PME606	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	3	1				1	1			1	1	3
CO2	1	1	3	1				1	1			1	1	3
CO3	1	1	3	1				1	1			1	1	3
CO4	1	1	3	1				1	1			1	1	3
CO5	1	1	3	1				1	1			1	1	3
Average	1	1	3	1				1	1			1	1	3

(1-LOW, 2-MEDIUM, 3-HIGH)

OAG101	Environment and Agricultural Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course prepares the students

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To understand the ecological context of agriculture and its concerns.
- To study the context of climate change and emerging global issues.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT-I INTRODUCTION 9

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation,

UNIT-II ENVIRONMENTAL CONCERNS 9

Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Disaster management. Floods, earthquakes, cyclones and landslides. Social issues and the environment, unsustainable to sustainable development. The Environment Protections Act, The Air Act, The water Act, The Wildlife Protection

UNIT-III CLIMATE CHANGE AND ECOLOGICAL DIVERSITY 9

Global warming and changing environment - Ecosystem changes - Changing blue green- grey water cycles - Water scarcity and water shortages - Desertification- Ecological diversity, wild life and agriculture - GM crops and their impacts on the environment - Insects and agriculture - Pollination crisis - Ecological farming principles - Forest fragmentation and agriculture - Agricultural biotechnology concerns.

9

UNIT-V SUSTAINABLE AGRICULTURE

9

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. To know how the environment and agriculture are related and the changes in the environmental due to agriculture.
2. To gather idea on about how the mechanization helps and impacts of soil erosion due to agricultural activities.
3. To gain knowledge on the need for sustainable agriculture.
4. To demonstrate how ecological balance is required for sustainability of agriculture.
5. To know the ecological diversity in agriculture and different technologies used in farming activities.

TEXTBOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
3. B.K.Desai and Pujari, B.T., “Sustainable Agriculture: A vision for future”, New India Publishing Agency, New Delhi, 2007.
4. Saroja Raman, “Agricultural Sustainability - Principles, Processes and Prospects”, CRC Press, 2013.
5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

REFERENCE BOOKS:

1. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.

2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century: proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994.
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989.
4. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. "Ecosystem principles and sustainable agriculture", Scitech Publications, Chennai, 1999.
5. Bhoopander Giri, Ram Prasad, Qiang-Sheng Wu, Ajit Varma, Biofertilizers for Sustainable Agriculture and Environment, 2019.

OAG101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	-	-	-	1	1	-	-	1	-	-	2	2	1	1
CO2	2	3	1	-	2	3	-	-	1	-	1	1	1	1	1	2
CO3	1	3	-	-	-	1	2	-	-	-	-	2	2	2	2	1
CO4	3	3	3	2	3	-	3	2	1	-	2	3	2	1	1	-
CO5	-	3	2	2	3	-	3	3	-	-	2	3	2	2	3	1
Average	2.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	1.0

**UNIT - V ORGANIC REGULATION AND CERTIFICATION PROCEDURE,
BRANDING, PACKAGING AND MARKETING OF ORGANIC
PRODUCTS**

9

Organic Certification-process-Requirements for Organic Certification Systems in India - Basic standards for Livestock Certification - NPOP - Marketing of Organic Produce - Integrated Farming System models for Sustainable Agriculture.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

1. To the completion of the course, the students will be able to understand the concepts of Organic farming and sustainable agriculture.
2. To the Students will gain knowledge on organic farming and Overview of Organic Farming in India.
3. To the students will be able to understand Microbial Inoculations in Organic Farming.
4. To the students can design Sustainable agriculture.
5. To the students will be understand Organic Regulation and Certification Procedure.

TEXTBOOKS:

1. Dr.S.Natarajan, Dr.P.Devasenapathy, Dr.R.Kalpana, Dr.C.Sudhalakshmi, Organic farming an overview, TNAU.
2. Dilip Nandwani Organic Farming for Sustainable Agriculture, 2016.
3. Jeyabalan Sangeetha, Kasem Soyong, Devarajan Thangadurai, Abdel Rahman Mohammad Al-Tawaha, Organic Farming for Sustainable Development, 2023.
4. Mohan Chand Rajbar, Organic Farming and Livestock Management in integrated farming: An Agro-entrepreneur manual to successful Integrated farm production, 2019.
5. Gopal Chandra De. 1980., Fundamentals of agronomy. Oxford and IBH Publishing.

REFERENCE BOOKS:

1. Agricultural and Processed Food Products Export Development Authority (APEDA). National Programme for organic production.
http://apeda.gov.in/apedawebsite/organic/Organic_Products.html

2. Singh, J.P. and N. Ravisankar.2015. Integrated Farming Systems for sustainable agricultural growth.
3. Renu Soni, Ruchitra Gupta. 2022 Organic Farming: A Sustainable Agricultural Practice, Journal of Thematic Analysis.
4. Gour, M. (2016). Organic farming in India: Status, issues and prospects. SOPAAN.
5. Santhosh kumar M., Reddy G. C., & Sangwan, P. S. (2017). A Review on Organic Farming–Sustainable Agriculture Development. International Journal of Pure and Applied Bioscience.

OAG102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
CO3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
CO4	3	2	-	-	3	2	-	-	-	-	-	3	2	-	-	3
CO5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
Average	2.0	3.0	0.0	2.0	3.0	2.0	3.0	3.0	0.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0

OAG103	SUSTAINABLE DEVELOPMENT THROUGH	L	T	P	C
	INDIAN KNOWLEDGE SYSTEM	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 9

IN INDIAN KNOWLEDGE SYSTEMS

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	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	-	-	-	1	-	-	2	-	3	1	-
CO3	-	-	-	3		1	2	-	-	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	1	-	-	3	-	1	-	2	-
CO5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	1.5	-	-	3	-	1	2	2	1.5	-	3	2	1.5	2.5	1.5	2

OCE101	Air and Noise Pollution Control Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.
- To create awareness among the sources and effects of air pollution.
- To gain knowledge on air pollution control equipments.
- To develop a knowledge on air quality standards.
- To gain knowledge of characteristics of air pollution and noise pollution.

UNIT- I INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards- Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT- II METEOROLOGY 9

Effects of Meteorology on Air pollution-Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns-Atmospheric Diffusion Theories-Dispersion models, plume rise.

UNIT- III CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT- IV CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment - Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of industries-Sources and Effects of Noise Pollution – Measurement – Standards -Control and Preventive measures.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

- An understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
- Ability to identify, formulate and solve air and noise pollution problems
- Ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipment.
- Ability to ensure quality, control and preventive measures.

TEXTBOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, “Air Pollution Control Engineering”, Tokyo, springer science & science media LLC,2004.
2. Noel de Nevers, “Air Pollution Control Engineering”, Waveland press,Inc 2017.
3. Anjaneyulu. Y, “Air Pollution and Control Technologies”, Allied Publishers (P) Ltd., India 2002.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I - Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
4. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited, 2007.

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	-	1	2	1	-
CO2	-	-	2	3	-	-	3	2	2	-	-	3	-	-	-	1
CO3	1	2	3	-	-	2	2	3	-	2	-	-	3	-	-	-
CO4	-	2	-	3	-	-	-	-	2	2	-	2	-	2	1	-
CO5	1	1	2	3	-	1	3	3	1	1	2	3	2	-	2	-
Average	1.0	2.0	2.0	3.0	0.0	1.0	3.0	3.0	2.0	2.0	2.0	3.0	2.0	2.0	1.0	1.0

COURSE 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**

COURSE OUTCOMES:

On successful completion of this course, students will be able to:

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.

TEXT BOOKS:

1. Canter, R.L, "Environmental impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 - Overview, Asian Development Bank, 1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

REFERENCES:

1. Becker H. A., Frank Vanclay , "The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010

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	1	-	-	1
CO2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
CO4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	2.0	2.0	2.0	0.0	2.0	3.0	2.0	0.0	3.0	0.0	2.0	1.0	1.0	0.0	1.0

COURSE 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

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.

TEXT BOOKS:

1. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
2. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
3. "Alternative Building Materials and Technologies" K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao.. New Age International, 2007.
4. "Green Building - Guidebook for sustainable Architecture", Dr. Michael Bauer, Peter mosle, Dr. Micheal Schwarz, Springer, 2007

REFERENCES:

1. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010.
2. Jerry Yudelson, Green building Through Integrated Design, McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building by Marian Keeler, Bill Burke.Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.

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	1	1	2	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
CO5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.0	2.0	2.0	3.0	0	0	3.0	0	2.0	1.0	1.0	2.0	1.0

OBJECTIVES:

- 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 Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	3	2	-	-	-	3	1	3	2	-	-	-	-
2	2	2	2	3	3	-	-	-	2	2	3	2	-	-	-	-
3	3	3	3	3	2	-	-	-	2	3	1	1	-	-	-	-
4	2	3	2	3	2	-	-	-	3	3	3	3	-	-	-	-
5	2	3	2	2	3	-	-	-	3	3	1	3	-	-	-	-
Avg	2.4	2.8	1.3	2.8	2.4	-	-	-	2.6	2.4	2.2	2.2	-	-	-	-

OBJECTIVES:

- To understand the basic concepts of open source software.
- To understand about open source databases.
- To understand about the open source programming languages.
- To understand and apply the concepts in python language.
- To understand the real world problems using case studies.

UNIT-I: INTRODUCTION**9**

Introduction to Open sources - Need of Open Sources - Advantages of Open Sources-Application of Open Sources. Open source operating systems: LINUX: Introduction -General Overview - Kernel Mode and user mode - Process - Advanced Concepts -Scheduling - Personalities - Cloning - Signals - Development with Linux.

UNIT-II: OPEN SOURCE DATABASE**9**

MySQL: Introduction - Setting up account - Starting, terminating and writing your ownSQL programs - Record selection Technology - Working with strings - Date and Time- Sorting Query Results - Generating Summary - Working with metadata - Usingsequences - MySQL and Web.

UNIT-III: OPEN SOURCE PROGRAMMING LANGUAGES**9**

PHP: Introduction - Programming in web environment - variables - constants -data;types - operators - Statements - Functions - Arrays - OOP - String Manipulation and regular expression - File handling and data storage - PHP and SQL database - PHP and LDAP - PHP Connectivity - Sending and receiving E-mails - Debugging and error handling - Security - Templates.

UNIT-IV: PYTHON**9**

Syntax and Style - Python Objects - Numbers - Sequences - Strings - Lists and Tuples - Dictionaries - Conditionals and Loops - Files - Input and Output - Errors and Exceptions - Functions - Modules - Classes and OOP - Execution Environment.

UNIT-V: CASE STUDIES**9**

Apache, BSD, Linux, Mozilla (Firefox), Wikipedia, Joomla, GCC, Open Office.

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 Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
4	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
5	2	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-
Avg	2.0	-	1.6	-	1.0	-	-	-	-	-	-	-	-	-	-	-

OBJECTIVES:

- To study the fundamentals about IoT
- To study about IoT Access technologies
- To study the design methodology and different IoT hardware platforms.
- To study the basics of IoT Data Analytics and supporting services.
- To study about various IoT case studies and industrial applications.

UNIT- I: FUNDAMENTALS OF IoT**9**

Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT- II: IoT PROTOCOLS**9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, 6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT- III: DESIGN AND DEVELOPMENT**9**

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details

UNIT- IV: DATA ANALYTICS AND SUPPORTING SERVICES**9**

Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M, Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

UNIT- V: CASE STUDIES/INDUSTRIAL APPLICATIONS

9

IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments, Industry 4.0 concepts.

TOTAL: 45 PERIODS

OUTCOMES:

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

- 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, 2017(unit 1,2,3,)
2. Internet of Things - A hands-on approach, Arshdeep Bahga, Vijay Madiseti, Universities Press, 2015 (unit 5)
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education(unit 4)

REFERENCES:

1. The Internet of Things - Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
2. "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence",Jan Ho" Iler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media,2011

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2				2			1	2	-	-	-
2	3	3	3	3									-	2	-	-
3	3	3	3		3		2	1		2			-	-	1	-
4	3	3	3	3	3						2		-	-	2	-
5	3	3	3	3	2	3	2			3	2	1	-	2	-	2
Avg	3	3	3	3	2.5	3	2	1		2.5	2	1	2	2	1.5	2

OUTCOMES:

- To understand the mechanics of operation and characteristics of linear model of machine learning
- Use R to implement methods for training and model selection ‘
- Acquire Knowledge in various learning techniques like decision tree, Analytical, Inductive and Reinforced learning.
- Identify and apply the appropriate machine learning techniques for classification, Pattern recognition, optimization and decision problems.
- Development of techniques in information science applications by applying Computational intelligence and appropriate machine learning techniques.

UNIT- I: INTRODUCTION**9**

Machine learning -Examples of Machine Learning applications-Learning Associations-Classification-Regression-Unsupervised Learning-Reinforcement Learning-Supervised learning: Learning a class from Examples-Regression-Model Selection and Generalization. Case Study: Familiarity with R tool and Python programming language and libraries

UNIT-II: CONCEPT LEARNING AND DECISION-TREE LEARNING**9**

Concept Learning - Concept learning Task - Concept Learning as search -Finding a maximally specific hypothesis - Version Spaces and Candidate elimination Algorithm -Inductive Bias Decision Tree Learning - Decision Tree representation -Problems for Decision Tree Learning - Hypothesis Search space - Inductive Bias in Decision Tree Learning - Issues in Decision Tree Learning. Case Study: Implementation of decision tree algorithm for problems in Retail Domain.

UNIT-III: MULTILAYER PERCEPTRONS AND DEEP LEARNING**9**

The Perceptron-Training a Perceptron-Learning Boolean Functions-Multilayer Perceptrons-MLP as Universal Approximator Back propagation Algorithm-Training Procedures Convolution Networks -The Convolution Operation-Pooling-Convolution and Pooling as an infinitely strong prior -Variants of the Basic Convolution Function -Structured Outputs -Data Types -Efficient Convolution Algorithms -Random and Unsupervised features. Case Study: Implementation of Back propagation algorithm for problems in financial domain.

UNIT-IV: CLUSTERING

9

Similarity-Based Clustering-Unsupervised learning problems-Hierarchical Agglomerative Clustering (HAC)-Single-link, completelink, group-average similarity- k-Means and Mixtures of Gaussians-Flat clusteringk-Means algorithms-Mixture of Gaussian modelEM-algorithm for mixture of Gaussian model. CaseStudy: Implementation of clustering algorithm for problems in financial/insurance/health care domain.

UNIT-V: REINFORCEMENT LEARNING

9

Introduction - learning task - Q learning - The Q function - Algorithm for Q learning - convergence- experimentation strategies - updating sequence -Non deterministic rewards and actions - Temporal difference learning -Generalizing from examples -relationship to dynamic programming Case Study: Implementation of Q learning algorithm/reinforcement learning for problems in automotive domain/games

TOTAL : 45 PERIODS

OUTCOMES:

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

- Understand the basics 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 2014, ISBN 978-0-262-02818-9.(Units 1,3(Multilayer Perceptrons) & 4)
2. Mitchell, Tom, "Machine Learning", New York, McGraw-Hill, First Edition, 2003. (Units 2,5)

REFERENCES:

1. Ian GoodFellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press Book (Unit 3 - Convolutional Networks), Nov. 2016
2. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC 2009.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press (MA) 2012.

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
Avg	1.2	1	1.3	1	1	1	1	-	1	-	-	1	1	1	1.6	2

OBJECTIVES:

- To understand the Tamil grammar and programming basics for Tamil computing.
- To understand the various types of Tamil Computing applications.
- To make the students understand the use of Tamil computing tools and Resources.
- To strengthen the students' ability to carry out the Computational Linguistics in Tamil computing.
- To understand the concepts of Tamil text processing using open – Tamil python library.

UNIT-I: TAMIL GRAMMAR**9**

Introduction to Computational Linguistics-Grammars-Alphabets: Classification & Properties - Words: classification and components - Sentences: Structures and word ordering.

UNIT-II: PROGRAMMING BASICS FOR TAMIL COMPUTING**9**

History of Tamil Computing - Standards & Fonts - UNICODE - Object Oriented Tamil Computing - Tamil text processing using open-tamil python library.

UNIT - III: COMPUTATIONAL LINGUISTICS**9**

Basic linguistics - Phonology - Phonology computing - lexicography - syntax - semantics - pragmatics- Regular languages-and their limitations-Finite-state automata.

UNIT-IV: TAMIL COMPUTING TOOLS & RESOURCES**9**

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Ontologies.

UNIT-V: TAMIL COMPUTING APPLICATIONS**9**

Machine Translation -Information retrieval & Extraction - Question Answering - Text Summarization- Automatic Indexing - Text Mining - Conceptual Search.

TOTAL: 45 PERIODS**OUTCOMES:**

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

- 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 Ruslan Mitkov, Oxford University Press, 2014.
2. Tamil Computing ,Dr.R.Ponnusamy, Allied Publishers private limited, 2024

REFERENCES:

1. Translation - Theory and Application, Valarmathi, International Institute of Tamil Studies, First Edition, 2001.
2. Tholkaappiyam - Thodariyal, Shanmugam, International Institute of Tamil Studies, First Edition, 2004.
3. J.E.Hopcroft, R.Motwani and J.D Ullman, - Introduction to Automata Theory, Languages and Computations, Third Edition, Pearson Education, 2013.
4. Natural language processing and computational linguistics, Bhargav Srinivasa Desikan Packt Publishing, first edition 2018.
5. The Phonology and morphology of tamil chrisdas Prathima, 2016.
6. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in

CO- PO - PSO Mapping

CO	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
Avg	1.2	1	1.3	1	1	1	1	1	1	1	1	1	1	1	1.6	2

OBJECTIVES:

- Principles of digital evidence handling and forensic investigation techniques.
- Proficiency in using forensic tools for imaging, data recovery, and analysis.
- Understanding legal and ethical considerations in cyber investigations.
- Incident response planning and execution for cyber incidents.
- Documentation and reporting of forensic findings for stakeholders and legal purposes.

UNIT – I : INTRODUCTION TO CYBER FORENSICS 9

Computer Forensics Fundamentals - Types of Computer Forensics Technology - Types of Computer Forensics Systems - Vendor and Computer Forensics Services.

UNIT – II : COMPUTER FORENSICS EVIDENCE AND CAPTURE 9

Data Recovery - Evidence Collection and Data Seizure-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.

UNIT – III : COMPUTER FORENSIC ANALYSIS 9

Discovery of Electronic Evidence- Identification of Data - Reconstructing Past Events - Fighting against Macro Threats - Information Warfare Arsenal - Tactics of the Military - Tactics of Terrorist and Rogues - Tactics of Private Companies.

UNIT – IV : INVESTIGATION 9

Arsenal - Surveillance Tools - Hackers and Theft of Components - Contemporary Computer Crime- Identity Theft and Identity Fraud - Organized Crime & Terrorism -Avenues Prosecution and Government Efforts - Applying the First Amendment to Computer Related Crime-The Fourth Amendment and other Legal Issues.

UNIT – V : COMPUTER FORENSIC INVESTIGATION CASES 9

Developing Forensic Capabilities - Searching and Seizing Computer Related Evidence - Processing Evidence and Report Preparation - Future Issues.

TOTAL : 45 PERIODS

OUTCOMES:

- To demonstrate proficiency in using forensic tools and techniques for digital evidence analysis.
- To critically evaluate and interpret digital artifacts to reconstruct cyber incident timelines.
- To apply legal and ethical principles to ensure compliance in cyber forensic investigations.
- To formulate and implement incident response strategies to mitigate cyber threats effectively.
- To prepare clear and comprehensive forensic reports and presentations for stakeholders.

TEXT BOOKS:

1. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005. (CHAPTERS 1 – 18). (UNIT I – IV)
2. Marjie T Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition, 2008. (CHAPTERS 3 – 13). (UNIT IV – V)

REFERENCES:

1. MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014.
2. Chad Steel, "Windows Forensics", Wiley, 1st Edition, 2006.
3. Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
4. Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004.

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
2	-	3	-	3	-		-	-	-	-	-	-	-	2	-	-
3	3	-	2		-	3	-	-	-	-	-	-	-	-	3	-
4	2	-	2		-	-	-	-	-	-	-	-	-	2		-
5	3	-	-	2	-	2	-	-	-	-	-	-	-	-	2	-
Avg	2.7	2.5	2	2.5	-	2.5	-	-	-	-	-	-	3	2	2.5	-

OBJECTIVES:

- To Understand Social Media Platforms: Learn how popular social media platforms work.
- To Identify Security Risks: Recognize threats and vulnerabilities on social media.
- To Privacy and Data Protection: Protect personal information on social media.
- To Legal and Ethical Issues: Understand legal and ethical issues in social media.
- To Security Best Practices: Apply methods to secure social media accounts.

UNIT-I: INTRODUCTION TO SOCIAL MEDIA SECURITY 9

Social Media Platforms-Communication Impact-Cybersecurity Basics-Security Threats-User Awareness-Breach Case Studies-Data Collection-Security Features-Future Trends.

Unit-II: PRIVACY AND ACCOUNT SECURITY 9

Privacy Settings-Strong Passwords-Two-Factor Authentication (2FA)-Geotagging Risks Personal Information- Third-Party Apps-Account Takeover-Encryption Role-Safe Posting.

UNIT-III: THREATS AND ATTACKS 9

Social Engineering-Cybercriminal Tactics-Suspicious Activity-Malware Links-Hacking Cases-Suspicious Content-Security Tests-Insider Threats-Threat Intelligence.

UNIT-IV: LEGAL AND ETHICAL ISSUES 9

International Laws-Intellectual Property-Privacy Policies-Ethical Data Use-User Responsibilities-Legal Disputes- Freedom of Speech-Compliance Requirements-RegulationFuture.

UNIT-V: ONLINE REPUTATION AND POLICIES 9

Reputation Strategies-Brand Impact-Crisis Management-Corporate Communication-Social Media Policies- Governance Role-Monitoring Tools-Employee Training-Cybersecurity Integration.

TOTAL: 45 PERIODS

OUTCOMES:

- 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.

TEXT BOOKS:

1. "Social Media Security: Leveraging Social Networking While Mitigating Risk" by Michael Cross.
2. "The Social Media Handbook: Rules, Policies, and Best Practices to Successfully Manage Your Organization's Social Media Presence, Posts, and Potential Legal Issues" by Nancy Flynn.

REFERENCES:

1. "Phishing Dark Waters: The Offensive and Defensive Sides of Malicious Emails" by Christopher Hadnagy and Michele Fincher.
2. The Ethical Hack: A Framework for Business Value Penetration Testing" by James S. Tiller.

CO – PO and PSO MAPPING:

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	3	-	-	-	-	-	-	-	-	3	-	2	-
2	-	1	-	2	-	-	-	-	-	-	-	-	3	-	1	-
3	-	-	1	2	3	-	-	-	-	-	-	-	3	-	1	-
4	-	1	-	2	-	-	-	-	-	-	-	-	3	-	2	-
5	1	1	-	2	2	-	-	-	-	-	-	-	3	1	2	-
Avg	1	1.2	1	2.2	2.5	-	-	-	-	-	-	-	3	1	1.6	-

OEC101	INTRODUCTION TO 5G COMMUNICATION	L	T	P	C
	NETWORKS	3	0	0	3

OBJECTIVES:

- To understand the evolution of wireless networks.
- To learn the various features of 5G.
- To get acquainted with the fundamentals of EPC.
- To study the processes associated with 5G architecture.
- To explore the spectrum sharing and spectrum trading.
- To assess the security features in 5G networks.

UNIT-I: EVOLUTION OF WIRELESS NETWORKS 9

Networks evolution: 1G, 2G, 3G, 4G, Evolution of radio access networks, Need for 5G. 4G versus 5G, Next Generation Core (NG-Core), visualized Evolved Packet Core (vEPC).

UNIT-II: 5G CONCEPTS AND CHALLENGES 9

Fundamentals of 5G technologies, Overview of 5G core network architecture, 5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT-III: NETWORK ARCHITECTURE AND THE PROCESSES 9

5G architecture and core, Network slicing, Multi access edge computing (MEC) Visualization of 5G components, End-to-end system architecture, Service continuity, Relation to EPC, and Edge computing.

UNIT-IV: PROTOCOLS AND SPECTRUM MANAGEMENT 9

5G protocols: 5G NAS, NGAP, GTP-U, IP Sec and GRE, Mobility management, Command and control, Spectrum sharing and Spectrum trading, Cognitive radio based on 5G.

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	2	2
OEC101.2	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.3	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.4	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.5	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.6	3	2	3	2	-	2	-	-	-	-	-	2	2	2
AVG	3	3	3	2	-	2	-	-	-	-	-	2	2	2

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	1	2
PEC504.2	1	-	1	-	-	-	-	-	-	-	-	2	2	2
PEC504.3	2	3	3	3	-	-	-	-	-	-	-	2	2	3
PEC504.4	1	-	2	-	-	-	-	-	-	-	-	2	2	2
PEC504.5	2	1	3	2	-	-	-	-	-	-	-	2	3	2
PEC504.6	2	3	3	2	-	-	-	-	-	-	-	2	3	2
AVG	2	3	3	2	-	-	-	-	-	-	-	2	2	2

OEC103	ARDUINO PROGRAMMING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution of IoT boards
- To program Arduino to control lights, motors and other devices
- To learn Arduino's architecture, including inputs and connectors for add-on devices.
- To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.
- To explore various options in programming Arduino boards
- To test, debug, and deploy the Arduino to solve real world problems

UNIT-I: INTRODUCTION TO SENSORS 9

Transducers, Classification, Roles of sensors in IoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators.

UNIT-II: ARDUINO GPIOs and APIs 9

Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, APIs / Packages- Quark SOC processor.

UNIT-III: ARDUINO INTERFACES 9

Sensor with Arduino- Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal - Reading various sensor data on serial monitor and LCD Display.

UNIT-IV: PROGRAMMING IN ARDUINO IoT DEVICE 9

Preparing the development environment (Arduino IDE), Exploring the Arduino language syntax, Coding, compiling, and uploading to the microcontroller, Working

with Arduino Communication Modules: Bluetooth Modules, Wi-Fi Modules and I2C and SPI.

UNIT-V: PROGRAMMING ESP 8266 MODULE

9

ESP8266 Wi-Fi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor, Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via Thing Speak.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the basics of sensors, its functioning.
- Execute basic and advanced assembly language programs.
- Learn the ways to interface I/O devices with processor for task sharing.
- Evoke the basics of co-processor and its ways to handle float values by its instruction set.
- Recognize the functionality of micro controller, latest version processors and its applications.
- Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyse the results.

TEXT BOOKS:

1. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, 2nd Edition, McGraw-Hill Education, 2017.
2. Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 1 st edition, McGraw Hill Education, 2015

REFERENCES:

1. Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Automation 2014.

2. Schwartz, Marco. Internet of things with arduino cookbook, 1st edition, Packt Publishing Ltd, 2016.
3. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 1st edition, Packt Publishing Ltd, 2015

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
OEC103.1	3	3	2	2	-	-	-	-	-	-	-	3	2	2
OEC103.2	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.3	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.4	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.5	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.6	3	2	3	2	-	-	-	-	-	-	-	2	2	2
AVG	3	3	3	2	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

The student should be made to:

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

UNIT – I: FOOD PROCESSING AND ITS IMPORTANCE 9

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

UNIT – II: METHODS OF FOOD HANDLING AND STORAGE 9

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

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

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

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

Rate of drying for food products; design parameters of different type of dryers; properties of

air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages. Waste disposal-solid and liquid waste, rodent and insect control, use of pesticides, ETP, selecting and installing necessary equipment.

UNIT – V: FOOD HYGIENE

9

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

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

CO2: Explain the food handling and storage processes.

CO3: Analyze the thermal and non-thermal processing methods.

CO4: Explore the drying process of foods.

CO5: Understand Food Hazards, Adulteration, and Safety in handling and procurement & Microbial considerations and sanitation.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”.Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles and Practice”.Surbhi Publications, 2001.
3. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.

REFERENCE BOOKS:

1. Shafiur M Rahman, “Handbook of Food Preservation”, Second Edition, CRC Press, 2007
2. Zeuthen Peter, Bogh-Sorensen Leif, “Food Preservation Techniques”, Wood Head Publishing, Cambridge, England, 2005.
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	-	-	-	-	-	-	1
CO2	2	3	1	2	-	-	-	2	-	-	-	2	-	1
CO3	3	2	1	2	-	1	1	-	-	-	-	2	-	1
CO4	3	2	1	2	-	1	1	-	-	-	-	2	-	1
CO5	3	1	2	-	-	1	1	-	-	-	-	2	-	1
Average	3	2	1.3	2.3	-	1	1	2	-	-	-	2	-	1

OBJECTIVES:

- To explore the characteristics of electrode configuration.
- To study the characteristics of Bio signals.
- To explain the necessity of bio amplifiers in biomedical signal processing.
- To analyze the different techniques used for measurement of non-electrical bio-parameters.
- To understand the biochemical measurement techniques and sensors.

UNIT – I: ELECTRODE CONFIGURATIONS**9**

Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode-skin interface impedance, polarization effects of electrode – non- polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT – II: BIOSIGNAL CHARACTERISTICS**9**

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

UNIT – III: BIOAMPLIFIERS**9**

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

UNIT – IV: MEASUREMENT OF BIO SIGNALS**9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements

UNIT – V: BIOCHEMICAL MEASUREMENTS**9**

Biochemical sensors - pH, pO₂ and pCO₂, Ion selective Field effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers,

colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

TOTAL PERIODS: 45

COURSE OUTCOMES:

CO1: Illustrate the origin of various biological signals and their characteristics.

CO2: Apply knowledge of bio signal characteristics.

CO3: Gain knowledge on various amplifiers involved in monitoring bio signals.

CO4: Identify appropriate instruments and methods for each physiological parameter.

CO5: Examine the biochemical measurement techniques.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

COURSE OBJECTIVES:

1. To know the Indian and global energy scenario.
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies.

UNIT-I: ENERGY SCENARIO**9**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.

UNIT -II: SOLAR ENERGY**9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT -III: WIND ENERGY**9**

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics – Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT -IV: BIO-ENERGY**9**

Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers – Cogeneration – Carbonization – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations
– Geothermal energy – Geothermal energy sources - Types of geothermal power plants
– Applications - Environmental impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1: Discuss the Indian and global energy scenario.
- CO2: Describe the various solar energy technologies and its applications.
- CO3: Explain the various wind energy technologies.
- CO4: Explore the various bio-energy technologies.
- CO5: Discuss the ocean and geothermal technologies.

TEXT BOOKS:

- T1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 :9390385636.
- T2. 2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 8120344707.

REFERENCES:

- R1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
- R2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
- R3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
- R4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
- R5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.

CO - PO and CO - PSO MAPPING

OEE101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2			1							3			
CO2	3	3	2			1							3			
CO3	3	3	2			1							3			
CO4	3	3	2			1							3			
CO5	3	3	2			1							3			
Average	3	3	2			1							3			

COURSE OBJECTIVES:

At the end of the course, the student is expected to

1. Acquire knowledge in the field of energy conservation and management.
2. Study the various measures for energy conservation in electrical devices both static & rotating machineries
3. Analyze the energy efficiency in thermal utilities
4. Know the concept of compressed air system and improve the efficiency.
5. Understand and analyze of Energy Economics.

UNIT-I: INTRODUCTION**9**

Energy - Power – Past & Present scenario of World; National Energy consumption Data –Environmental aspects associated with energy utilization – Energy conservation and its importance - need for energy management – Energy accounting -Energy monitoring, targeting and reporting- Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers.

UNIT -II: ELECTRICAL SYSTEMS**9**

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors automatic power factor controllers - transformer losses - Electric motors: motor efficiency - factors affecting motor performance - energy saving opportunities with energy efficient motors – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination. Lighting System: Light source, choice of lighting, luminance requirements – ballast - energy efficient lighting controls - energy conservation avenues

UNIT -III: THERMAL SYSTEMS**9**

Introduction to fuels- Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces,

excess air, heat distribution, temperature control, draft control, waste heat recovery –
Refractory : types, selection and application of refractories, heat loss .

UNIT -IV: COMPRESSED AIR SYSTEM

9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – Diesel Generating System - methods adopted for effecting ENCON – economics of ENCON adoption in all the utilities-

UNIT -V: ECONOMICS

9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1: Acquire knowledge in the field of energy conservation and management process.
- CO2: Learn the various measures for energy conservation in electrical devices.
- CO3: Design the effective thermal utility system.
- CO4: Improve the efficiency in compressed air system.
- CO5: Suggest methodologies for Energy Economics.

TEXT BOOKS:

- T1.Mehmet Kanoğlu, Yunus A. Çengel, 'Energy Efficiency and Management for Engineers', 1st Edition, McGraw-Hill Education, 2020.
- T2.D Moncef Krati, "Energy Audit of Building Systems: An Engineering Approach", Second Edition, CRC Press, 2016.
- T3.Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education (India) Private Limited,2015

REFERENCES:

- R1. Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits',American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
- R2. Charles M. Gottschalk, 'Industrial Energy Conservation', Wiley, 1996.

CO - PO and CO - PSO MAPPING

PPS403	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1		1		3				2			1			
CO2			2		1				2			1	1	2		
CO3		1		3		2							1			
CO4	3					3		2			2		1			
CO5		2		3	2		1	2				2	2			
Average	2	1.3	2	2.3	1.5	2.6	1	2	2	2	2	1.5	1.2	2		

COURSE OBJECTIVES:

1. To know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures.
2. To acquire the knowledge on modelling, sizing of batteries.
3. To understand the working principle, construction and characteristics of various motors.
4. To provide knowledge about various power converters and control.
5. To understand the Hybrid and Electric vehicles.

UNIT-I: DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency-. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.

UNIT -II: ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra-capacitors. Battery Management System

UNIT -III: MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT -IV: POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor,

PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations – operating modes.

UNIT -V: HYBRID AND ELECTRIC VEHICLES

9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles – Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1: Understand the operation and architecture of electric and hybrid vehicles.
- CO2: Identify various energy source options like battery and fuel cell.
- CO3: Select suitable electric motor for applications in hybrid and electric vehicles.
- CO4: Explain the role of power electronics in hybrid and electric vehicles
- CO5: Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

- T1. 1. Iqbal Husain, “ Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press,2003
- T2. 2. Mehrdad Ehsani, “ Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRCPress,2005.

REFERENCES:

- R1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “ John Wiley & Sons,2003
- R2. Lino Guzzella, “ Vehicle Propulsion System” Springer Publications,2005
- R3. 3. Ron HodKinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication,2005.

CO - PO and CO - PSO MAPPING

OEE103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	2	3	2					1	1	2		2	
CO2	3	3	3	2	3	2						1		1		1
CO3	3	3	3	2	3	2	3					2	2			1
CO4	3	3	3	2	3	2					1	1				
CO5	3	3	3	2	3	2	2				1	1	1			
Average	3	3	3	2	3	2	2.5				1	1.2	1.6	1	2	1

COURSE OBJECTIVES

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

UNIT-I INTRODUCTION TO ROBOTICS**9**

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT-II DRIVE SYSTEMS AND GRIPPERS**9**

Pneumatic Drives-Hydraulic Drives-Electrical Drives- Fundamental features and Applications of A.C & D.C. Servo Motors, Stepper Motors, Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Selection and Design Considerations

UNIT-III SENSORS FOR ROBOT**9**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors.

UNIT-IV KINEMATICS AND PROGRAMMING**9**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Programming Types-Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple

Programs.

UNIT-V IMPLEMENTATION OF ROBOTS

9

RGV, AGV; Implementation of Robots in Industries -Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

TEXTBOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

REFERENCE BOOKS

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb.S.R., "Robotics Technology and Flexible Automation", Tata McGraw Hill Book Co. 1994.
3. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence",McGraw Hill Book Co., 1987.
5. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.

CO - PO and CO - PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	1				1					1	1	1
CO2	2	3	1	2					1	1			2	2	3
CO3	2	3	2	3		3	2	1	2	1		1	2	2	1
CO4	2	1			1										1
CO5	2	1	3	1	3	2	2	1			2	2	1	2	1
AVG.	2.2	1.8	1.4	1.4	0.8	1	0.8	0.6	0.6	0.4	0.4	0.6	1.2	1.4	1.4

OEI102	SENSORS FOR ENGINEERING APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To know the various stimuli that are to be measured in real life instrumentation.
- To select the right process or phenomena of the sensor.
- To aware of the various sensors available for measurement and control applications.

UNIT-I INTRODUCTION TO SENSORS 9

What is a sensor and what is a transducer? Electrical sensor – need for sensors in the modern world. Different fields of sensors based on the stimuli - various schematics for active and passive sensors. General characteristics and specifications of sensors - Implications of specifications uses of sensors - measurement of stimuli - block diagram of sensor system. Brief description of each block.

UNIT-II TRANSDUCERS 9

Sensors for mechanical systems or mechanical sensors - Displacement - acceleration and force - flow of fluids - level indicators - pressure in fluids - stress in solids. Typical sensors - wire and film strain gauges, anemometers, piezo electric and magnetostrictive accelerometers, potentiometric sensors, LVDT.

UNIT-III TEMPERATURE SENSORS 9

Thermal sensors - temperature - temperature difference - heat quantity. Thermometers for different situation - thermocouples thermistors - color pyrometry. Optical sensors: light intensity - wavelength and color - light dependent resistors, photodiode, photo transistor- Radiation detectors: radiation intensity, particle counter - Gieger Muller counter (gas based), Hallide radiation detectors.

UNIT-IV MAGNETIC SENSORS 9

Introduction- magnetic field, magnetic flux density – magneto resistors, Hall sensors, super conduction squids. Acoustic or sonic sensors: Intensity of sound, frequency of sound in various media, various forms of microphones, piezo electric sensors.

UNIT-V ELECTRICAL SENSORS 9

Introduction- conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. High frequency sensors like microwave frequency sensors, wavelength measuring sensors. MEMs and MEM based sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Appreciate the operation of various measuring and control instruments which they encounter in their respective fields.
- Visualize the sensors and the measuring systems when they have to work in areas of interdisciplinary nature.
- Also think of sensors and sensors systems when for a new situation they encounter in their career
- Identify and select the right process or phenomena on which the sensor should depend on.
- Know various stimuli that are to be measured in real life instrumentation.

TEXTBOOKS

1. Doebelin, "Measurement Systems: Application and Design", McGraw Hill Kogakusha Ltd.
2. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim "Microsensors, MEMS and Smart Devices", New York: Wiley, 2001.
3. Henry Bolte, "Sensors - A Comprehensive Sensors", John Wiley.

CO - PO and CO - PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	1	1	1	3	1	2	1	1	2		2
CO2	2		2	2			1								
CO3	2	2				1	1					1	1	2	
CO4	3	3	3	3	1			3	1	2					
CO5	2	1	2	1	1	1	1	2	1	1	1	1	2	2	2
AVG.	2.4	1.6	1.8	1.6	0.6	0.6	0.8	1.6	0.6	1	0.4	0.6	1	0.8	0.8

OBJECTIVES:

- 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	3	2	1
2	1	-	2	-	3	3	-	-	-	3	3	1	1	-	2
3	3	2	2	-	2	1	1	1	1	1	1	1	3	2	2
4	3	3	3	-	2	1	1	1	1	1	1	1	3	3	3
5	3	3	3	-	3	1	1	1	1	1	1	1	3	3	3
Avg	2.6	2.4	2.4	-	2.2	1.4	1.0	1.0	1.0	1.6	1.8	1.0	2.6	2.0	2.3

OBJECTIVES:

- To develop CAD models for 3D printing.
- To import and export CAD data and generate. STL file.
- To select a specific material for the given application.
- To select a 3D printing process for an application.
- To produce a product using 3D printing or Additive Manufacturing (AM).

UNIT – I: 3D PRINTING (ADDITIVE MANUFACTURING) 9

Introduction, The Generic AM Process, Classification of AM Process, Advantages, Additive V/s Conventional Manufacturing processes, Applications- the Benefits of AM.

UNIT – II: CAD FOR ADDITIVE MANUFACTURING 9

Steps in Additive Manufacturing-Variation from one AM Machine to another- Application Areas That Don't Involve Conventional CAD Modeling-CAD Tools for AM -Preparation of CAD Models: The STL File, STL File Format, Binary/ASCII, Creating STL Files from a CAD System -Problems with STL Files.

UNIT – III: ADDITIVE MANUFACTURING TECHNIQUES 9

Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process, Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, Defence, Automotive, Construction, Food Processing, Machine Tools.

UNIT – IV: MATERIALS 9

Polymers, Metals, Non-Metals, Ceramics. Various forms of raw material – Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials

UNIT – V: ADDITIVE MANUFACTURING EQUIPMENT AND POST PROCESSING

9

Process equipment- design and process parameters, Governing bonding mechanism, Common faults and troubleshooting, Process design, Post processing: requirement and techniques, Product quality, Inspection and testing, Defects and their causes

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate. STL file.
- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXT BOOKS:

1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1. (Unit I & II)
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126. (Unit II to V)

REFERENCES:

1. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
2. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”, World Scientific, 2017.
3. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer 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	-	-	-	-	-	-	-	-	-	-	3	2
4	-	-	-	3	2	-	-	-	-	-	2	-	-	-	3	2
5	-	-	2	3	2	-	-	-	-	-	-	-	-	-	2	1
Av g	2	2	2. 2	2. 6	2	-	-	-	-	-	2	2	-	-	2. 6	1. 6

OBJECTIVES:

- Design static web page using Markup languages.
- Design and implement web pages using style sheets.
- Implement with java script web applications with dynamic web pages.
- Understand working of Web servers and Design Methodologies with MVC Architecture.
- Develop web applications using XML.

UNIT- I: INTRODUCTION TO WEB FRAMEWORKS**9**

Basics of web development – Overview of web frameworks - MVC architecture - Popular web frameworks: Django, Flask, Ruby on Rails, Laravel, Express.js - Benefits of using web frameworks

UNIT- II : CLIENT- SIDE FRAMEWORKS**9**

Introduction to client-side frameworks - React.js: Components, JSX, State and Props, Lifecycle Methods - Angular: Modules, Components, Services, Directives, Data Binding - Vue.js: Vue instance, Templates, Components, Vue Router

UNIT- III : SERVER - SIDE FRAMEWORKS**9**

Introduction to server-side frameworks - Django: Models, Views, Templates, Forms, Admin Interface - Flask: Routing, Templates, WTForms, SQLAlchemy - Node.js with Express.js:Middleware, Routing, Templating, REST APIs

UNIT- IV: DATABASE INTEGRATION**9**

Database fundamentals - SQL vs NoSQL databases - ORM (Object-Relational Mapping) concepts - Integrating databases with Django (using Django ORM) - Integrating databases with Flask (using SQLAlchemy) - Integrating databases with Node.js using Mongoose for MongoDB

UNIT- V : FULL-STACK DEVELOPMENT**9**

Overview of full-stack development - RESTful APIs and Web Services - Authentication and Authorization - Deployment and Hosting - Case Studies: Building a full-stack application with React and Django/Node.js

OUTCOMES:

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

- Understand the fundamental concepts and architecture of web frameworks.
- Develop web applications using client-side frameworks.
- Build dynamic server-side applications with popular server-side frameworks.
- Integrate databases and manage data within web applications.
- Implement full-stack web applications combining client side and server-side technologies.

TEXT BOOKS:

1. "Web Development with Node and Express: Leveraging the JavaScript Stack" by Ethan Brown Unit 1,3,4,5
2. "Django for Beginners: Build websites with Python and Django" by William S. Vincent Unit 1,3,5
3. "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux" by Kirupa Chinnathambi Unit 2,5

REFERENCES:

1. "Flask Web Development: Developing Web Applications with Python" by Miguel Grinberg Unit 3,4
2. "Pro Angular 9: Build Powerful and Dynamic Web Apps" by Adam Freeman Unit 2
3. "Full-Stack Vue.js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel" by Anthony Gore Unit 1,5

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	3	-	-	-	-	2	1	2	3	2	2	-
2	2	3	3	2	3	-	-	-	2	3	2	2	3	2	3	-
3	2	3	3	3	3	-	-	-	2	2	2	2	3	2	3	-
4	2	2	3	2	3	-	-	-	2	2	1	2	3	3	3	-
5	2	3	3	3	3	-	-	-	2	3	3	2	3	3	3	-
Avg	2.2	2.6	2.8	2.4	3	-	-	-	1.6	2.4	1.8	2	3	2.4	2.8	-

(Common to all branches)

OBJECTIVES

- To make the students familiar with the properties and applications of nanomaterials.
- To acquaint the student with the synthesis of nanomaterials by different methods.
- To provide knowledge on the different characterisation techniques employed to characterise the nanomaterials.
- To inculcate the students on the knowledge of nanocomposites, biodegradable polymer-based nanocomposites, and clay polymer nanocomposites.
- To enlighten the needs and utilization of nanomaterials in various fields such as energy, water treatment process, agriculture, electronics, medicine, engineering and Information technology.

UNIT I PROPERTIES OF NANOMATERIALS 9

Definition – importance of nano structured materials - size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials. Surface area - band gap energy and its applications. Photochemistry and electrochemistry of nanomaterials –ionic properties of nanomaterials- Nanocatalysis. Green Materials – biomaterials, biopolymers and bioplastics.

UNIT II SYNTHESIS OF NANOMATERIALS 9

Bottom-up and top-down approach to obtain nanomaterials. Chemical methods: co-precipitation methods, sol-gel technique, photochemical synthesis. Physical methods: high energy ball milling, PVD methods, gas phase condensation and magnetron sputtering.

UNIT III STRUCTURAL CHARACTERISTICS 9

Introduction, principles, instrumentation and applications of powder X-ray diffraction, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, nanoindentation, small angle X-ray and neutron scattering and BET analysis method.

UNIT IV NANOCOMPOSITES 9

Introduction, the importance of nanocomposites, binary and ternary nanocomposites. Synthesis, properties and applications of metal-metal oxide and metal oxide-metal oxide nanocomposites, biodegradable polymer-based nanocomposites, thermoplastic nanocomposites, nylon-6 nanocomposites, clay polymer nanocomposites.

UNIT V APPLICATIONS OF NANOMATERIALS 9

Introduction, applications of nanomaterials in renewable energy generation, drug delivery, cosmetics, tissue engineering, bioinformatics, nanomedicine, molecular motors, bioelectronics & spintronics, textiles, cosmetics, agriculture & food technology, high integrated circuits, information technology, defence and aerospace. Practice of nanoparticles for environmental remediation and water treatment.

Total Periods: 45

OUTCOMES

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

1. Evaluate and understand the different types of nanomaterials and their properties.
2. Understand the proper methods for synthesizing nanomaterials.
3. Recommend the characterization techniques for various nanomaterials.
4. Illustrate the functioning and properties of nanocomposites and their interference.
5. Develop a more profound knowledge on the applications of nanomaterials in various fields.

TEXTBOOKS

1. C. N. R. Rao, Achim Muller, Anthony K. Cheetham, "The Chemistry of Nanomaterials: Synthesis, Properties and Applications", 2nd Edition Wiley-VCH, Germany, 2006.
2. Geoffrey A. Ozin, Andre C. Arsenault, Ludovico Cademartiri, Chad A. Mirkin, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2nd Edition, United Kingdom, 2008.
3. Azamal Husen, Khwaja Salahuddin Siddiqi, "Advances in Smart Nanomaterials and their Applications (Micro and Nano Technologies)", 1st Edition, Elsevier, Netherlands, 2023.

REFERENCES

1. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis, United Kingdom, 2012.
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, London, 2004.
3. N. Kumar, "Concise concepts of nanoscience and nanomaterials", Scientific publishers, New Delhi, 2019.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, Hyderabad, 2018.
5. Korada, Viswanatha Sharma, Hamid, Nor Hisham, Engineering Applications of Nanotechnology: From Energy to Drug Delivery, Springer, United States, 2017.

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

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

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

VERTICAL 1: FINTECH AND BLOCKCHAIN

BAM101

FINANCIAL MANAGEMENT

L T P C

3 0 0 3

COURSE OBJECTIVES

1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance.
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy.
5. To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT 9

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of Money-Risk and return concepts.

UNIT II SOURCES OF FINANCE 9

Long term sources of Finance-Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits etc.

UNIT III INVESTMENT DECISIONS 9

Investment Decisions: Capital budgeting – Need and Importance –Techniques of Capital Budgeting - Payback - ARR – NPV – IRR – Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock - Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION 9

Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy.

UNIT V WORKING CAPITAL DECISION 9

Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital - Working capital operating cycle. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will have an understanding on Time value of money and role of a finance manager.
2. Students will be able to analyze the various avenues available to generate long term funds for investments through capital markets and other sources.
3. Students will be able to apply various techniques for Investment decisions.
4. Students will be able to choose the right approach for financing and dividend decisions to solve business issues.
5. Students will be able to analyze the requirement and management of working capital.

REFERENCES

1. M.Y. Khan and P.K. Jain Financial Management, text, problems and cases Tata McGraw Hill, 8th edition 2017.
2. I.M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018.
3. Prasanna Chandra, Financial Management – Theory and Practice, 9th edition, Tata McGraw Hill, 2017.
4. Rajiv Srivastava and Anil 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	-	-	3	-	-	-
CO2	-	3	3	-	-	-	-	3	3	-	-	-	-	3	-	-
CO3	-	-	3	1	-	-	-	-	3	1	-	-	-	-	3	-
CO4	3	-	-	-	-	-	3	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	3	-	-	-	-	-	3	-	2	3	1	3
CON	3	3	3	1	3	-	3	3	3	1	3	-	2	2.3	2	3

COURSE OBJECTIVES

1. To introduce the foundational concepts of Financial Technology (FinTech) and its applications in personal finance, inclusive finance, and digital financial services.
2. To familiarize students with digital payment systems and cryptocurrencies, including their underlying technologies, security concerns, and legal frameworks.
3. To provide insights into InsurTech innovations, focusing on the integration of AI, ML, and IoT in risk management, underwriting, and fraud detection in insurance.
4. To enable understanding of peer-to-peer lending models and crowdfunding ecosystems, with a focus on digital infrastructure and financing solutions for SMEs and MSMEs.
5. To develop awareness of global and domestic FinTech regulations, and the emergence of RegTech as a tool for ensuring regulatory compliance and fraud monitoring using AI.

UNIT I INTRODUCTION TO FINTECH AND DIGITAL FINANCE**9**

Overview of FinTech: Definition, scope, applications. History of Financial Innovation and Digitization. Alternative Finance: Crowdfunding – Types (Charity, Equity), platforms. Introduction to Initial Coin Offering (ICO). Role of FinTech in personal finance and inclusive finance.

UNIT II DIGITAL PAYMENTS AND CRYPTOCURRENCIES**9**

Introduction to Cryptocurrencies: Bitcoin and Applications. Types of Cryptocurrencies and Digital Wallets. Basics of Blockchain Technology. National Payment Systems: Real-Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Unified Payments Interface (UPI). Digital Payments: Smart Cards, Mobile Payments, Payment Gateways, Virtual Currencies. Legal, Security, Privacy, and Ethical Issues in Digital Transactions.

UNIT III INSURTECH AND DIGITAL INSURANCE INNOVATIONS**9**

Introduction to InsurTech. Role of (Artificial Intelligence (AI), Machine Language (ML), and Internet of Things (IoT) in insurance services. Risk Modelling, Fraud Detection. Innovations in Claims Processing and Underwriting. Impact on traditional insurance business models.

UNIT IV P2P LENDING AND FINANCIAL INCLUSION**9**

Peer-to-Peer (P2P) and Marketplace Lending. Architecture and Technology Platforms. Crowdfunding Unicorns and Business Models. Financing for SME/MSME – Opportunities, Challenges, and FinTech Solutions.

UNIT V FINTECH REGULATIONS AND REGTECH

9

Global and Indian FinTech Regulations. Legal and Regulatory Risks. RegTech: Definition, Evolution. RegTech Ecosystem – Institutions, Startups, Regulators. Role of AI in Compliance and Fraud Monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to explain the fundamentals of cryptocurrencies, digital wallets, blockchain and payment systems such as UPI, RTGS, and IMPS, along with related security and regulatory aspects.
2. Students will describe the evolution of digital finance and analyze alternative finance models like crowdfunding and Initial Coin Offerings (ICO).
3. Students will evaluate the role of AI, ML, and IoT in InsurTech applications such as underwriting, claims processing, risk modeling, and fraud detection.
4. Students will analyze P2P lending and crowdfunding platforms, infrastructure, and innovations for SME/MSME financing.
5. Students will interpret FinTech regulations and assess the role of RegTech and AI in ensuring compliance and detecting fraud.

REFERENCES

1. Swanson, Seth Fintech for Beginners: Understanding and Utilizing the Power of Technology. Create Space Independent Publishing Platform 2016.
2. Tanda, Alessandra & Schena, Cristiana-Maria FinTech, BigTech and Banks: Digitalisation and Its Impact on Banking Business Models. Springer 2019.
3. Diedrich, Henning Ethereum : Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations. Wildfire Publishing 2016.
4. William, Jacob Fin Tech: The Beginner's Guide to Financial Technology. Create Space Independent Publishing Platform 2016.
5. Indian Institute of Banking and Finance (IIBF) Digital Banking. Taxmann Publications 2016.

COURSE OBJECTIVES

1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION**9**

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY**9**

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY**9**

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE**9**

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH**9**

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks

partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to understand and describe the historical phases of FinTech.
2. Students can able to recognize how FinTech is revolutionizing payments, lending, wealth tech, insurance, and emerging sectors across different regions.
3. Students can able to understand the nuances of fintech in wealth management industry.
4. Students can able to compare major FinTech hubs and understand strategic collaborations between traditional financial institutions and tech firms.
5. Students will understand the future of fintech.

REFERENCES

1. Arner D., Barberis J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
5. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020

VERTICAL 2: ENTREPRENEURSHIP

BAM201

FOUNDATIONS OF ENTREPRENEURSHIP

L T P C
3 0 0 3

COURSE OBJECTIVES

1. To develop and strengthen the entrepreneurial quality and motivation of learners.
2. To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
4. To empower the learners to run a Technology driven business efficiently and effectively.
5. To cultivate entrepreneurial skills, increase awareness of entrepreneurship, and foster a culture of innovation and job creation.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP

9

Entrepreneurship- Definition, Need, Scope -Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Barriers to Entrepreneurship– Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT

9

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP

9

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends- Managing Techno Stress – Eustress and Distress – Coping Strategies of Techno Stress.

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP

9

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies.

UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP

9

Effective Business Management Strategies for Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be able to learn the basics of Entrepreneurship.
2. Students can understand the business ownership patterns and environment.
3. Students can understand the Job opportunities in Industries relating to Technopreneurship.
4. Students will learn about applications of technopreneurship and successful technopreneurs.
5. Students will acquaint with the recent and emerging trends in entrepreneurship.

REFERENCES

1. S.S. Khanka, “Entrepreneurial Development” S. Chand & Co.Ltd.Ram Nagar New Delhi, 2021.
2. Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning.
3. Daniel Mankani. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall 2003.
4. Edward Elgar. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub 2007.
5. Lang,J.TheHigh-TechEntrepreneur'sHandbook,Ft.com 2002.

COURSE OBJECTIVES

1. To develop and strengthen the Leadership qualities and motivation of learners.
2. To impart the Leadership skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of Team Building in managing Technology oriented businesses.
4. To empower the learners to build robust teams for running and leading a business efficiently and effectively.
5. To emphasize the importance of ethics and values in leadership practices.

UNIT I INTRODUCTION TO MANAGING TEAMS 9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) - Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS 9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP 9
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation – Effective Communication in Leadership - Leadership Attributes - Personality Traits and Leadership-Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS 9
Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership – Change Management - Role of Ethics and Values in Organisational Leadership.

UNIT V LEADERSHIP EFFECTIVENESS

9

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership – Motivation and Employee Engagement - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of managing teams for business.
2. students will understand developing effective teams for business management.
3. Students will understand the fundamentals of leadership for running a business.
4. Students will learn about the importance of leadership for business development.
5. Students will acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES

1. "Leadership and Team Building" by Uday Kumar Haldar, First Edition, Oxford University Press, New Delhi 2010.
2. "The Five Dysfunctions of a Team: A Leadership Fable" by Patrick Lencioni, 20th Anniversary Edition, Jossey-Bass 2002.
3. Hughes, R.L, Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. 2019.
4. Katzenback, J.R., Smith,D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, 2015.
5. Haldar, U.K., Leadership and Team Building, Oxford University Press, 2010.

COURSE OBJECTIVES

1. To develop the creativity skills among the learners.
2. To impart the knowledge of creative intelligence essential for entrepreneurs.
3. To impart the knowledge of Innovation in Industries.
4. To know the applications of innovation in entrepreneurship.
5. To develop innovative business models for business.

UNIT I CREATIVITY**9**

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology - Creative Personality and Motivation - Creativity Training.

UNIT II CREATIVE INTELLIGENCE**9**

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION**9**

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation- Inbound and Outbound Ideation-Product Innovation and Process- Technological, Organizational Innovation – Indicators Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system

UNIT IV INNOVATION AND ENTREPRENEURSHIP**9**

Innovation and Entrepreneurship: Entrepreneurial Mindset, Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit

UNIT V INNOVATIVE BUSINESS MODELS**9**

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models –Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of creativity for developing Entrepreneurship
2. Students will understand the importance of creative intelligence for business growth
3. Students will understand the advances through Innovation in Industries
4. Students will learn about applications of innovation in building successful ventures
5. Students will acquaint with developing innovative business models to run the business efficiently and effectively

REFERENCES

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand & Sons, 2021.
2. Innovation Management, C.S.G. Krishnama charyulu, R. Lalitha, Himalaya Publishing House, 2nd edition, 2017.
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4. A. Dale Timpe, Creativity, Jaico Publishing House, 2003. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
5. Tidd, J., & Bessant, J. Managing innovation: Integrating technological, market and organizational change. UK: Wiley 2020.

COURSE OBJECTIVES

1. To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
2. To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
3. To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.
4. To consider the various decision areas within marketing and the tools and methods used by marketing managers for making decisions.
5. To appreciate how a marketing perspective is important in your own personal and professional development.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT**9**

Introduction-Market and Marketing – Concepts – Functions of Marketing - Importance of Marketing
Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix
The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT II MARKETING ENVIRONMENT**9**

Introduction-Environmental Scanning- Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT III PRODUCT AND PRICING MANAGEMENT**9**

Product-Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies
Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBUTION MANAGEMENT**9**

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) –
Introduction to Advertising and Sales Promotion –Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)-Logistics Management- Introduction to Retailing and Wholesaling.

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT

9

Introduction - Relationship Marketing vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing, E-Marketing or Online Marketing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will have the awareness of marketing management process.
2. Students will understand the marketing environment.
3. Students will acquaint about product and pricing strategies.
4. Students will have the knowledge of promotion and distribution in marketing management.
5. Students can comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.
2. Marketing Management, Philip Kotler and Kevin Lane Keller, PHI 15th Ed, 2015.
3. Marketing Management-An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India, 5th edition, 2015.
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.

COURSE OBJECTIVES

1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.
4. To understand the training and compensation practices in Industry
5. To create an awareness on controlling measures followed HR practitioners.

UNIT I INTRODUCTION TO HRM 9

Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting – HR Audit - Challenges in HRM.

UNIT II HUMAN RESOURCE PLANNING 9

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION 9

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources –e Recruitment - Selection Process- Selection techniques -E-Selection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT 9

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices

UNIT V CONTROLLING HUMAN RESOURCES 9

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods- Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment – Union - Management Relationship - Recent Trends

TOTAL :45 PERIODS

COURSE OUTCOMES

1. Students will understand the Evolution of HRM and Challenges faced by HR Managers
2. Students will learn about the HR Planning Methods and practices.
3. Students will acquaint about the Recruitment and Selection Techniques followed in Industries.
4. Students will know about the methods of Training and Employee Development.
5. Students will comprehend the techniques of controlling human resources in organisations.

REFERENCES

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e, Pearson, 2015.
2. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
3. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
4. R. Wayne Mondy, Human Resource Management, Pearson, 2015.
5. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012

COURSE OBJECTIVES

1. To introduce the fundamentals of financing entrepreneurial ventures.
2. To understand the structure and avenues for debt and equity financing.
3. To explore government initiatives and institutional frameworks for start-ups.
4. To equip students with practical knowledge of fundraising processes for new ventures.
5. To develop competencies in evaluating financing strategies for new businesses.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE**9**

Setting up new Business Ventures – Need - Scope - Startup Ecosystem in India-Franchising - Location Strategy, Registration Process - Legal Requirements- State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT II INTRODUCTION TO VENTURE FINANCING**9**

Venture Finance–Definition–Historic Background– Importance – Funding New Ventures–Need–Scope– Types – Cost of Project–Means of Financing -Estimation of Working Capital–Requirement of funds– Mix of Debt and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING**9**

Fund for Capital Assets - Term Loans - Leasing and Hire Purchase - Money Market instruments – Bonds, Debentures, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT IV SOURCES OF EQUITY FINANCING**9**

Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital- Venture Valuation- meaning and Basic Mechanics of Valuation

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES**9**

Investor Decision Process - Identifying the appropriate investors- Targeting investors- Building Investor Relationships-Investor Selection Criteria- Company Creation-Raising Funds-Seed Funding- VC Selection Criteria – Process- Methods- VC Investment Process in India-Recent Trends

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of starting a new business venture.
2. Students can identify various venture financing opportunities
3. Students will understand the sources of debt financing.
4. Students will understand the sources of equity financing.
5. Students will acquaint and Formulate strategies for effective fundraising in real-world scenarios.

REFERENCES

1. Chandra, P. Projects: Planning, analysis, financing, implementation, and review (8th ed.). McGraw Hill Education, 2017.
2. Ramsinghani, M., The business of venture capital: The art of raising a fund, structuring investments, portfolio management, and exits (3rd ed.). Wiley. 2021.
3. Prasanna Chandra, Projects planning, Analysis, Selection, Financing, Implementation and Review, McGraw Hill Education India Pvt Ltd, New Delhi, 2019.
4. Byers, Thomas. Technology Ventures: From Idea to Enterprise. McGraw – Hill Higher Education, 2014
5. Steven Rogers, Entrepreneurial Finance: Finance and Business Strategies for the Serious Entrepreneur 3e, Tata Mc Graw Hill, 2014.

VERTICAL 3: PUBLIC ADMINISTRATION

BAM301

PRINCIPLES OF PUBLIC ADMINISTRATION

L T P C
3 0 0 3

COURSE OBJECTIVES

1. To understand the nature, scope and essentials of Public Administration administrative theories and concepts to make sense of administrative practices.
2. To evaluate the changing paradigms of Public Administration.
3. To understand the synthesizing knowledge of public administration from public perspective.
4. To study and explore the approaches of administrative process.
5. To cover the principles, practices and the impact of public administration on society.

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning- Nature and Scope of Public Administration, Evolution of Public Administration, Public Administration and Private Administration, Public Administration –Arts, Science or both, Public Administration - relations to other social sciences, Importance of Public Administration.

UNIT II EMERGING TRENDS IN PUBLIC ADMINISTRATION 9

New Public Administration–Formulating the structure, New Public Management, Globalization and Public Administration, Paradigm Shift from Government to Governance.

UNIT III ADMINISTRATIVE ORGANIZATIONS 9

Forms of Administrative Organizations –Departments, Public Corporations, Public sector undertakings, Independent Regulatory Commissions, Line and Staff Agencies, Administrative Tribunal.

UNIT IV APPROACHES AND THEORIES OF PUBLIC ADMINISTRATION 9

Classical Approach, Administrative Approach, Scientific Management Approach, Bureaucratic Approach, Human Relations Approach, Ecological Approach.

UNIT V PRINCIPLES AND PRACTICES OF PUBLIC ADMINISTRATION 9

Chief Executive - Meaning, Types, Functions & Qualities of Chief Executive, Supervision, Communication - meaning, types of communication & its importance in

Public Administration, Centralization & Decentralization, Public Relation, Meaning, Methods & Significance, Decision making - Types, Techniques and Processes, Leadership - Styles –Approaches.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Students will understand public administration theory and concepts from multiple perspectives.
2. Students will appreciate the nature, scope and dynamics of Public Administration.
3. Students will acquaint with India's development experience and changing role of administration practices.
4. Students will grasp the administrative theories, concepts and principles to make sense of administration in the developing era.
5. Students will demonstrate the integrative knowledge, skills and ethics necessary for responsible Administrative, management and leadership positions.

REFERENCES

1. Lakshmi Kanth ,Public Administration by McGraw Hill,2018
2. Rosenbloom David, Public Administration: Understanding Management, Politics, and Law in the Public Sector, McGraw Hill, 2018.
3. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
4. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
5. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.

COURSE OBJECTIVES

1. To know about the basic structure of Indian Constitution, Fundamental Rights(FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
2. To know about the functioning of three wings of the government i.e., executive, legislative and judiciary.
3. To know the State Executive s Union territories.
4. To know about the Local Administration from Corporation to Village Level.
5. To learn the pattern of Election systems and concept of E-Governance.

UNIT I INTRODUCTION**9**

Meaning of the Constitution Law and Constitutionalism - Constituent Assembly. Government of India Act of 1935 and Indian Independence Act of 1947 – Enforcement of COI and its Salient Features – Why Tamilnadu's "Sengol" in Parliament (1947 & 2023)- Samvidhan Divas - The Preamble. The Constitutional amendments in India - National Emergency, President Rule, Financial Emergency - Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT II THE CENTRE: EXECUTIVE, LEGISLATIVE AND JUDICIARY**9**

Meaning of Indian Flag & Ashoka Chakra. Indian Parliament – RS - LS – Power & Functions. Honourable "The President" & "The Vice President", "The Prime Minister" - Power & Functions - Comparison of Indian President with the United States - Central Ministry of Council. The Independence of the Supreme Court - Appointment of Supreme & High Courts Judges (Collegium) - Judicial Review, Judicial Activism, and PIL -, The Lokpal & Lok Ayuktas 2013 – NRC & CAA (Illegal Migrants) - Abrogation of Article 370 in J & K – Need of Uniform Civil Code.

UNIT III THE STATE GOVERNMENT, UNION TERRITORIES STATE LEGISLATURE**9**

Madras Presidency to Tamil Nadu – Tamil Nadu Emblem. State Executives – His Excellency "The Governor" – Power & Functions, Chief Minister – Power & Functions, State Cabinet, Members of Legislative Assembly – Role. Union Territories – Power & Functions. Federal System, Centre-State Relations. High Court & Subordinate Courts- Lok Adalat 1982 Vs Arbitration Tribunal.

UNIT IV LOCAL ADMINISTRATION**9**

Corporation – Mayor, Chairman District Administration Head - Role and Importance, Role of Elected Representative – Pachayati Raj: Functions PRI – Grama Sabha. Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy.

UNIT V ELECTION SYSTEMS AND E-GOVERNANCE**9**

Election Commission: Role of Chief Election Commissioner - State Election Commission – One India One Election. National Good Governance Day - Governance and role of Engineers in E-Governance, Need for reformed engineering serving at the Centre and State, E- Courts, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

1. Students will identify and explore the basic features and modalities about Indian constitution.
2. Students will differentiate and relate the functioning of 3 wings of India.
3. Students will understand the state level executives and state courts
4. Students will identify the role of Mayor and elected representatives of Municipalities
5. Students will know the role of Election Commission apply knowledge and E-governance.

REFERENCES

1. BR. Ambedkar, Rupa Publications. The Constitution of India. Rupa Publications. 2024.
2. Singh, M. P. (Ed.). EBC's V. N. Shukla's Constitution of India (14th ed., reprint 2024). Eastern Book Company.
3. Bakshi, P. M The Constitution of India (19th ed.). Universal Law Publishing (LexisNexis) 2023.
4. Babu, D. D. Introduction to the Constitution of India (27th ed.). Lexis Nexis 2024.
5. Sharma, B. K. Introduction to the Constitution of India (11th ed.). PHI Learning 2024.

COURSE OBJECTIVES

1. To understand the fundamental principles, scope, and evolution of Public Personnel Administration.
2. To analyze different types of personnel systems and their relevance in democratic governance.
3. To examine the processes of recruitment, training and promotion within the public sector.
4. To gain insights into the structure and functioning of All India Services and State Public Service Commissions.
5. To evaluate employer-employee relations, wage systems and benefits in the context of public sector employment.

UNIT I INTRODUCTION TO PERSONNEL ADMINISTRATION**9**

Meaning, Scope and Importance of Personnel Administration - Evolution of Public Personnel Administration-Personnel Administration vs. Human Resource Management – Challenges in Personnel Administration – Types of Personnel Systems Bureaucratic, Democratic and Representative systems-Emerging Trends in Personnel Administration

UNIT II PERSONNEL SYSTEMS AND ADMINISTRATIVE ETHICS**9**

Generalist Vs Specialist – Comparative Analysis of Personnel Systems – Role of Civil Servants in Policy Implementation - Relationship between Civil Servants and Political Executives - Mechanisms for Promoting Administrative Accountability-Civil Servant's Relationship with Political Executive – Ethics and Integrity in Administration - Mechanisms for Promoting Administrative Accountability

UNIT III RECRUITMENT, TRAINING AND PROMOTION**9**

Recruitment: Direct Recruitment and Recruitment from Within – Methods of Manpower Planning- Training: Objectives and Need –Types of Training: Induction, In-service, Orientation, Refresher - Performance Appraisal and Merit-based Promotion – Promotion

UNIT IV PUBLIC SERVICE FRAMEWORK IN INDIA**9**

All India Services – Structure and Cadre Management – Rules and Regulations Governing Service Conditions – Code of Conduct and Disciplinary Actions –State Public Service Commissions: Functions and Autonomy - UPSC and Its Constitutional Mandate - Reservation Policy in Services - Gender Sensitization and Inclusivity in Services.

UNIT V EMPLOYEE RELATIONS AND COMPENSATIONS

9

Employer Employee Relations – Wage Theories and Compensation Models – Principles of Pay Fixation
-Salary Structures in Indian Civil Services –Salary Structures in Indian Civil Services –Social Security
Benefits and Retirement Schemes - Wage and Salary Administration – Allowances and Benefits

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will demonstrate a comprehensive understanding of the nature, scope, and importance of public personnel administration
2. Students will be able to distinguish between bureaucratic, democratic, and representative personnel systems in public administration.
3. Students will apply knowledge of recruitment, training and promotion practices to real-world administrative scenarios.
4. Students will critically analyze the structure and functioning of the All India Services and State Public Service Commissions.
5. Students will evaluate wage and salary administration, allowances and employee relations within the framework of public sector employment.

REFERENCES

1. Public Personnel Administration, 6th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2015.
2. Personnel Management in Government, 7th Ed, by R. Wayne Boss 2016.
3. Human Resource Management in Public Service, 5th Ed, by Richard C. Kearney, Jerrell D. Cogburn 2015.
4. Public Administration: An Introduction, 12th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2019.
5. Public Personnel Management, 4th Ed, by Donald E. Klingner, John Nalbandian 2018

COURSE OBJECTIVES

1. To introduce students to the evolution of administrative thought
2. To study the contributions of key administrative thinkers
3. To develop an understanding of leadership, governance, and management principles
4. To relate classical theories to contemporary administrative practices
5. To enhance analytical and critical thinking skills

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration. Public Administration - Introduction, Principles of Organization and Management, Public Policy and Governance, Administrative Structure in India, Ethics and Accountability in Public Administration, Technology and Public Administration, Contemporary Issues in Public Administration.

UNIT II THEORIES OF ORGANIZATION 9

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory. Introduction to Organizations, Neo-Classical Theories, Modern Theories, Contemporary Approaches, Organization Design and Structure, Leadership and Motivation in Organizations, Applications to Modern Industry and Technology.

UNIT III ORGANIZATIONAL BEHAVIOUR AND DESIGN 9

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design. Organizational Behaviour - Introduction, Individual Behaviour in Organizations, Group Behaviour and Team Dynamics, Leadership and Power, Conflict and Negotiation, Organizational Culture and Climate, Organizational Change and Development, Contemporary Issues in OB.

UNIT IV MOTIVATION AND LEADERSHIP 9

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making Motivation - Definition and Importance, Content Theories, Process Theories. Leadership - Meaning, Roles, and Importance of Leadership, Leadership

Theories. Decision Making - Nature and Types of Decisions, Decision-Making Process: Steps and Models. Contemporary Perspectives, Applications and Case Studies.

UNIT V ADMINISTRATIVE THINKERS

9

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard. Peter Drucker Introduction to Administrative Thought, Kautilya (Chanakya) - Arthashastra: Concepts of Governance and Statecraft. Woodrow Wilson - The Study of Administration as a discipline. Chester I. Barnard - The Functions of the Executive, Concept of Formal and Informal Organizations, Peter F. Drucker - Management by Objectives (MBO), Comparing Key Contributions: Classical vs Modern Perspectives. Administrative Principles in Startups, Tech Companies, and Government Projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand foundational ideas of administration
2. Students will be able to analyze different administrative and management theories
3. Students will apply classical principles to modern contexts
4. Students will be able to evaluate the role of leadership and ethics in administration
5. Students will develop problem-solving skills using administrative models

REFERENCES

1. R. K. Sapru – Administrative Theories & Management Thought, 3rd Edition, 2013
2. “Public Administration Theories & Principles” (Vidya R., Rajaram), Kindle 2024 Edition
3. Fernando Lunenburg & Allen Irby – included in Development of Administrative Theory, SAGE Publications 2022
4. Global Encyclopedia of Public Administration, Public Policy, and Governance. Springer Publications, 2nd Edition, 2020
5. Administrative Theories: Approaches, Concepts and Thinkers in Public Administration, Rakesh Hooja, Ramesh K Arora 2007

COURSE OBJECTIVES

1. To understand the historical evolution and constitutional framework of Indian administration.
2. To analyze the role and functioning of key constitutional authorities and administrative institutions.
3. To explore the structure, functions, and challenges of local governance and grassroots administration.
4. To examine the impact of coalition politics and the role of ethics in administrative integrity
5. To evaluate the mechanisms for corruption control, including Ombudsman, Lokpal & Lok Ayukta.

UNIT I INTRODUCTION TO INDIAN ADMINISTRATION**9**

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India, Separation of powers and checks & balances in governance

UNIT II LOCAL GOVERNMENT AND ADMINISTRATION**9**

Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government, Role of Smart Cities & Urban Local Bodies in governance

UNIT III CONSTITUTIONAL AMENDMENTS**9**

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992, Implementation challenges and success stories of decentralized governance, Case studies on local governance reforms

UNIT IV POLITICS AND ETHICS**9**

Coalition politics in India, Integrity and Vigilance in Indian Administration, Role of transparency and accountability in governance (RTI Act, Citizen Charters), Ethical dilemmas in civil services and administrative ethics.

UNIT V TECHNOLOGY IN ADMINISTRATION

9

Corruption–Ombudsman, Lokpal & Lok Ayuktha, Recent anti-corruption measures (Whistle blower Protection Act, Black Money laws), Digital governance and technology-driven transparency in administration

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will gain a comprehensive understanding of India's administrative system, governance structure, and reforms.
2. They will be able to critically assess the functioning of constitutional authorities and their influence on policymaking
3. Learners will develop the ability to analyze local governance models and propose solutions for administrative challenges.
4. They will demonstrate awareness of political dynamics, ethics, and accountability in governance.
5. Graduates will be equipped to evaluate anti-corruption measures and suggest improvements for transparent administration.

REFERENCES

1. S.R. Maheswari : Indian Administration - Orient Black Swan, Sixth edition, 2001
2. 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.

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.

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.

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.

1. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Analytics: Concepts, Techniques, and Applications with XL Miner, 3rd Edition, 2016, Wiley.
2. U Dinesh Kumar, Business Analytics: The Science of Data – Driven Decision Making, 2nd Edition, 2020, Wiley India Pvt. Ltd.
3. V. Ramesh and K.N. Prasad, Data Mining and Data Warehousing, 2nd Edition, 2020, Wiley India Pvt. Ltd.
4. V.P Jain, Data Mining Techniques for Marketing, Sales, and Customer Relationship Management, 1st Edition, 2016, BPB Publications.
5. Anil Maheshwari, Data Analytics Made Accessible, 2nd Edition, 2017, Amazon Digital Services LLC.

COURSE OBJECTIVES

1. To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
2. To know the different types of HR metrics and understand their respective impact and application.
3. To understand the impact and use of HR metrics and their connection with HR analytics.
4. To understand common work force issues and resolving the musing people analytics.
5. The learners will be conversant about HR metrics and ready to apply at work settings.

UNIT I INTRODUCTION TO HR ANALYTICS 9

HR analytics - People Analytics: Definition- context - stages of maturity - Human Capital in the Value Chain: impact on business. HR Analytics vs HR Metrics – HR metrics and KPIs.

UNIT II HR ANALYTICS I: RECRUITMENT 9

Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire- Recruitment to HR cost - Recruitment analysis.

UNIT III HR ANALYTICS II: TRAINING AND DEVELOPMENT 9

Training & Development Metrics: Percentage of employee trained- Internally and externally trained-Training hours and cost per employee - ROI -Optimising the ROI of HR Programs - Training and Development analysis.

UNIT IV HR ANALYTICS III: EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics: Talent Retention - Retention index - Voluntary and involuntary turnover- Turnover by department, grades, performance, and service tenure - Internal hired index - Engagement Survey Analysis. Career Progression Metrics : Promotion index - Rotation index - Career path index - Level wise succession readiness index.

UNIT V HR ANALYTICS IV: WORK FORCE DIVERSITY AND DEVELOPMENT 9

Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling- Churn over index - Workforce diversity index - Gender mix - Differently abled index- Revenue per employee – Operating cost per employee - PBT per employee - HR cost per employee- HR budget variance - Compensation to HR cost.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be conversant about HR metrics and ready to apply at work settings.
2. Students will be able to resolve HR issues using people analytics.
3. Students will gain knowledge about analytics of training and development.
4. Students will know about the analytics of employee engagement and career progression
5. Students are competent in the analytics of work force diversity and development.

REFERENCES

1. Ferrar, J., & Green, D. Excellence in People Analytics: How to Use Data to Create Value and Drive Business Success (2nd ed.). Kogan Page. 2021.
2. Soundararajan, R., & Singh, K. Winning on HR Analytics: Leveraging Data for Competitive Advantage. SAGE Publications Pvt. Ltd. 2022.
3. Edwards, M. R., Minbaeva, D., Levenson, A., & Huselid, M. A. (Eds.). Workforce Analytics: A Global Perspective. Routledge. 2023.
4. Jang, D., Edwards, M., & Edwards, K. Using R in HR Analytics. Kogan Page 2023.
5. Lochab, A., Duhan, P., & Dangi, H.K. HR Analytics: Concepts and Applications. S. Chand Publishing. 2025.

COURSE OBJECTIVES

1. To showcase today's opportunities to leverage the power of marketing on the web and social media through web analytics.
2. Understand the role of social media web analytics within the digital marketing landscape.
3. Identify, define, and interpret commonly used web metrics and KPIs.
4. Understand analytical methods to transform social media data into marketing insights.
5. Understand the process of search engine optimization and the search behaviors of customers.

UNIT I MARKETING ANALYTICS**9**

Introduction to Marketing Analytics - Marketing Budget and Marketing Performance Measure, Marketing Metrics and Its Applications - Financial Implications of Various Marketing Strategies- Geographical Mapping, Data Exploration, Market Basket Analysis.

UNIT II COMMUNITY BUILDING AND MANAGEMENT**9**

The History and Evolution of Social Media, Understanding the Science of Social Media, Goals for Using Social Media, Social Media Audience and Influencers, Keys to Community Building, Promoting Social Media Pages, Linking Social Media Accounts, The Viral Impact of Social Media, and Social Media as a Business.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS**9**

Social Media Policies-Etiquette, Privacy- Ethical Problems Posed by Emerging Social Media Technologies - The Basics of Tracking Social Media. - Social Media Analytics- Insights Gained from Social Media- Customized Campaign Performance Reports - Observations of Social Media Use.

UNIT IV WEB ANALYTICS**9**

Web Analytics—Present and Future—Data Collection—Importance and Options, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of A Successful Web Analytics Strategy, Web Analytics Fundamentals, Concepts, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS**9**

Search Engine Optimization (SEO), User Engagement, User-Generated Content, Web Traffic Analysis, Navigation, Usability, Eye Tracking, Online Security and Ethics, Content Management System, Data Visualization. RSS Feeds, Mobile Platforms, Understanding Search Behaviors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. The students will understand Marketing in Social Media, Web, and Social Media Analytics and their Potential Impact.
2. The students will be able to enhance their social media marketing skills.
3. The students can develop a mass communication strategy and guide marketing campaigns.
4. The students will understand the fundamentals and concepts of web analytics.
5. The students will learn to use the resulting insights effectively to support website design decisions, campaign optimisation, search analytics, etc.

REFERENCES

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013.
2. Christian Fuchs, Social Media: A Critical Introduction, Sage Publications Ltd, 2014.
3. Bittu Kumar, Social Networking, V & S Publishers, 2013.
4. Avinash Kaushik, Web Analytics - An Hour A Day, Wiley Publishing, 2007.
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media And Cafepress 2004.

COURSE OBJECTIVES

1. To introduce students to the foundational concepts of analytics and their strategic role in transforming supply chains using descriptive, predictive, and prescriptive methods.
2. To equip learners with quantitative tools for warehousing decisions, including mathematical programming and heuristic methods for facility layout and space optimization.
3. To develop an in-depth understanding of inventory management techniques, emphasizing risk analysis, aggregation models, and multi-echelon planning.
4. To provide analytical skills to model and solve complex transportation and distribution network problems using graph theory, flow models, and routing algorithms.
5. To enable application of Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, and TOPSIS in supply chain decision scenarios.

UNIT I INTRODUCTION**9**

Introduction to analytics – descriptive, predictive, and prescriptive analytics, Data-driven supply chains, Road map for data-driven supply chains. Transforming supply chains, Barriers to implementation of supply chain strategies.

UNIT II WAREHOUSING DECISIONS**9**

Mathematical programming models - P-median methods - Guided LP approach - Balmer–Wolfe method, Greedy drop heuristics, Dynamic location models, Space determination and layout methods.

UNIT III INVENTORY MANAGEMENT**9**

Inventory aggregation models - Dynamic lot sizing methods, Multi-echelon inventory models, Aggregate inventory system and limit, Risk analysis in the supply chain - Measuring transit risks, Supply risks, Delivering risks, and risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS**9**

The notion of graphs, Minimal spanning trees, Shortest path algorithms, Maximal flow problems, Multistage transshipments, and transportation problems, Set covering and set partitioning problems, Traveling salesman algorithms, and deficit function approach, Scheduling Algorithms.

UNIT V – MCDM MODELS**9**

Multi-Criteria Decision-Making (MCDM) Techniques, Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the Analytical Network Process (ANP), TOPSIS-Application in SCM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand and explain the concepts of descriptive, predictive, and prescriptive analytics and their role in enhancing data-driven supply chain decision-making.
2. Students will apply mathematical programming and heuristic methods such as P-median, Guided LP, and Greedy Drop techniques to make effective warehousing and location decisions.
3. Students will analyze and manage inventory using aggregation models, multi-echelon systems, and risk pooling strategies to improve supply chain resilience and efficiency.
4. Students will solve transportation network problems using graph-based algorithms like shortest path, maximal flow, and traveling salesman models to optimize logistics performance.
5. Students will evaluate complex supply chain scenarios using Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, TOPSIS, and fuzzy logic for better strategic decision-Making.

REFERENCES

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.
3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
4. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management , I.K. International Publishing House Pvt. Ltd., 2016.
5. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

COURSE OBJECTIVES

1. To introduce fundamental financial concepts and decision-making techniques relevant to corporate finance.
2. To familiarize students with the basics of financial markets and time-series analysis techniques for estimating risk and return.
3. To provide insights into portfolio theory and option pricing models used for investment analysis.
4. To expose students to basic technical indicators and simulation strategies for analyzing stock market behavior.
5. To enable students to understand and apply basic credit risk models using statistical and machine learning techniques.

UNIT I FOUNDATIONS OF CORPORATE FINANCIAL ANALYSIS**9**

Introduction to financial analytics. Basic financial models – Time value of money, cash flow analysis, cost of capital. Project appraisal methods – Payback period, NPV, IRR. Capital budgeting and financial break-even analysis.

UNIT II FINANCIAL MARKET DATA AND TIME-SERIES ANALYSIS**9**

Introduction to financial market instruments – Stocks and Bonds. Basics of risk and return. Overview of financial data and Time-Series characteristics. Introduction to Value at Risk (VaR). Basics of Auto Regressive Moving Average (ARMA), Autoregressive Conditional Heteroscedasticity (ARCH), and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models for volatility forecasting.

UNIT III PORTFOLIO THEORY AND DERIVATIVES**9**

Portfolio diversification and risk-return trade-off. Capital Asset Pricing Model (CAPM). Sharpe ratio. Option pricing basics – Binomial model, Black-Scholes model. Implied volatility and option strategies.

UNIT IV TECHNICAL ANALYSIS AND TRADING SIMULATIONS**9**

Overview of technical indicators – Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), Rate of Change (ROC), Moving Averages, Candlestick patterns. Simulation of basic trading strategies. Introduction to algorithmic trading concepts. Prediction of stock prices using chart patterns.

UNIT V CREDIT RISK ANALYTICS

9

Introduction to credit risk. Data pre-processing for credit modelling. Logistic regression, decision trees, and model evaluation techniques. Application of analytics in credit scoring and loan approvals, and evaluating credit risk model.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will apply core financial concepts to evaluate corporate investment decisions using tools like NPV and IRR.
2. Students will analyze risk and return using financial time-series models and interpret key market indicators.
3. Students can able to construct and assess investment portfolios and derivative strategies using theoretical models.
4. Students will use basic technical analysis indicators and simulate simple trading strategies.
5. Students can develop and evaluate credit risk models using statistical methods like logistic regression and decision trees.

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1. Mark J. Bennett, Dirk L. Hugen, "Financial Analytics with R: Building a Laptop Laboratory for Data Science", Cambridge University Press, 1st Edition, 2016.
2. Pavel Ryzhov, "Haskell Financial Data Modeling and Predictive Analytics", Packt Publishing, 1st Edition, 2013.
3. Edward E. Williams, John A. Dobelman, "Quantitative Financial Analytics: The Path to Investment Profits", World Scientific Publishing, 1st Edition, 2017.
4. Yuxing Yan, "Python for Finance – Second Edition: Apply Powerful Finance Models and Quantitative Analysis with Python", Packt Publishing, 2nd Edition, 2017.
5. James Ma Weiming, "Mastering Python for Finance – Second Edition: Implement Advanced State-of-the-Art Financial Statistical Applications Using Python", Packt Publishing, 2nd Edition, 2019.

VERTICAL - V

AGM501	SUSTAINABLE INFRASTRUCTURE	L	T	P	C
	DEVELOPMENT	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).

9

UNIT- IV SUSTAINABLE CONSTRUCTION MATERIALS

9

UNIT- V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS

9

ase Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. — Use of Emerging Technologies — IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for

maintenance .

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the environment sustainability goals at global and Indian scenario.
2. Understand risks in development of projects and suggest mitigation measures.
3. Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
4. Explain Life Cycle Analysis and life cycle cost of construction materials.
5. Explain the new technologies for maintenance of infrastructure projects.

TEXTBOOKS:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine

REFERENCE BOOKS:

1. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press.
2. Munier N, "Introduction to Sustainability", Springer 2005.
3. Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.
4. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009
5. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010

AGM501	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	1	1	-	2	3	1	1	-	2	1	1	2	1	-
CO2	3	1	3	2	1	2	2	-	1	1	1	2	2	2	2	-
CO3	2	2	3	1	1	1	1	-	-	-	1	1	1	3	1	-
CO4	3	1	3	2	2	1	3	1	1	1	1	2	2	2	2	-
CO5	3	1	2	2	2	2	3	1	-	1	1	2	2	3	2	-
Average	3	1	3	2	2	2	3	1	1	1	1	2	2	3	2	-

AGM502	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems,
- To introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.
- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT- I AGROECOLOGY , AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS 9

ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems.

UNIT- II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT 9

soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control.

UNIT- III WATER MANAGEMENT 9

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

pes 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

licators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability
- Alternative agriculture approaches/ farming techniques for sustainable food production -
Goals and components of a community food system - Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able

1. Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
2. Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
3. Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
4. Develop energy and waste management plans for promoting sustainable agriculture in non- sustainable farming areas
5. Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

TEXTBOOKS:

1. Approaches to Sustainable Agriculture — Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
3. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
4. Saroja Raman, “Agricultural Sustainability – Principles, Processes and Prospects”, CRC Press, 2013.
5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

REFERENCE BOOKS:

1. Agricultural Economics and Agribusiness, Cramer, Jensen, and Southgate, John Wiley.
2. Agricultural Economics, Drummond and Goodwin, Prentice Hall.

3. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.
4. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020
5. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.

AGM502	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	2	-	-	-	-	-	2	-	2	-	-	2	2	-	-
CO2	-	2	-	2	2	2	-	-	-	-	-	-	3	2	-	-
CO3	-	-	-	2		2	-	-	-	-	-	-	3	2	3	-
CO4	3	2	-	-	2	-	-	2	2	2	2	-	3	2	3	-
CO5	-	2	3	2	-	-	1	-	-	-	-	1	-	2	-	-
Average	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3	-

AGM503	SUSTAINABLE BIO MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT- I INTRODUCTION TO BIOMATERIALS 9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolytic 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 – Polyurethane- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT- III BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al₂O₃) -Zirconia (ZrO₂)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT- IV METALS AS BIOMATERIALS 9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of

metallic implants — biological tolerance of implant metals

UNIT- V NANOBIMATERIALS

9

Steel construction, Types of steel used for construction, Methods of utilizing steel construction, Advantages and Applications of steel in construction.

Advanced Materials: Adhesives in construction industry-Acrylics, Bridge bearings, Industrial waste materials in concrete Rapid wall panels, Moisture Barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will gain familiarity with Biomaterials and they will understand their importance.
2. Students will get an overview of different biopolymers and their properties
3. Students gain knowledge on some of the important Bioceramics and Biocomposite materials
4. Students gain knowledge on metals as biomaterials
5. Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

TEXTBOOKS:

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.
2. Donglu shi “Introduction to Biomaterials” Tsinghua University press, 2006.
3. Joon Park, R.S.Lakes “Biomaterials An Introduction” third edition, Springer 2007.
4. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh “Characterization of Biomaterials” Wood head publishing, 2013.
5. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.

REFERENCE BOOKS:

1. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018
2. Leopoldo Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.

3. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.
4. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.
5. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

AGM503	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	1	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	2	1	-	-	-	-	-	-	-	-	-	-
Average	2.2	1.8	1.8		1.7	1	-	-	-	-	-	-	-	-	-	-

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 perylene-tetracarboxylic bis - 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

roduction 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

eaner 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

een Buildings Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and

insulation, ventilation, passive solar features. Ecofriendly and cost effective materials, Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand the principles of green engineering and technology
2. To learn about pollution using hazardous chemicals and solvents
3. To modify processes and products to make them green and safe.
4. To design processes and products using green technology.
5. To understand advanced technology in green synthesis.

TEXTBOOKS:

1. Soli J. Arceivala, "GREEN TECHNOLOGIES", McGraw Hill Education, 2017.
2. Khan B.H, Non conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
3. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.
4. Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi 2009.
5. Paul L. Bishop, Pollution prevention–Fundamentals and Practices, McGraw-Hill-international 2000.

REFERENCE BOOKS:

1. Ritu Dogra, "Renewable Energy and Green Technology", Brillion Publishing, 2023.
2. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications, 2008
3. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017
4. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
5. Sambit Kumar Mishra, Zdzislaw Polkowski, Samarjeet Borah, Ritesh Dash, "AI in Manufacturing and Green Technology: Methods and Applications" CRC Press, 2021.

AGM505	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
CO5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.0	2.0	2.0	3.0	0	0	3.0	0	2.0	1.0	1.0	2.0	1.0

GM506	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.
- To know the analytical and instrumental methods to measure various IEQ parameters
- To familiarize the regulations, standards and guidelines of IEQ
- To learn the fundamentals of computational fluid dynamics (CFD)

UNIT- I ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction to indoor environmental quality – Parameters: Thermal Comfort - thermal balance of human body – instrumentation and measurement - impact of thermal comfort on human productivity and health.

UNIT- II MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT- III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT- IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT 9

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification- exposure assessment- dose-response assessment; risk characterization.

UNIT- V AUTOMATED DATA ACQUISITION AND PROCESSING 9

Fundamentals of mass transport – definition of intraphase and inter-phase chemical flux; interphase mass transport, diffusion coefficient and convection mass transfer coefficients. Chemical Exchange between air-water Overall transport model and scenarios.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- After completion of this course, the students will know
 1. Basic concepts of environmental standards and monitoring.
 2. The ambient air quality and water quality standards;
 3. The various instrumental methods and their principles for environmental monitoring.
 4. The significance of environmental standards in monitoring quality and sustainability of the environment.
 5. The various ways of raising environmental awareness among the people.

TEXTBOOKS:

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc.
3. Pengler, J.D.; McCarthy, J.F.; Same, J.M., Indoor Air Quality Handbook. McGraw Hill, 2000.
4. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
5. Daoliang Li, Shuangyin Liu, “Water Quality Monitoring and Management” Elsevier, 2018.

REFERENCE BOOKS:

1. Nazaroff, W.W., and Alvarez-Cohen, L., Environmental Engineering Science. Wiley sons, Newyork, 2001.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.

3. Maroni, M.; Seifert, B.; Lindvall, T., Indoor Air Quality: A Comprehensive Reference Book. Elsevier Science Ltd, 1996.
4. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.
5. Nicolas Mazzeo, “Air Quality Monitoring, Assessment and Management”, IntechOpen.

CE	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
CO2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
CO4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	2.0	2.0	2.0	0.0	2.0	3.0	2.0	0.0	3.0	0.0	2.0	1.0	1.0	0.0	1.0