



ST. JOSEPH'S
COLLEGE OF ENGINEERING
AND TECHNOLOGY,
- PALAI -
AUTONOMOUS

Choondacherry P.O., Pala, Kottayam - 686579
Kerala, India



SYLLABUS

B. Tech.

MECHANICAL ENGINEERING

2024 SCHEME

Semester V & VI

Semester V

FIFTH SEMESTER														
(July-December)														
Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs./
						L	T	P	R		CIE	ESE		
1	A	24SJPCMET501	PC	PC	Dynamics of Machinery	3	1	0	0	5	40	60	4	4
2	B	24SJPCMET502	PC	PC	Advanced Manufacturing Engineering	3	1	0	0	5	40	60	4	4
3	C	24SJPCMET503	PC	PC	Heat and Mass Transfer	3	0	0	0	4.5	40	60	3	3
4	D	24SJPBMET504	PC-PBL	PB	Management for Engineers	3	0	0	1	5.5	60	40	4	4
5	E	24SJPEMET52N	PE	PE	<i>Program Elective - 2</i>	3	0	0	0	4.5	40	60	3	3
6	I*	24SJICHUM506	HMC	IC	Constitution of India (MOOC)	-	-	-	-	2	-	-	1	-
7	L	24SJPCMEL507	PCL	PC	Thermal Engineering Lab - 1	0	0	3	0	1.5	50	50	2	3
8	Q	24SJPCMEL508	PCL	PC	Mechanical Engineering Lab	0	0	3	0	1.5	50	50	2	3
9	R/M/H		VAC		Remedial / Minor / Honours Course	3	1	0	0	5			4*	4*
	S5/S6	Industrial Visit (Maximum 6 Days are permitted, Not Exceeding more than 4 Working Days) / Industrial Training												
Total										30/35			23/27*	24/28*

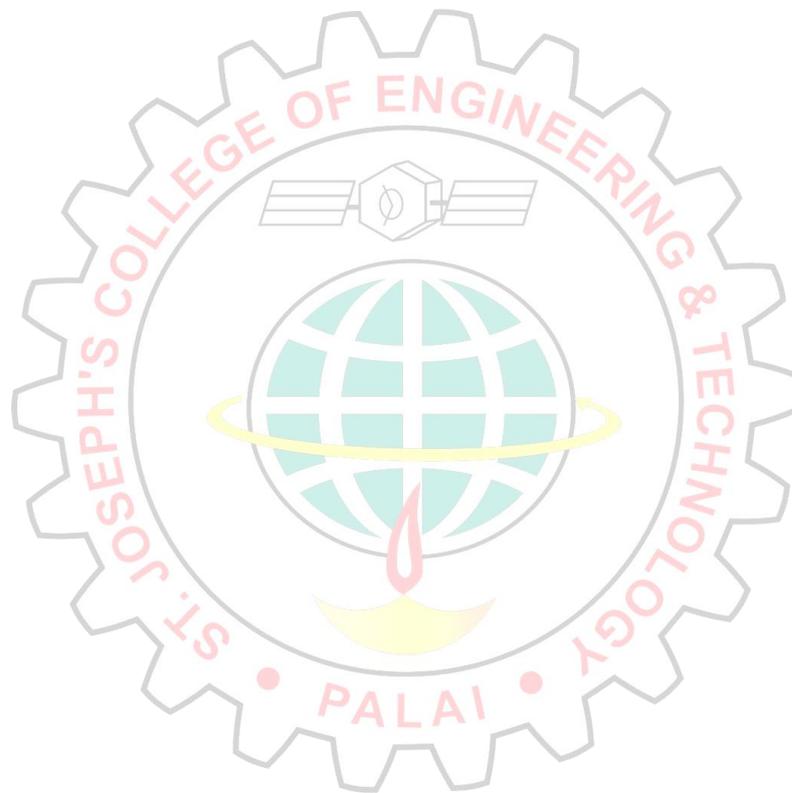
*No Grade Points will be awarded for the MOOC course and I slot course.

Industrial Training:

Students who are not participating in the industrial visit must attend industrial training during that period

PROGRAM ELECTIVE 2: 24SJPEMET52N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
E	24SJPEMET521	Computational Fluid Dynamics	3-0-0-0	3	3
	24SJPEMET522	Design for Manufacture and Assembly	3-0-0-0		3
	24SJPEMET523	Computer Aided Design and Analysis	3-0-0-0		3
	24SJPEMET524	Additive Manufacturing	3-0-0-0		3
	24SJPEMET526	Energy Economics and Policy	3-0-0-0		3
	24SJPEMET527	Human Resources Management	3-0-0-0		3
	24SJPEMET528	Operations Research	3-0-0-0		3
	24SJPEMET525	Instrumentation and Control Systems	3-0-0-0		5 or 3



DYNAMICS OF MACHINERY

Course Code	24SJPCMET501	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Mechanics of Machinery (24SJPBMET404)	Course Type	PC

Course Objectives:

- To understand the rigid- body dynamics of kinematically driven machine components and perform the force analysis
- To understand the gyroscopic effect on stability of road vehicles, aero planes, ships; devise methods to control the fluctuation of power and speed of IC engines, perform balancing of masses to reduce vibrations in machines
- To understand the theory of vibrations and perform analysis of single degree of freedom (SDOF) systems.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Perform the force analysis of four bar kinematic systems.	K3
CO2	Perform balancing of rotating and reciprocating masses in machines; understand the function and determine the gyroscopic effect on stability of automobiles, ships and aeroplanes.	K3
CO3	Understand the principle of governors/ flywheel for the control of speed/energy fluctuation in engines or machines, and perform its analysis and design.	K3
CO4	To determine the natural frequencies, perform the analysis of free or harmonically excited vibration response of damped and undamped vibratory SDOF systems	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	3	-	-	-	-	2	-	-	2	3	2
CO2	3	2	3	-	-	-	-	2	-	-	2	3	2
CO3	3	2	3	-	-	2	-	2	-	-	2	3	2
CO4	3	2	3	-	3	2	-	2	-	-	2	3	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Static Force analysis: Static equilibrium conditions, Two & three force members, four bar and slider crank mechanisms (graphical or analytical), method of virtual work. Dynamic force analysis: Force & moment equilibrium, Inertial forces, D' Alembert's principle. Dynamic analysis of four-bar and slider-crank mechanisms.	11	1
2	Gyroscope - effect of gyroscopic couple on - bearings, the stability of two-wheel, four-wheel vehicles, ships and aircrafts. Balancing of rotating masses- single mass, several masses in same and in different planes; Balancing of reciprocating masses, partial balancing of single cylinder and multi-cylinder inline engines.	11	2
3	Flywheels- turning moment diagrams-for four stroke IC engines; Coefficient of fluctuation of energy, speed; energy stored in a flywheel, design of flywheels, applications. Governor Mechanisms- types of governors, gravity controlled -Watt, Porter and Proell governors, Spring controlled- Hartnell governor; Isochronism, sensitivity, stability and hunting.	11	3
4	Vibration Analysis: Undamped free vibrations of SDOF systems - natural frequency of longitudinal, transverse and torsional vibrations by Newton's method and energy method; Damped systems and critical damping, logarithmic decrement. Forced harmonic vibration, response of reciprocating and rotating unbalance, magnification factor, resonance; whirling of rotating shafts, vibration isolation and transmissibility, accelerometer. (theory only)	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Theory of Machines	S. S. Rattan	Tata McGraw-Hill Education	4 th Edition, 2017
2	Theory of Machines and Mechanisms	Ballaney P. L.	Khanna Publishers	21 st Edition, 2017
3	Theory of Machines	Thomas Bevan	Pearson Education Ltd.	3 rd Edition, 2010
4	Textbook of Mechanical Vibrations	Dukkipati R.V, J Srinivas	Prentice Hall India	2 nd Edition 2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Theory of Mechanisms and Machines	Amithabha Ghosh, Asok Kumar Malik	East West Press	3 rd Edition, 2011
2	Kinematics and dynamics of machinery	Robert L Norton	McGraw-Hill Education	1 st Edition in SI units 2009
3	Kinematics and Dynamics of Machinery	Charles E. Wilson, J. Peter Sadler	Pearson Education Ltd.	3 rd Edition, 2008
4	Theory of Machines and Mechanisms	John J. Uicker, Gordon R. Pennock, Joseph E. Shigley	Oxford University Press	5 th Edition, 2017
5	Theory of vibration with applications	W. T Thomson	CBS Publishers	1 st Indian Edition, 1990
6	Mechanical vibrations and Industrial noise control	Lasithan L G	PHI Learning	1 st Edition, 2014

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Static & Dynamic Force analysis	https://nptel.ac.in/courses/112104114/
2	Gyroscope & Balancing of mass	https://nptel.ac.in/courses/112104114/
3	Fly wheel & Governor mechanism	https://nptel.ac.in/courses/112104114/
4	Vibration Analysis	https://nptel.ac.in/courses/112104114/
4	Fundamentals of Vibration	https://www.youtube.com/watch?v=9t9qZMhnRFE https://www.youtube.com/watch?v=R7pF2WC4hXQ

ADVANCED MANUFACTURING ENGINEERING

Course Code	24SJPCMET502	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Manufacturing Processes (24SJPBMET304), Machine Tools and Metrology (24SJPCMET402)	Course Type	PC

Course Objectives:

- Learn how to program CNC machines and control automated equipment with PLC.
- To introduce machining principles and processes in the manufacturing of precision components and products that use non-conventional technologies.
- To offer a basic understanding of machining capabilities, limitations, and productivity of advanced manufacturing techniques.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop CNC programming, select appropriate tooling and parameters.	K3
CO2	Categorize the various non-traditional material removal processes based on energy sources and mechanisms employed.	K2
CO3	Analyze the processes and evaluate the role of each process parameter during the micromachining of various advanced material removal processes.	K3
CO4	Explain the processes used in additive manufacturing for a range of materials and applications.	K2

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	2	2	-
CO3	3	-	-	-	2	-	-	-	-	-	2	-	2
CO4	3	-	-	-	2	-	-	-	-	-	2	-	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	CNC: systems – Principle of operation, components of CNC system, coordinate systems, classification of CNC systems, point-to-point and contouring systems, incremental and absolute programming methods, open loop and closed loop systems, feedback devices. Programmable Logic Controllers (PLC) – input and output devices, ladder logic programming, simple problems only. Interpolators: linear, circular and complete interpolator. Manual part programming - Computer aided part programming - APT. Programming exercises in turning, drilling and milling operations. <i>(At least one programming exercise must be included in the end-semester examination).</i>	11	1
2	Advanced Machining Processes: ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM), Electrochemical machining (ECM), Electro discharge machining (EDM), Electron beam machining (EBM), Laser beam machining (LBM), Plasma arc machining (PAM), Ion beam machining (IBM).	11	2
3	Advanced Metal Forming Processes: High velocity forming of metals - Sheet metal forming - explosive forming - Electro hydraulic forming - Electro Magnetic Forming. Stress waves and deformation in solids – types of elastic body waves- relation at free boundaries- relative particle velocity. Microfabrication process: CVD, PVD, LIGA process. Micromachining: Diamond turn mechanism.	11	3
4	Advanced finishing processes: - Abrasive Flow Machining, Magnetic Abrasive Finishing. - Magnetorheological Finishing, Magnetorheological Abrasive Flow Finishing, Magnetic Float Polishing, Elastic Emission Machining. Material addition processes: - stereo-lithography, selective laser sintering, fused deposition modeling, laminated object manufacturing, laser-engineered net-shaping.	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination- 1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any

one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub-divisions. <p>(4x9 = 36 marks)</p>	60

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer control of manufacturing systems	Yoram Koren	TMH	2017
2	Advanced Machining Processes	Jain V.K.	Narosa publishers	2014
3	Introduction to Micromachining	Jain V.K.	Narosa publishers	2014
4	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Ian Gibson, David Rosen, Brent Stucker	Springer Nature	2nd ed. 2015
5	Advanced Manufacturing Processes	Vasdev Malhotra	Taylor and Francis	2024

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer-Aided Design and Manufacturing	M.P. Groover, E.M. Zimmers, Jr.	Prentice Hall of India	1987
2	Programmable logic controllers	Petruzella Frank.D.	McGraw Hill	2016
3	Developments in high-speed metal forming	Davies K and Austin E. R	The Machinery Publishing Co	1970

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	CNC Programming	https://nptel.ac.in/courses/112105211
2	Advanced Machining Process	https://nptel.ac.in/courses/112104028
3	Additive Manufacturing	https://nptel.ac.in/courses/102108078

HEAT AND MASS TRANSFER

Course Code	24SJPCMET503	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	24SJPCMET403 Engineering Thermodynamics	Course Type	PC

Course Objectives:

- Apply heat transfer principles to solve engineering problems
- Understand principles of various heat transfer equipment.
- Apply mass transfer principles to solve engineering problems.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To apply the principles of heat conduction in engineering problems	K3
CO2	To apply mechanisms of natural and forced heat convection and understand the factors influencing the design of heat transfer equipment.	K3
CO3	To understand the principles of thermal radiation and apply the principles for radiation shielding	K3
CO4	To understand the principles modern cooling techniques and solve mass transfer problems using correlations.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	2	-	-	-	-	-	-	-	2	3	-
CO2	3	3	3	-	-	-	-	-	-	-	2	3	-
CO3	3	3	2	-	-	-	-	-	-	-	2	3	-
CO4	3	3	2	-	-	-	-	-	-	-	2	3	3

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Modes of heat transfer – Mechanisms and laws of heat transfer – thermal conductivity, convective heat transfer coefficient, overall heat transfer coefficient.</p> <p>General heat conduction equation in three dimensions through plane wall (derivation needed), cylindrical and spherical walls (only equation) –initial and boundary conditions - One Dimensional Steady state heat conduction - Thermal Conductivity – concept of thermal resistance – critical radius – conduction with heat generation.</p> <p>Transient heat conduction – Lumped system analysis – transient heat conduction analysis of bodies with non-negligible internal temperature gradient</p> <p>Heat transfer through extended surfaces – classification of fins – heat transfer rate from a fin (rectangular fin, pin fin) – boundary conditions – fin effectiveness and fin efficiency.</p> <p>Introduction to finite difference method for steady state heat conduction analysis. (concept only)</p>	8	1
2	<p>Convection heat transfer</p> <p>Forced convection – concept of thermal and hydrodynamic boundary layers (internal and external flows) –thermal diffusivity – momentum diffusivity – fluid friction and heat transfer relationship – developing and developed flows (hydrodynamic and thermal). Non-dimensional numbers in heat transfer.</p> <p>External heat convection from flat plate/cylinder/ sphere during laminar and turbulent flow. Internal heat transfer in a circular pipe during laminar and turbulent flow. Analogy between heat and momentum transfer.</p> <p>Natural convection – natural convection heat transfer from vertical plate, horizontal and vertical cylinder.</p> <p>Heat exchanger – classification – design considerations and parameters – compact heat exchangers – effect of fouling- heat exchanger analysis – LMTD and NTU methods.</p>	10	2
3	<p>Radiation heat transfer</p> <p>Basic laws of radiation heat transfer – Black, gray, diffuse and real surfaces - emission characteristics and laws of black body radiation - solid angle and radiation intensity – radiation heat exchange between two infinite and finite back surfaces – shape factors- radiation heat exchange between two infinite parallel diffuse gray surfaces. Electrical network analogy for radiation heat exchange. Radiation shields.</p>	10	3
4	<p>Mass Transfer</p> <p>Introduction to mass transfer – diffusion coefficient – Fick’s law of diffusion- steady state diffusion in stationary medium- diffusion in moving medium- diffusion through a membrane.</p> <p>Convective mass transfer – non-dimensional numbers – analogy between heat and mass transfer – correlations.</p> <p>Cooling of electronic equipment – need – various methods – influencing factors. Introduction to heat pipes. Electric battery cooling – various methods - phase change material, fin cooling, air cooling, liquid cooling. (description only)</p>	8	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

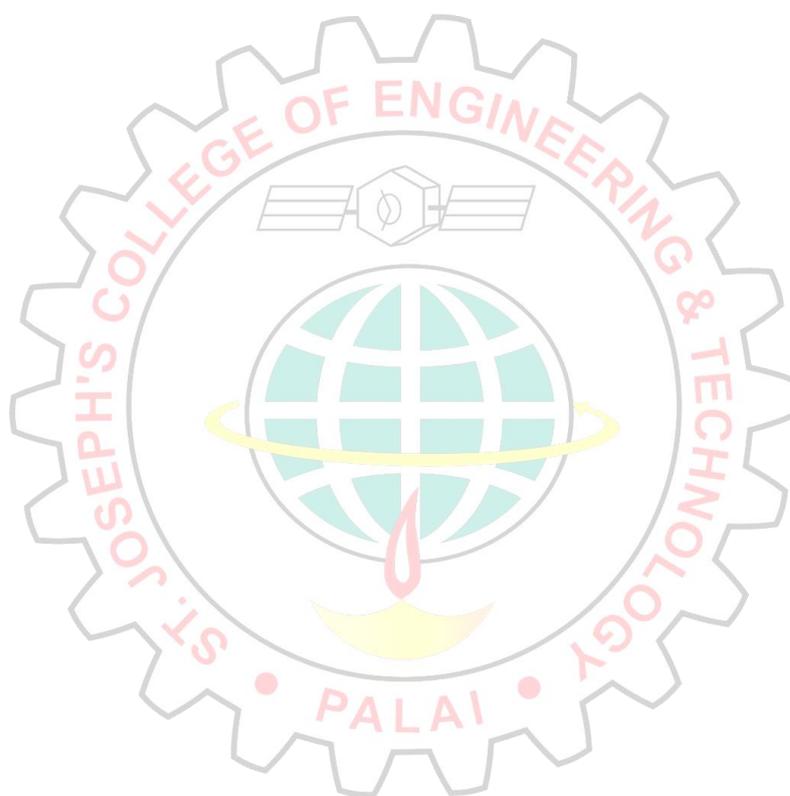
Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Engineering Heat and Mass Transfer	R. C. Sachdeva	New Age International Publishers	6 th edition, 2022
2	A Textbook of Heat and Mass Transfer	R. K. Rajput	S. Chand	7 th edition, 2018
3	Engineering Heat and Mass Transfer	Mahesh M. Rathore	Laxmi Publications	4 th Edition, 2023
4	Heat and Mass Transfer – Fundamentals and Applications	Yunus A. Cengel and Afshin J. Ghajar	McGraw Hill	6 th edition, 2020

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles of Heat and Mass Transfer	Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine	Wiley Publishers	8 th edition, 2017
2	A text book on Heat Transfer	S.P. Sukhatme	Universities Press	4 th edition, 2005
3	Heat Transfer Engineering: Fundamentals and Techniques	C. Balaji, Balaji Srinivasan, Sateesh Gedupudi	Academic Press	1 st edition, 2020
4	Heat Transfer	J. P. Holman, Souvik Bhattacharyya	McGraw Hill Education	10 th edition, 2017

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Introduction to heat and mass transfer	https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PLFAE2526F899ACC78
2	Conduction	https://www.youtube.com/watch?v=xAcZ9-zNYIY&list=PLFAE2526F899ACC78&index=4
3	Convection	https://www.youtube.com/watch?v=IGmWHUsBQ4U&list=PLFAE2526F899ACC78&index=18
4	Radiation	https://www.youtube.com/watch?v=CDncSyDvpdQ&list=PLFAE2526F899ACC78&index=10
4	Mass Transfer	https://www.youtube.com/watch?v=qFJg7bwr2PA&list=PLFAE2526F899ACC78&index=33



MANAGEMENT FOR ENGINEERS

Course Code	24SJPBMET504	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PC-PBL

Course Objectives:

- To develop ability to critically evaluate a variety of management practices in the contemporary context
- To understand and apply a variety of management and organisational theories in practice
- To create sustainable organisations.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop ability to critically analyse a variety of management practices in the contemporary context	K4
CO2	Examine the broad functions of management and Demonstrate ability in decision making and productivity analysis	K3
CO3	Apply project management techniques to manage projects and understand the functional areas of management	K3
CO4	Introduce the concept of market, marketing and marketing strategies	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	3	2	2	1	1	1	1	1	2	3	2	1
CO2	1	3	2	1	2	-	-	-	-	3	1	3	1
CO3	1	2	3	1	3	1	1	2	2	3	2	3	1
CO4	-	-	1	-	-	1	-	1	1	1	1	1	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to Management: Art and science perspectives – External environment – Classical, neo – classical and modern management theories – Levels of managers and skill required – Systems approach Planning – Types of plans – Mission, Goal, Strategy, Programme, Procedure Organizing - Organization levels and span of control – Delegation – Organization structures – line and staff concepts	11	1
2	Leading and Controlling: Leading Vs Managing - Dimensions of Leadership - Leadership Behaviour and styles - Transactional and Transformational Leadership -Basic control process Decision Making: Steps, Decision under certainty, risk and uncertainty: Decision trees, EMV method, EOL method, MaxiMin criterion, MiniMax criterion, MiniMax regret criterion.	11	2
3	Project Management: Network construction, AON, AOA diagrams – Redundancy – CPM and PERT networks – Scheduling computations – PERT time estimates – Probability of completion of project – crashing Human resource management: Manpower planning, recruitment, selection, placement, training, development, performance management - Motivation - mechanism and theories	11	3
4	Operations management – Introduction - Concept of Productivity and its measurement – Forecasting – moving average – weighted moving average Marketing management – Marketing mix – Market segmentation, Market targeting and product positioning – Product life cycle, Marketing strategies for different stages of product life cycle – Sales promotion and methods – Channels of distribution Corporate Social Responsibility, Introduction to sustainable development goals	11	4

Course Assessment Method (CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 2 marks (8x2 = 16 marks)	<ul style="list-style-type: none"> 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. (4x6 = 24 marks) 	40

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles and Practice of Management	Prasad L.M.	Sultan Chand & Sons	11 th Revised Edition, 2025
2	Essentials of Management	Harold Koontz, Heinz Wehrich, Mark V. Cannice	McGraw Hill	11 th Edition, 2020
3	Industrial Engineering and Management	S.C. Sharma, T.R. Banga	Khanna Book Publishing Co.(p) Ltd.	2 nd Edition, 2017
4	Engineering Economy and Management	Pravin Kumar	Wiley India	1 st Edition, 2019
5	Operations Management: Theory and Practice	B. Mahadevan	Pearson	3 rd Edition, 2018
6	Principles of Management	P. C. Tripathi and P. N. Reddy	McGraw Hill	6 th Edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Marketing Management	Philip Kotler, Kevin Keller, Alexander Chernev and Jagdish N. Sheth	Pearson	16 th Edition, 2018
2	Human Resource Management: Text and Cases	K. Aswathappa and Sadhna Dash	McGraw Hill	10 th Edition, 2023
3	Management: Principles and Practices	R. W. Griffin	Cengage	11 th Edition. 2017
4	Marketing Management	Philip Kotler, Kevin Keller, Alexander Chernev and Jagdish N. Sheth	Pearson	16 th Edition, 2018
5	Production and Operations Management	S.N. Chary	McGraw Hill	6 th Edition, 2019

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Introduction & Theories: Definition, Nature, Purpose, Scope: Concept, Types, Strategic Management and Planning	https://nptel.ac.in/courses/110105146
1	Evolution of Management Thought	https://onlinecourses.swayam2.ac.in/ini24_mg01/preview
2	Leading and controlling	https://onlinecourses.nptel.ac.in/noc24_mg47/preview
2	Decision Making	https://onlinecourses.nptel.ac.in/noc25_mg150/preview
3	Project Management	https://onlinecourses.nptel.ac.in/noc25_mg127/preview
3	Human Resource Management	https://onlinecourses.swayam2.ac.in/cec21_mg06/preview
4	Corporate Social Responsibility	https://onlinecourses.nptel.ac.in/noc23_mg94/preview



THERMAL ENGINEERING LAB-1

Course Code	24SJPCMEL507	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	24SJPCMET403 Engineering Thermodynamics	Course Type	PCL

Course Objectives:

- To conduct experiment for measuring viscosity and conduct experiment on refrigeration and air-conditioning test rigs.
- To conduct the various heat transfer experiments

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Measure thermo-physical properties of solid, liquid, gaseous fuels and engine oil	K4
CO2	Analyse the performance of Refrigeration and air conditioning systems	K4
CO3	Evaluate thermal properties of materials in conduction, convection and radiation	K4
CO4	Analyse the performance of heat exchangers and heat pipes	K4
CO5	Perform the calibration of thermocouples and analyze the temperature measurement accuracy and reliability.	K4

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	-	-	2	-	-	-	2	3	-	-	3	2
CO2	3	-	-	2	-	-	-	2	3	-	-	3	2
CO3	3	-	-	2	-	-	-	2	3	-	-	3	2
CO4	3	-	-	2	-	-	-	2	3	-	-	3	2

EXPERIMENTS

Expt. No.	Experiments	CO
1	Determination of viscosity of lubricating oils and fuels and its variation with temperature	1
2	Determination of flash and fire points of petroleum fuels and oils.	1
3	Study and performance test on Refrigeration system (Refrigeration test rig)	2
4	Study and performance test on Air-conditioning system (Air-conditioning test rig)	2
5	Calibration of Thermocouples	5
6	Determination of LMTD and effectiveness of parallel flow, Counter flow and cross flow heat exchangers	4
7	Performance studies on a shell and tube heat exchanger	4
8	Development of heat transfer correlation for heat exchangers/condenser using modified Wilson Plot Method	4
9	Determination of heat transfer coefficients in free convection	3
10	Determination of heat transfer coefficients in forced convection	3
11	Determination of thermal conductivity of solids (composite wall/metal rod)	3
12	Determination of thermal conductivity of powder	3
13	Determination of thermal conductivity of liquids	3
14	Measurement of unsteady state conduction heat transfer	3
15	Determination of emissivity of a specimen	3
16	Determination of Stefan Boltzman constant	3
17	Measurement of solar radiation	3
18	Experimental study of dropwise and film-wise condensation	3
19	Experiments on boiling heat transfer	3
20	Performance study on heat pipe	4
<i>Note: 10 Experiments are mandatory</i>		

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Preparation/ Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming.	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** *The external examiner shall endorse the record*

Continuous Assessment (25 Marks)**1. Preparation and Pre-Lab Work (7 Marks)**

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks)**1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.

- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
 - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
 - Creativity and logic in algorithm or experimental design.
- 2. Conduct of Experiment/Execution of Work/Programming (15 Marks)**
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
- 3. Result with Valid Inference/Quality of Output (10 Marks)**
- Accuracy of Results: Precision and correctness of the obtained results.
 - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
- 4. Viva Voce (10 Marks)**
- Ability to explain the experiment, procedure results and answer related questions
 - Proficiency in answering questions related to theoretical and practical aspects of the subject.
- 5. Record (5 Marks)**
- Completeness, clarity, and accuracy of the lab record submitted

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Heat Transfer a Practical Approach	Yunus A. Cengel	Tata McGraw-Hill Education	4th Edition, 2012.
2	Fundamentals of Engineering, Heat and Mass Transfer	R. C. Sachdeva	New Age publication,	3 rd Edition, 2012.
3	Heat transfer	Holman J. P	Mc Graw-Hill	10th. Ed., 2009
4	Heat and Mass Transfer	Frank P. Incropera and David P. Dewitt	John Wiley and sons	2011
5	Fundamentals of Heat and Mass Transfer	Kothandaraman C. P	New Age International, New Delhi.	2006
6	Thermal Engineering	R K Rajput	Laxmi Publications	11 th Edition, 2020

Sl.No	Topic	NPTEL, Video Links
1	Measurement of thermo-physical properties	https://nptel.ac.in/courses/112106138
2	Measurement of Thermal Conductivity	https://www.youtube.com/watch?v=b8GDNYbj7L4
3	Heat exchangers	https://www.youtube.com/watch?v=Kj0ebo-vVAg

MECHANICAL ENGINEERING LAB

Course Code	24SJPCMEL508	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Machine Tools and Metrology (24SJPCMET402)	Course Type	PCL

Course Objectives:

- To get an idea of the dimensional & form accuracy of products
- To get exposure to equipment and exercises related to machine dynamics, basics of hydraulic and pneumatic devices, basic concepts of stepper motors, basic ideas of data acquisition systems and automation

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Choose the appropriate instruments for different measurements	K3
CO2	Determine dimensional and form accuracies of various components	K3
CO3	Develop knowledge of designing and analysing mechanisms in machinery	K3
CO4	Demonstrate the functions and control of various devices used for industrial automation	K3
CO5	Demonstrate 3D printing technique	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	-	-	2	-	-	2	2	-	-	2	3	3
CO2	3	2	-	2	2	-	2	2	2	-	-	3	3
CO3	3	2	-	2	-	-	-	2	2	-	-	3	3
CO4	3	-	-	-	-	-	-	2	2	-	-	3	3
CO5	3	-	-	-	2	-	-	2	2	-	-	3	3

SYLLABUS

Expt. No.	Experiments	CO
PART 1 (Any six experiments)		
1	Calibration of vernier caliper, micrometer, LVDT and dial gauge. Determine the class of fits between the given shaft and hole. Etc. Study and analysis of repeatability and reproducibility	1,2
2	Angular measurements using sine bar, bevel protractor, combination sets, clinometers, angle dekkor etc.	1,2
3	Measurement of straightness, flatness, squareness and roundness error using autocollimator, Laser interferometer, spirit level, dial gauge etc.	1,2
4	Measurement of displacement, velocity and acceleration of vibration.	3
5	Measurement of surface roughness of turned, milled, grounded, lapped surfaces and glass etc.	1,2
6	Measurement of strain using strain gauges and strain indicators using various bridge arrangements	1,2
7	Measurement of screw thread parameters	1,2
8	Measurement of gear profile error and other parameters	1,2
9	Bore diameter measurement	1,2
10	Use of Tool maker's microscope	1,2
11	Analysis of automobile exhaust gas and flue gas.	1
12	Demonstration of Coordinate Measuring Machine for the evaluation of form errors	2
PART 2 (Any six experiments)		
1	Experiment on Whirling of shaft	3
2	Experiment on Gyroscope	3
3	Experiment on Universal governor apparatus	3
4	Experiment on Free and forced vibration analysis	3
5	Experiment on any Non-destructive testing.	3
6	Exercises on hydraulic and pneumatic circuits using trainer units	3
7	Exercises on electro-pneumatic and electro-hydraulic circuits using trainer units	3
8	Exercises on Motion controller using AC/DC motor, servo motors and stepper motors with encoders to determine the operating characteristics.	3
9	Exercises on PC-based data acquisition systems with any software.	3
10	Study of PLC programming, Controlling variable speed drive through PLC	3
11	Exercises on the robotic trainer units	4
12	Exercises on 3-D printing	4

A minimum of 12 sets of experiments are mandatory

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing

- materials/equipment.
 - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
 - Creativity and logic in algorithm or experimental design.
- 2. Conduct of Experiment/Execution of Work/Programming (15 Marks)**
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
- 3. Result with Valid Inference/Quality of Output (10 Marks)**
- Accuracy of Results: Precision and correctness of the obtained results.
 - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
- 4. Viva Voce (10 Marks)**
- Ability to explain the experiment, procedure results and answer related questions
 - Proficiency in answering questions related to theoretical and practical aspects of the subject.
- 5. Record (5 Marks)**
- Completeness, clarity,
Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
 - **Endorsement by External Examiner:** *The external examiner shall endorse the record*

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Metrology for Engineers	Shotbolt C.R. and Gayler J.F.W,	ELBS, London	5 th Edition,1990
2	Kinematics and Dynamics of Machinery	C.E.Wilson, P. Sadler	Pearson Education	2005
3	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering	W.Bolton	Person Education Limited, New Delhi	2007
4	Textbook of Mechanical Vibrations	Dukkipati R.V, J Srinivas	Prentice Hall India	2nd Edition2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Measurements	Collett, C.V. and Hope, A. D	ELBS/Longman	Second edition, 1983
2	Machines and Mechanisms Applied Kinematic Analysis	D.H.Myskza	Pearson Education	2013
3	Mechatronics: Integrated Mechanical Electronic Systems	K.P.Ramachandran, G.K.Vijayaraghavan, M.S.Balasundaram	Wiley India Pvt. Ltd., New Delhi	2008

PROGRAM ELECTIVE 2

COMPUTATIONAL FLUID DYNAMICS

Course Code	24SJPEMET521	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- The finite difference methods and finite volume methods as a means of solving different types of differential equations that arise in fluid dynamics and heat transfer.
- The fundamentals of numerical analysis, ordinary differential equations and partial differential equations related to fluid mechanics and heat transfer
- The error control and stability considerations associated with numerical solutions.
- A class of methods used in computational fluid dynamics for numerically solving the Navier- Stokes equations for 2D incompressible flows.

Course Outcomes (COs)

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

Course Outcome	Description	Bloom's Knowledge Level (KL)
CO1	To understand the governing equations of fluid flow and heat transfer.	K2
CO2	To apply finite difference methods to simple partial differential equations	K3
CO3	Demonstrate the use of the finite volume method for simple one-dimensional and two-dimensional heat conduction problems.	K3
CO4	Apply the finite volume method to solve convection–diffusion and incompressible flow problems and interpret CFD results graphically.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2	2	-	1	-	-	-	-	-	-	-	2	2
CO2	3	3	-	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	2	2
CO4	3	3	-	3	-	-	-	-	-	-	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to Computational Fluid Dynamics, Governing Equations of fluid flow and heat transfer, Conservative form of Navier-Stokes equation, General transport equation. Physical and mathematical classifications of partial differential equations. Elliptic, parabolic and hyperbolic equations, comparison of experimental, theoretical and numerical approaches, applications of CFD.	9	1
2	Discretization-converting derivatives to their finite difference forms- Taylor's series approach and polynomial fitting approach. Central difference, backward difference, and forward difference of first and second order derivatives. Solution of partial differential equations using finite difference equations. Discretization error, truncation error, round off error. Consistency and numerical stability. Iterative convergence, condition for convergence, rate of convergence. Termination of iteration. Boundary and Initial conditions	9	2
3	Introduction to finite volume method. Finite volume method for steady one-dimensional conduction problems. one-dimensional transient heat conduction problems -explicit, implicit, Crank- Nicholson schemes, under and over relaxations, handling of boundary conditions; dealing with Dirichlet, Neumann, and Robins type boundary conditions; two-dimensional steady state conduction problems; point-by-point and line-by-line method of solution; tri-diagonal matrix algorithm.	9	3
4	Finite volume method for steady-state diffusion and convection-diffusion problems; Central difference and Upwind schemes for convection and diffusion problems. Two dimensional incompressible viscous flows. Staggered grid. Pressure correction methods. Solution algorithm for pressure-velocity coupling in steady flows- SIMPLE algorithm to solve Navier - Stokes equations. Computer graphics techniques to present CFD results.	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computational Fluid Dynamics	John D Anderson Jr	McGraw-Hill Book Company	2012
2	Numerical Heat Transfer and Fluid Flow	S V Patankar,	McGraw-Hill	2018
3	An Introduction to Computational Fluid Dynamics: The Finite Volume Method	H. Versteeg, W. Malalasekera	Pearson	2nd, 2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to computational fluid dynamics	Anil W. Date	Cambridge University Press	2005
2	Computational Fluid Dynamics: A Practical Approach	Jiyuan Tu	Elsevier	3 rd , 2024
3	Introduction to Computational Fluid Dynamics: Development, Application and Analysis	Atul Sharma	Springer	2020
4	Computational Fluid Dynamics: Principles and Applications	Jiri Blazek	Elsevier	2006
5	Computational Fluid Dynamics	K. A. Hoffmann and S. T. Chiang	Engineering Education System	2000

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Governing equations of fluid flow and Heat transfer	https://nptel.ac.in/courses/112105045
2	Solution of partial differential equations using finite difference equations	https://onlinecourses.nptel.ac.in/noc20_me64/preview
3	Introduction to finite volume method	https://onlinecourses.nptel.ac.in/noc21_me126/preview
4	Finite volume method for steady-state diffusion and convection-diffusion problems	https://onlinecourses.nptel.ac.in/noc20_me64/preview

DESIGN FOR MANUFACTURE AND ASSEMBLY

Course Code	24SJPEMET522	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3-0-0-0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Manufacturing Process 24SJPBMET304	Course Type	PE

Course Objectives:

- To introduce the design guidelines for different manufacturing processes.
- To apply concepts of Design for Manufacture and Assembly to optimize product manufacturability and sustainability.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the knowledge of DFM & DFMA guidelines for new designs.	K3
CO2	Apply DFA guidelines for new product development.	K3
CO3	Design parts for better machinability.	K3
CO4	Design cast and injection moulded parts for products with improved manufacturability and sustainability.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	-	3	2	-	-	-	2	-	-	-	-	2	-
CO2	-	3	2	-	-	-	2	-	-	-	-	2	-
CO3	-	2	2	-	-	-	-	-	-	-	-	2	-
CO4	-	2	2	-	-	-	3	-	-	-	-	2	-
CO5	-	2	2	-	-	-	-	-	-	-	-	2	-

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Introduction to DFMA: History of DFMA, Steps for applying DFMA, Advantages of applying DFMA, Reasons for not implementing DFMA.</p> <p>Introduction to Manufacturing Process: Classification of manufacturing process, Basic manufacturing processes, Mechanical properties of materials, Introduction to materials and material selection, Classification of engineering materials, Material selection for product design, Process capability analysis.</p>	9	1
2	<p>Introduction to Assembly: The assembly process, Characteristics and applications, Economic significance of assembly, General taxonomies of assembly operation and systems, assembling a product.</p> <p>Design for Assembly: Introduction, Design consideration, DFA methodology, General Design Guidelines for Manual Assembly for Part Handling and for Insertion and Fastening, General Rules for Product Design for Automation.</p> <p>Design for Fastening: Introduction, Design recommendation for fastening methods and fasteners.</p> <p>Design for disassembly.</p>	9	2
3	<p>Design for machining: Introduction to machining, Recommended materials for machinability, Machining Using Single-Point Cutting Tools, Machining Using Multipoint Tools.</p> <p>Design for turning operation: Process description, typical characteristics and applications, Suitable materials, Design recommendations.</p> <p>Design for machining round holes: Introduction, Suitable materials, Design recommendations.</p> <p>Design for milling: Process description, Characteristics and applications of parts produced on milling machines, Design recommendations.</p>	9	3
4	<p>Design for Casting processes:</p> <p>Sand casting: Typical characteristics of sand cast part, Design recommendations.</p> <p>Die casting: Introduction, Applications, Suitable material consideration, Design recommendations.</p> <p>Injection moulding: Introduction, Typical characteristics of injection moulded parts, Effect of shrinkage, Suitable materials, Design recommendations.</p> <p>Design for Reliability and Sustainability: Probabilistic definition of failures, Causes and remedies of Failure.</p> <p>Design for Environment, Life Cycle Assessment.</p>	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

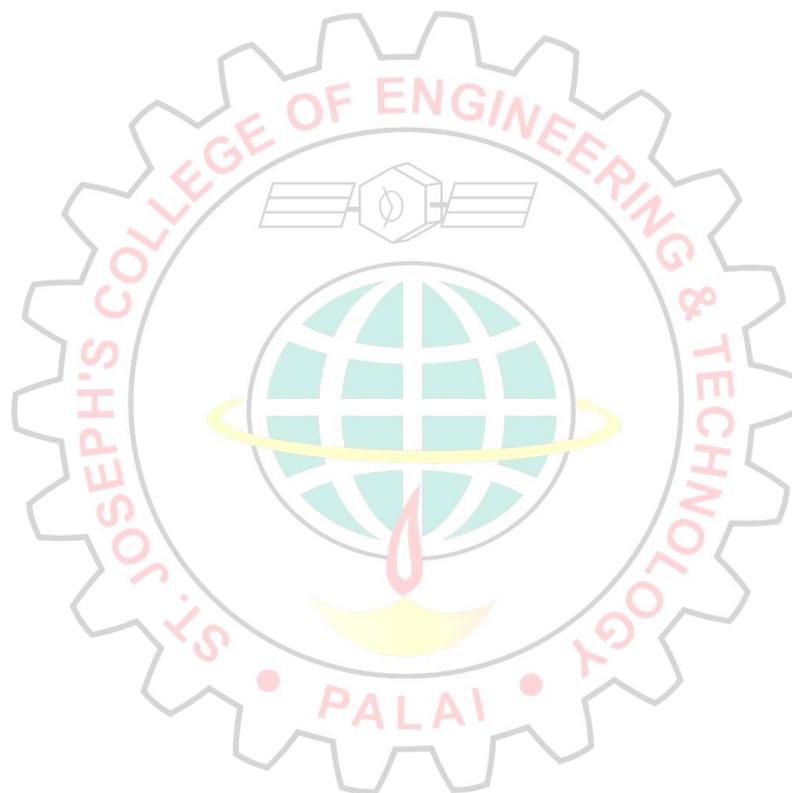
Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Product Design for Manufacture and Assembly	Geoffrey Boothroyd, Peter Dewhurst, Winston Knight	CRC press	Third Edition, 2010
2	Product design and Manufacturing	A.K. Chitale and R.C. Gupta	Prentice Hall of India	Fifth Edition, 2011
3	Engineering Design: A Materials and processing Approach	Dieter, G.E.	McGraw Hill Co. Ltd	2000
4	Design for Manufacturing and assembly	O. Molloy, S. Tilley and E.A. Warman	Chapman &Hall, London, UK	2012

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Design for Manufacturability Handbook	James G. Bralla	McGraw-Hill companies, New York	Second Edition, 1998
2	Assembly Automation and Product Design	Geoffrey Boothroyd	CRC press	Second Edition, 2005
3	Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development	D. E. Whitney	Oxford University Press, New York	2004
4	Industrial Design, Materials and Manufacture Guide	J. Lesko	John Willy and Sons, Inc	1999

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Manufacturing Processes	https://nptel.ac.in/courses/107103012
2	DFM guidelines for machining processes	https://nptel.ac.in/courses/107103012
3	DFM guidelines for casting processes	https://nptel.ac.in/courses/107103012
4	DFMA	https://nptel.ac.in/courses/107103012



COMPUTER AIDED DESIGN AND ANALYSIS

Course Code	24SJPEMET523	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- To provide a foundational understanding of CAD, including its historical evolution, industrial applications, and key components such as geometric and solid modelling, CAD/CAM/CAE/CAPP packages, hardware, and software developments.
- To develop proficiency in 2D and 3D computer graphics, focusing on transformations, drawing algorithms, solid modelling techniques, and coordinate systems, alongside foundational knowledge in finite element method (FEM) and finite volume method (FVM).

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the historical developments and industrial applications of CAD, including key components and latest software developments.	K2
CO2	Apply 2D transformation techniques, including rotation, reflection, scaling, and line and curve drawing algorithms in CAD software.	K3
CO3	Apply 3D graphics and solid modeling techniques, such as Bezier and B-spline curves, and their application in creating complex geometric forms.	K3
CO4	Understand finite element analysis (FEA) and finite volume methods (FVM) including discretization, formulation, and boundary condition implementation for simple structural and fluid flow problems.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	1	-	-	-	-	-	-	2	2
CO2	3	2	-	-	1	-	-	-	-	-	-	2	2
CO3	3	2	-	-	1	-	-	-	-	-	-	2	2
CO4	3	2	-	-	1	-	-	-	-	-	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to CAD, historical developments, industrial look at CAD, comparison of CAD with traditional designing, application of computers in design, basics of geometric and solid modeling, packages for CAD/CAM/CAE/CAPP, hardware in CAD components, user interaction devices, design database, graphic standards, data exchange formats, raster scan, random scan, various display systems, CAD software, latest developments in the area, PDM, PLM and CAD	9	1
2	Transformation of points and lines, 2-D rotation, reflection, scaling, combined transformation, homogeneous coordinates, shearing, orthographic and perspective projections, simple problems, line drawing algorithms, DDA algorithm, Bresenham's line algorithm, circle drawing algorithms, Bresenham's circle algorithm, curve drawing algorithms.	9	2
3	3D graphics, algebraic and geometric forms, tangent and normal, blending functions, straight lines, conics, cubic splines, Bezier curves, B- spline curves, solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation, cell decomposition, spatial occupancy enumeration, coordinate systems for solid modelling.	10	3
4	Introduction to finite element analysis, steps involved in FEM, pre-processing phase, discretization, types of elements, stiffness matrix Fundamentals of Finite volume methods, different types of finite volume grids, approximation of surface and volume integrals; interpolation methods, Review of governing equations	8	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	CAD/CAM Computer Aided Design and Manufacturing	M.P. Groover, E.M. Zimmers, Jr.	Prentice Hall of India	2014
2	CAD/CAM: Theory and Practice	Ibrahim Zeid, R Sivasubramanian	McGraw Hill Education	2 nd , 2009
3	Product Design and Development	Karl T. Ulrich, Steven D. Eppinger	McGraw Hill Education	7 th , 2020
4	Introduction to Finite Elements in Engineering,	T. R. Chandrupatla and A. D. Belagundu	Pearson Education	2001

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	CAD/CAM – Principle Practice and Manufacturing Management	Chris McMahon and Jimmie Browne	Addision Wesley England,	1998
2	Mathematical Elements in Computer Graphics,	D. F. Rogers and J. A. Adams	McGraw-Hill	1990
3	A First course in Finite Element Method	Daryl Logan	Thomson Learning	2007
4	Computer Graphics with open GL,	Donald Hearn, M. Pauline Baker and Warren Carithers	Pearson Education	2001

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1 to 4	Module 1 - 4	https://nptel.ac.in/courses/112102101 https://nptel.ac.in/courses/112102102

ADDITIVE MANUFACTURING

Course Code	24SJPEMET524	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

1. To demonstrate appropriate level of understanding on principles of additive manufacturing
2. To explore different additive manufacturing processes and suggest suitable methods for building a particular component
3. To design prototypes by identifying suitable process with optimum process parameters
4. Apply design for additive manufacturing guidelines in designing mass customized products

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concept of AM from conventional manufacturing systems and data processing techniques in AM process	K2
CO2	Understand the working principles and process parameters of additive manufacturing processes	K2
CO3	Understand the working principles and process parameters of High energy additive manufacturing (HEAM) processes	K2
CO4	Identify the need of design for additive manufacturing	K2

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2	2	2	2	-	2	-	-	-	-	-	2	2
CO2	2	-	2	3	2	2	-	-	-	-	-	2	2
CO3	2	-	2	3	2	2	-	-	-	-	-	2	2
CO4	3	2	3	2	2	2	-	-	-	-	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Introduction to Additive Manufacturing (AM) –Basic principle of AM- Procedure of product development in AM process chain. Classification of additive manufacturing processes, Basic concept, Digitization techniques, Benefits and challenges in AM.</p> <p>Data processing for AM- CAD model preparation, Part orientation and support generation, Slicing methods, Tool path generation, STL Formats. Demonstration of slicing software packages.</p>	8	1
2	<p>Common AM technologies: Principle, materials, process parameters, advantages and applications of: Stereo Lithography (SLA), Digital Light Processing (DLP), Continuous Liquid Interface Production (CLIP), Laminated Object Manufacturing (LOM), Ultrasonic AM (UAM), 3D printing, Binder Jetting, Material Jetting, Fused Deposition Modelling (FDM), Direct Ink Writing (DIW).</p>	8	2
3	<p>Powder Bed Fusion AM Processes Principle, materials, process parameters, advantages and applications of: Selective Laser Sintering (SLS), Selection Laser Melting (SLM), Electron Beam Melting (EBM)</p> <p>Directed Energy Deposition AM Processes: Laser Engineering Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.</p> <p>Friction stir additive manufacturing: process, parameters, advantages, limitations and applications</p> <p>Wire Arc Additive Manufacturing (WAAM): Process, parameters, applications, advantages and disadvantages</p>	10	3
4	<p>Design for AM (DFAM)</p> <p>Introduction to geometric modelling, Modelling of Synthetic curves like Hermite, Bezier and B-spline, Parametric Representation of freeform surfaces, Design freedom with AM, Need for Design for Additive Manufacturing (DFAM), CAD tools vs. DFAM tools, Requirements of DFAM methods, General Guidelines for DFAM, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post-processing. AM unique capabilities, DFAM concepts and objectives, Design freedom and synthesis methods.</p> <p>Applications for AM</p> <p>Applications: Prototyping, Industrial tooling, Aerospace, Automobile, Medical etc.</p>	10	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

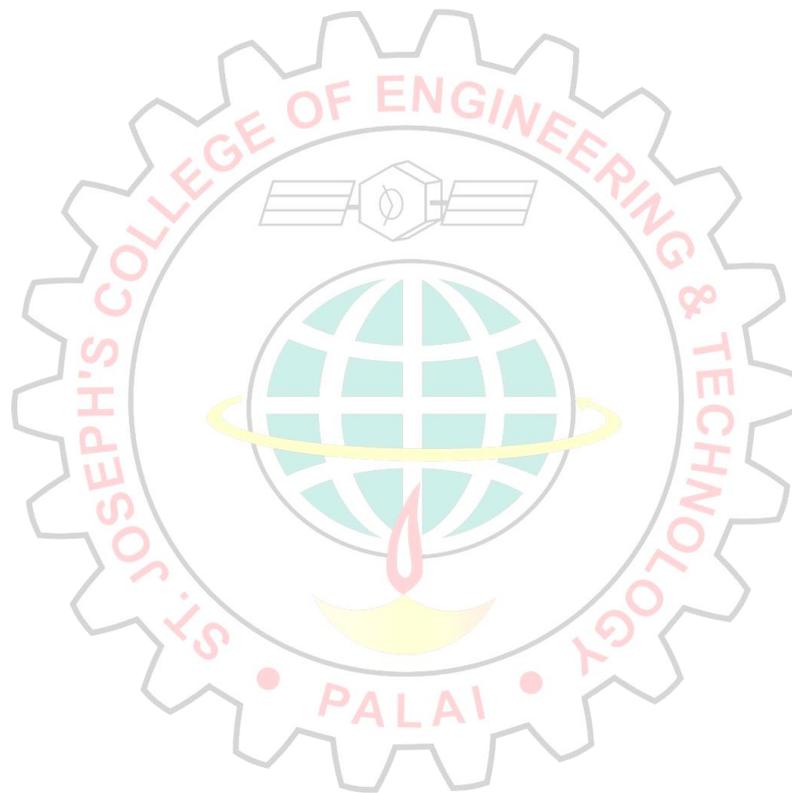
In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Additive Manufacturing Technologies-3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Gibson I D. W. Rosen I and B. Stucker	Springer	Second Edition, 2015
2	Additive Manufacturing	Amit Bandyopadhyay Susmita Bose	CRC Press Taylor & Francis Group	Second Edition, 2020
3	Rapid Prototyping: Laser-based and Other Technologies	Patri K. Venuvinod and Weiyin Ma	Springer	First Edition, 2004
4	Design for Advanced Manufacturing: Technologies and Process	Laroux K, Gillespie	Mc Graw Hill,	Second Edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling	D.T. Pham and S.S. Dimov	Springer London Ltd	Softcover reprint of the original 1st ed. 2011
2	Additive Manufacturing: Principles, technologies and Application	C.P. Paul, A.N. Junoop	McGraw Hill	First Edition, 2021
3	Additive Manufacturing Technologies	S. Shiva, Anuj K. Shukla	Wiley	First Edition, 2024
4	Additive Manufacturing: Fundamentals and Advancements	Manu Srivastava, Sandeep Rathee, Sachin Maheshwari	CRC Press	First Edition, 2019
5	Laser-Induced Materials and Processes for Rapid Prototyping	L Lu, J. Y. H. Fuh and Y.S. Wong	Springer	First Edition, 2001

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1 to 3	Fundamentals of Additive Manufacturing Technologies	https://nptel.ac.in/courses/112103306
4	Design for Additive manufacturing (DFAM)	https://www.youtube.com/watch?v=I-0E-eiJdWk&list=PLyqSpQzTE6M8wvoQVFrhZ0W1_gufYJGwg&index=24



ENERGY ECONOMICS AND POLICY

Course Code	24SJPEMET526	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- To learn and understand the set of policies that has developed to regulate energy-related behaviour, as well as the economic concepts that direct the actions of energy producers and consumers.
- To understand different facets of energy supply and demand, with an emphasis on policies that support sustainable energy supply, learn the relationship between energy, the environment, and emission reduction strategies

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand energy systems, accounting methods, and the role of government in energy innovation and investment decisions.	K2
CO2	Analyse behavioural approaches for energy efficiency, emission abatement, and alignment with UN SDGs.	K3
CO3	Examine energy market structures, regulatory frameworks, and economic implications of resource depletion and unregulated markets.	K3
CO4	Assess carbon emission trends, explore hydrogen-based solutions for carbon neutrality, and appraise energy policies supporting global sustainability goals.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	-	-	-	-	2	-	-	-	-	2	2	1
CO2	-	-	-	-	-	2	3	2	-	-	2	-	2
CO3	3	2	-	-	-	2	-	-	-	-	2	-	2
CO4	-	-	-	-	-	2	3	-	-	-	2	-	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Energy as a resource and its accounting, Government role in innovation: Introduction, Energy as a system, System of economic accounting for energy. Government's role in mobilising investment and innovation in energy, the importance of the investment environment.</p> <p>Energy efficiency characteristics, energy supply and demand analysis. a review of Energy Efficiency Measures (EEM) characteristics, adoption and measures of EEM, supply and demand analyses, energy demand science for a decarbonized society.</p> <p>Energy statistics influence on energy consumption for oil rich countries. Global influence of oil-rich countries, oil-rich countries statistics, geo-political influence, energy transitions, energy policy shifts.</p>	10	1
2	<p>Behaviour change approach to promote and sustain energy efficiency: behaviour gaps, biases, design thinking methodology, ripple effect.</p> <p>Drivers of human behaviour to meet UN SDGs in relation with energy: Role of individuals in attaining SDGs, behavioural aspects in energy modelling, behaviour changes for sustainable development.</p> <p>Energy efficiency and emission abatement relations. abatement of emissions through energy efficiency, sector wise analysis, harnessing renewable energy potential (case studies in some countries).</p>	8	2
3	<p>Energy market analysis, regulations by government of India: Scenario analyses, feasible options for developing an energy future, the impacts, costs, and financial risks of the various scenarios for transitioning to the energy future, market penetration pathways.</p> <p>The economics of depleting resources & the oil sector examples: resource depletion and overuse, combating resource depletion and misuse and pollution, the prospects for greener growth-policies and politics of low-carbon growth.</p> <p>Unregulated markets and technological change: Oil and natural gas sector examples. the emergence of markets, natural gas market, transportation market, markets in other segments of the gas industry, trading models in the deregulated natural gas industry, under development and unregulated markets: reasons why unregulated markets reproduce underdevelopment.</p>	10	3
4	<p>Carbon Emission: Recent trends and shift in policies in India, case studies of different countries. Sector wise emission trends in India, electricity, industry, transportation, buildings, agriculture, policies, case study of other countries.</p> <p>Hydrogen: A Pathway to Carbon Neutral Economy, possibilities and approaches. Hydrogen production and potential utilization, technical challenges, codes and standards development-public awareness and social acceptance.</p> <p>Energy Policy: A Foundation for Transition. energy efficient policies to achieve SDGs for countries, importance of Conference of Parties (COP).</p> <p>Energy Transition: A paradigm shift, future prospects and emerging</p>	8	4

trends, the link between energy policy, energy transition, and sustainability in oil-rich countries, energy policy research a pathway to achieve UN SDGs. The role of COP in emission abatement, COP goals and agenda, major outcomes of COP		
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Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8 x 3 = 24 marks) 	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4 x 9 = 36 marks) 	60

Text Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Energy Economics: Concepts, Issues, Markets and Governance Second Edition (Selected chapters),	Subhes C. Bhattacharyya,	Springer. London, UK.	2019
2	Energy Policy: Perspectives, Challenges and Future Directions (Selected chapters)	K J Sreekanth	Nova Publishers USA	2018

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Energy Efficiency Improvements with Emission Abatement for Energy Sustainability	K J Sreekanth (Editor)	Springer Nature Singapore	2024
2	The Economics of Exhaustible Resources	Harold Hotelling	Journal of Political Economy	Vol. 39, No. 2, 1931, pp. 137-175
3	An Introduction to Energy Economics	Paul Stevens (Editor)	EE Publishing, UK	Vol.1, 2000

Video Links (NPTEL, SWAYAM...)			
Module No.	Topic		Link ID
1-4	Energy Economics and Policy		https://youtube.com/playlist?list=PLyqSpQzTE6M_b6b57hv9Bh6OqoWesWWX5&si=yp3uQyC_L6wVc5IE
4	Carbon Emissions, Hydrogen Economy, and Energy Transition		https://youtu.be/CPz2u32pL4Y?si=xJctwEdWS5cA1xf0

HUMAN RESOURCES MANAGEMENT

Course Code	24SJPEMET527	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

1. Understand the HRM Concepts in organisation.
2. To familiarise the Recruitment & selection process
3. To familiarize the Career Development ways in an organization.
4. Acquire the knowledge about Employee safety measures and Labour activities

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To familiarise with the basic concepts in HR Management and Evaluate the Job design & analysis methods.	K5
CO2	Identify the Recruitment and selection methods.	K1
CO3	understand the training process of Employees and Understand various career development procedures.	K2
CO4	Analyse the various employee issues in an organisation and Identify various safety issues and stress faced by employees	K4

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	1	-	-	-	-	1	2	1	-	-	1	1	-
CO2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	1	-	-	-	-	1	1	3	-	1	2	1	-
CO4	1	-	-	-	-	2	3	2	-	-	1	2	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>HUMAN RESOURCE MANAGEMENT: Concept of Human Management in a system-Organisation and Function of the HR. Objectives and Characteristics of HRM. Role of HR manager-Responsibility- Competitiveness- HR policies -HRM Concepts.</p> <p>JOB ANALYSIS & JOB DESIGN: Job Analysis- Job title- duties & essential functions- job specification -Techniques & Approaches in Job Analysis. Job design -considerations in job design-Types of Job design approaches.</p>	9	1
2	<p>HR PLANNING: Definition-HR planning system- HR forecasting—Importance of HR Planning- Human resource information system.</p> <p>RECRUITMENT & SELECTION: Concept of Recruitment-objectives- Sources of Recruitment- Internal & External Sources-Recruitment Process-Common constraints in recruitment. Selection- Selection Process-Screening- Employment Test-Interview- Physical Examination- Job offer, Various Approaches in Hiring Decisions</p>	9	2
3	<p>TRAINING: Training- Need for training- Induction Training-Effective training Programme Process-Structural issues in Training.</p> <p>CAREER DEVELOPMENT: Employee development methods-performance management -Components of effective performance management -performance appraisal- purposes of appraisal – methods of performance appraisal- promotion –transfers. -Incentive systems-Employee Benefits. -Types of Benefit schemes</p>	9	3
4	<p>LABOUR RELATIONS: Relation between management and labours-Labour unions -objectives- Collective Bargaining -Negotiations-Strikes-Grievance Handling-Grievance redressal methods.</p> <p>EMPLOYEE SAFETY AND HEALTH: Employee safety- awareness – Accident prevention -creating safe environment -employee health problems and preventive measures-job stress – employee assistance programmes.</p>	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	International Human Resource Management	Srinivas R Kandula	SAGE publication	2nd Edition (2018)
2	Human Resource management -Text and Cases	K. Aswathappa, Sadhna Dash	McGrawhill	10th Edition (2023)
3	Human Resource Management	Dr. TRaju, Dr. S Jayabharathi	Biztantra publications	1 ST Edition (2014)
4	Human Resource Management	Gary Dessler	Pearson Publication	18th Edition, 2024

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Human Resource Management and Digitalization	Franca cantoni, Gianlugi Mangia	Routledge publication	1 st Edition 2020
2	Human Resource Management	Jacquina Gilbert	Vibrant publishers	1st Edition 2019
3	Human Resource Management and Digitalization	Franca cantoni, Gianlugi Mangia	Routledge publication	1 st Edition 2020
4	Human Resource Management	Jacquina Gilbert	Vibrant publishers	1st Edition 2019

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Covers organization structure,	https://nptel.ac.in/courses/110102058
2	Job Analysis, Performance Appraisal, Training, Compensation, and Employee Relations.	https://nptel.ac.in/courses/110105069
3	Nature and Scope of HRM, Job Design, HR Planning, Recruitment, and Industrial Relations.	https://nptel.ac.in/courses/122105020
4	HR Analytics and the use of modern technology.	https://onlinecourses.nptel.ac.in/noc25_mg05/preview

OPERATIONS RESEARCH

Course Code	24SJPEMET528	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- To understand the role of Operations Research (OR) in decision making.
- To apply different OR techniques for solving managerial problems.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To formulate and solve linear programming problems and perform sensitivity analysis.	K3
CO2	To formulate and solve transportation and assignment problems.	K3
CO3	To apply basic sequencing techniques for processing jobs through machines and familiarize the evolutionary algorithms for optimization problems.	K3
CO4	To solve simple problems in game theory and queuing theory.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	1
CO2	3	2	-	-	2	-	-	-	-	-	-	2	1
CO3	3	2	-	-	3	-	-	-	-	-	-	2	1
CO4	3	2	-	-	2	-	-	-	-	-	-	2	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to Operations Research (OR) and Linear Programming: Basics of OR, Modelling approach, Linear Programming (LP), Formulation of LP models. Graphical method, Simplex method, Big-M Method, Two Phase Method, Sensitivity Analysis.	10	1
2	Transportation Problem: Mathematical Formulation, Initial Basic Feasible Solution, North West Corner method, Least Cost method, Vogel's Approximation Method, Optimality test by MODI method. Assignment problem: Hungarian method.	8	2
3	Sequencing Problem: Basic terminologies, Processing of n Jobs through 2 machines, Processing of n Jobs through 3 machines, Processing n Jobs, through m machines. Non-traditional Optimization Techniques: Genetic Algorithm (GA), Simulated Annealing and Particle Swarm Optimization (Theory only) - Introduction, Key concepts, Algorithm.	9	3
4	Game Theory: Games with saddle points, Games without saddle points - 2 x 2 games, Graphical method for m x 2 & 2 x n games. Queuing theory: Characteristics of Queuing Systems, Performance Measures in Queuing Systems, Kendall's Notations, Classic Queuing Models, Single-server exponential arrival and service times.	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Operations Research: An Introduction	Hamdy A. Taha	Pearson	Tenth Edition, 2019
2	Operations Research	Panneerselvam R.	PHI Pvt. Ltd.	Third Edition, 2023
3	Quantitative Techniques in Management	N. D Vohra. & Hitesh Arora	McGraw Hill	Sixth Edition, 2021
4	Soft Computing Fundamentals and Applications	Dilip K. Pratikar	Alpha Science	Revised Edition, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Optimization: Theory and Applications	Rao, S.S.	Wiley Eastern.	Second Edition, 1984
2	Introduction to Operations Research,	F. S. Hillier & G. J. Leiberman:	McGraw Hill	Eleventh Edition, 2020
3	Operations Research Principles and Practice	Ravindran, Phillips and Solberg,	Wiley & Sons	Second Edition, 1987
4	Operations Research	Prem Kumar Gupta & D. S. Hira,	S Chand Publication	Seventh Edition, 2021

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Linear Programming Problems	https://onlinecourses.nptel.ac.in/noc24_ma55
2	Transportation Problems	https://onlinecourses.nptel.ac.in/noc24_ma55
3	Sequencing	https://onlinecourses.swayam2.ac.in/cec24_ma05
4	Game Theory and Queuing Theory	https://onlinecourses.swayam2.ac.in/cec24_ma05

INSTRUMENTATION AND CONTROL SYSTEMS

Course Code	24SJPEMET525	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

1. To understand the basic principles of instrumentation.
2. Familiarize with various types of sensors and transducers used for measuring physical quantities
3. Gain knowledge of the fundamental concepts of control systems including open-loop and closed-loop systems.
4. Learn about system dynamics, mathematical modelling of physical systems and stability analysis of LTI systems.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To gain knowledge about industrial measurement systems and different elements such as sensors and transducers for different industrial architecture.	K2
CO2	Acquire knowledge about signal conditional circuits like amplifiers, filters, ADC, etc. for working industrial measurement systems.	K3
CO3	To exercise the role of various control blocks and components in feedback systems.	K3
CO4	To analyse the time domain responses of linear systems and apply Root locus technique to assess the performance and analyse the stability of LTI system.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	1	2	2	2	-	-	-	-	-	1	2	3
CO2	2	2	2	2	2	-	-	-	-	-	2	2	3
CO3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	2	3	3

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Industrial measurement systems – different types of industrial variables and measurement systems elements. Sensors – Sensor components, Resistive sensors, Inductive sensors, Capacitive sensors, Thermoelectric sensors, Piezoelectric sensors. Transducers - Definition and classification. LVDT, Electromagnetic and Ultrasonic flow meters, Piezoelectric transducers - Modes of operation, Force transducer, Load cell, Strain gauge etc.	9	1
2	Industrial signal conditioning systems, Operational amplifiers - Amplifier circuits with ideal operational amplifiers - Current-to voltage converters - Inverting voltage amplifiers - Non-inverting voltage amplifiers - Differential amplifiers -Instrumentation amplifiers. Filters – Passive filters - First and second order RC-filters - Low-pass first-order RC-filter – High pass first- order RC-filter – Band pass filters, A/D converters for industrial measurements systems . Data Acquisition Systems (DAS) – Objectives of DAS.	9	2
3	System Modelling - Open loop and closed loop control systems, Transfer function of LTI systems - Electrical, translational and rotational systems – Force voltage and force current analogy Block diagram representation - block diagram reduction, Signal flow graph - Mason's gain formula. Control system components: Transfer functions of DC and AC servo motors – Control applications of Tacho generator and Stepper motor. Characteristic equation of Closed loop systems. Controllers- P, PI, and PID controllers.	9	3
4	Time domain analysis of control systems: Time domain specifications, Impulse and Step responses of first order and second order systems. Error analysis: Steady state error analysis - static error coefficients of type 0,1,2 systems. Stability Analysis: Concept of stability— Routh's stability criterion, Root locus method. Frequency Domain Analysis: Frequency Domain Specifications, Stability in Frequency Domain, Gain Margin, Phase Margin, Bode Plot, Polar Plot, Nyquist Plot.	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Instrumentation	K Krishnaswamy	New Age International Publishers, New Delhi	2003
2	Measurement systems applications and design	Ernest O. Doebelin	McGraw- Hill Publishing Company	2004
3	Control Systems Engineering	Nise N.S.	Wiley Eastern	6 th Edition
4	Modern Control Engineering	Ogata K	Prentice Hall of India.	5 th Edition
5	Control Systems	K R Varmah	Tata McGraw-Hill	2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles of Industrial Instrumentation	Patranabis D	McGraw-Hill Education	3rd Edition, 2017
2	Industrial Instrumentation and Control	Singh, S. K	Tata McGraw-Hill Education	2009
3	Control Systems Principles and Design	Gopal M	Tata McGraw Hill	4/e
4	Automatic Control Systems	Kuo B. C	Prentice Hall of India	7/e

Module No.	Link ID
1	https://nptel.ac.in/courses/108105064
2	https://nptel.ac.in/courses/108105062
3, 4	https://nptel.ac.in/courses/107106081

Semester VI

SIXTH SEMESTER															
(January – June)															
Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs/ Week	
						L	T	P	R		CIE	ESE			
1	A	24SJPCMET601	PC	PC	Industrial and System Engineering	3	0	0	0	4.5	40	60	3	3	
2	B	24SJPCMET602	PC	PC	Machine Design	3	0	0	0	4.5	40	60	3	3	
3	C	24SJPEMET63N	PE	PE	<i>Program Elective - 3</i>	3	0	0	0	4.5	40	60	3	3	
4	D	24SJPBMET604	PC-PBL	PB	Thermal Engineering	3	0	0	1	5.5	60	40	4	4	
5	F	24SJGCEST605	ESC	GC	Design Thinking and Product Development (Group Specific Syllabus)	2	0	0	0	3	40	60	2	2	
6	O [#]	24SJOE - - T61N	OE/ILE	OE/IE	<i>Open Elective - 1</i>	3	0	0	0	4.5	40	60	3	3	
		24SJIE - - T61N	<i>Industry Linked Elective - 1</i>												
7	L	24SJPCMEL607	PCL	PC	Computer Aided Design and Analysis Lab	0	0	3	0	1.5	50	50	2	3	
8	P	24SJPCMEP608	PWS	PC	Mini Project: Socially Relevant Project	0	0	0	3	3	50	50	2	3	
9	Q	24SJPCMEL609	PCL	PC	Thermal Engineering Lab - 2	0	0	2	0	1	50	50	1	2	
10	R/ M/ H		VAC		REMEDIAL / MINOR / HONOURS COURSE	3	1	0	0	5			4*	4*	
	S5/ S6	Industrial Visit (Maximum of 6 Days are permitted, Not Exceeding more than 4 Working Days) / Industrial Training													
Total										32/37			23/26*	26/29*	

[#]Open Elective or Industry linked Elective applicable for ME Students only

Note: Open Electives are such courses which will be offered by other departments. Like ME department students have to opt open electives from EC/CS/EE etc. departments.

Industrial Training: Students who are not participating in the industrial visit must attend industrial training during that period.

PROGRAM ELECTIVE 3: 24SJPEMET63N					
SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
C	24SJPEMET631	Power Plant Engineering	3-0-0-0	3	3
	24SJPEMET632	Compressible Fluid Flow	3-0-0-0		3
	24SJPEMET633	Industrial Tribology	3-0-0-0		3
	24SJPEMET634	Finite Element Methods	3-0-0-0		3
	24SJPEMET636	Non-destructive Testing	3-0-0-0		3
	24SJPEMET637	Industrial Safety Engineering	3-0-0-0		3
	24SJPEMET638	Marketing Management	3-0-0-0		3
	24SJPEMET635	Advanced Materials	3-0-0-0		5 or 3

Open Electives offered by ME department to students of other departments

OPEN ELECTIVE 1: 24SJOEMET61N					
SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
O	24SJOEMET611	Introduction to Business Analytics	3-0-0-0	3	3
	24SJOEMET612	Quantitative Techniques for Engineers	3-0-0-0		3
	24SJOEMET613	Automotive Technology	3-0-0-0		3
	24SJOEMET614	Renewable Energy Engineering	3-0-0-0		3
	24SJOEMET615	Quality Engineering and Management	3-0-0-0		3
	24SJOEMET616	Additive Manufacturing	3-0-0-0		3
	24SJOEMET617	Solar Energy Conservation Systems	3-0-0-0		3

INDUSTRIAL & SYSTEMS ENGINEERING

Course Code	24SJPCMET601	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PC

Course Objectives:

- To introduce key Industrial Engineering principles for effective design, productivity, and quality improvement.
- To enable use of various tools and techniques for continuous quality improvement.
- To provide ideas on implementation of quality standards.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To impart knowledge of Industrial Engineering and work measurement techniques for improving productivity, quality, and efficiency.	K2
CO2	To understand inventory and materials management techniques for cost reduction, value improvement, and operational efficiency.	K2
CO3	To understand Lean and Agile Manufacturing principles for improving flexibility, waste reduction, and productivity.	K2
CO4	To understand ERP concepts, implementation, and integration with modern enterprise technologies for effective business management.	K2

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	1	2	1	3	2	–	3	2	3	2
CO2	3	3	2	–	3	2	2	-	3	3	2	3	2
CO3	2	3	3	3	3	2	2	3	3	3	3	3	2
CO4	2	3	3	2	3	2	2	3	3	3	3	2	3

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Introduction to Industrial Engineering: Evolution of modern Concepts in Industrial Engineering - Functions of Industrial Engineering - Field of application of Industrial Engineering - Human factors in design - Principles of good product design- tolerance design- quality and cost considerations- product life cycle- standardization, simplification, diversification- concurrent engineering- comparison of production alternatives - Economic aspects- C-V-P analysis – simple problems.</p> <p>Work Measurement: Techniques, time study, steps, work sampling, Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time, and standard time determination. (Numerical)</p>	9	1
2	<p>Inventory and Inventory Control: Materials: Profit Centre: Role of materials management techniques in material productivity improvement, cost reduction and value improvement.</p> <p>Inventory: Functions, Costs, Classifications, Deterministic inventory models and Quantity discount Inventory Control: EOQ (Numericals), concepts, type of Inventory models-deterministic and probabilistic, Selective inventory control, Simple problems Just-in-Time system (JIT) and Supply Chain Management (SCM).</p>	9	2
3	<p>Lean and Agile manufacturing: Principles of Lean Manufacturing (LM) – Basic elements of LM– Introduction to LM Tools- Concept of wastes in LM and their narration - stages of 5S and waste elimination - Conventional Manufacturing versus Lean Manufacturing - Need for LM. Agile manufacturing - Definition, business need, conceptual frame work, characteristics, and generic features - Approaches to enhance ability in manufacturing - Managing people in agile organization.</p>	9	3
4	<p>Introduction of enterprise resource planning (ERP): - Concept of Enterprise, ERP Overview - Integrated information system - Myths about ERP – Evolution of ERP- Benefits of ERP implementation - Success and failure factors of ERP implementation - Small, medium and large enterprise vendor solutions- ERP and related technology: Business intelligence (BI), E-Commerce and E-Business, Business Process Reengineering (BPR), Data warehousing, Data mining, Online Analytical Processing(OLAP), Product lifecycle management(PLC), Supply chain management(SCM), Customer relationship management (CRM)- ERP implementation challenges - Emerging trends on ERP</p>	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Engineering & Production Management	Martand T. Telsang	S. Chand and Company Limited, 2018.	Third Edition, 2018
2	Industrial Engineering & Production Management	M. Mahajan	Dhanpat Rai & Co. (P) Limited	Second Edition, 2022
3	Industrial Engineering and Management	O. P. Khanna	Dhanpat Rai Publications	Third Edition, 2018
4	ERP Demystified	Alexis Leon	Tata McGraw Hill Education Private Limited, New Delhi	2008.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Maynard's Industrial Engineering Handbook	Kjell Zandin and Harold Maynard	McGraw-Hill Education	5 th Edition, 2001
2	Industrial Engineering and Management A New Perspective	Philip E. Hicks	McGraw Hill Education	1 st Edition, 2000
3	Industrial Engineering and Management	B. Kumar	Khanna Publishers,	10th Edition, 2004
4	Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities	S.R. Devadasan, V. Mohan Sivakumar, R. Murugesh and PR Shalij	PHI Learning private Limited	1 st edition,2022

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/112107292 https://nptel.ac.in/courses/112107143
2	https://nptel.ac.in/courses/112107142
3	https://nptel.ac.in/courses/112104188 https://www.youtube.com/watch?v=7M_uMhxZtC4
4	https://nptel.ac.in/courses/110101010 https://www.youtube.com/watch?v=NzyhYxUCjlg

MACHINE DESIGN

Course Code	24SJPCMET602	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Mechanics of Solids (24SJPCMET302)	Course Type	PC

Course Objectives:

- To review concepts of statics and strength of materials.
- To introduce fundamental approaches to failure prevention of components.
- To provide knowledge in the design of common machine elements such as fasteners, springs, belts and pressure vessels.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Interpret component behavior subjected to static and fatigue loads and identify the failure criteria	K3
CO2	Analyze the load carrying capacity of riveted joints, and welded joints	K4
CO3	Analyze stress carrying capacity and deformation of helical and leaf springs	K4
CO4	Analyze the load carrying capacity of belts and pressure vessels	K4

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	2	-	-	-	2	2	-	-	-	2	2
CO2	3	3	2	-	-	-	2	2	-	-	-	2	2
CO3	3	3	2	-	-	-	2	2	-	-	-	2	2
CO4	3	3	2	-	-	-	2	2	-	-	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to Design- Definition, steps in design process, preferred numbers, standards and codes in design. Materials and their properties- Elastic and plastic behaviour of metals, ductile and brittle behaviour, shear, bending and torsional stresses, Factor of safety, stress concentration, combined stresses, stress concentration factor. Notch sensitivity, Shock and impact loads, fatigue loading, endurance limit stress, factors affecting endurance limit, Design for fatigue loading; Combined steady and variable stress- Gerber, Goodman and Soderberg method	10	1
2	Design of riveted joints- Material for rivets, modes of failure, efficiency of joint, design of boiler and tank joints, structural joints. Design of welded joints- welding symbols, stresses in fillet and butt welds, Butt joint in tension, fillet weld in tension, fillet joint under torsion, fillet weld under bending, eccentrically loaded welds.	9	2
3	Springs- classification, spring materials, stresses and deflection of helical springs, axial loading, curvature effect, resilience, static and fatigue loading, surging, critical frequency, concentric springs, end construction. Leaf springs- Flat springs, semi elliptical laminated leaf springs, design of leaf springs, nipping	9	3
4	Design of flat belt- materials for belts, slip of the belts, creep, centrifugal tension. Design of V-belt drives, Advantages and limitations of V-belt drive Cylinders and Pressure vessels, thin cylinders, thick cylinders, Open and closed vessels, Lame's, Clavarino's and Birnie's equations. Dilation.	8	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Machine Design – An Integrated Approach	Robert L. Norton	Pearson Education	5 th edition, 2018
2	Design of Machine elements	V.B. Bhandari	Tata McGraw Hill	5 th edition, 2020
3	Design of Machine elements,	Jalaludeen	Anuradha Publications, Chennai	2014
4	A Text book of Machine Design	Dr. P. C. Sharma, Dr. D. K. Aggarwal	S.K. Kataria & Sons	2017

Data Books permitted for reference in the final examination				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Design Data Hand Book	K. Mahadevan, K. Balaveera Reddy	CBS Publishers & Distributors	4 th edition, 2019
2	PSG Design Data Hand book	PSG Tech	DPV Printers, Coimbatore	2022
3	Machine Design Data Handbook	Narayana Iyengar B.R, Lingaiah K	Tata McGraw Hill/Suma Publications	1984

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanical Engineering Design	J. E. Shigley	McGraw Hill	2003
2	Fundamentals of Machine Component Design,	Juvinall R.C, Marshek K.M.	John Wiley	5 th edition, 2011
3	Shigley's Mechanical Engineering Design	Richard G. Budynas, J. Keith Nisbett	McGraw Hill	11 th edition, 2020
4	Design of Machine Elements	M. F. Spotts, T. E. Shoup	Pearson Education	8 th edition, 2019
5	Machine Elements: Life and Design	Boris M Klebanov, David M. Barlam, Frederic E. Nystrom	CRC Press	2019

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1 - 4	Module 1 - 4	https://nptel.ac.in/courses/112105124 https://nptel.ac.in/courses/112105125

THERMAL ENGINEERING

Course Code	24SJPBMET604	CIE Marks	60
Teaching Hours/Week (L:T:P:R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	24SJPCMET403 Engineering Thermodynamics	Course Type	PC-PBL

Course Objectives:

- To become proficient with steam turbines and steam power systems.
- To comprehend and evaluate the performance of internal combustion engines and examine their combustion processes

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the basic thermodynamic principles and analyse the operation of steam power cycles	K3
CO2	Analyse the performance of steam turbines and identify methods to improve their efficiency.	K3
CO3	Identify the performance parameters of IC engines and evaluate their performance.	K3
CO4	Explain the combustion phenomenon and pollution in IC engines and latest advancements in IC engines technology	K2
CO5	Conduct case studies, carry out simulation/testing, and prototyping.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	1
CO2	3	3	-	-	-	-	-	-	-	-	-	3	1
CO3	3	2	-	-	-	-	-	-	-	-	-	3	1
CO4	2	2	-	-	-	3	-	-	-	-	2	3	2
CO5	3	3	2	2	2	2	1	2	3	3	2	3	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Steam Power Cycle: Simple Rankine cycle, Improvements in Rankine cycles - Reheat and Regenerative cycles – Numerical problems.</p> <p>Steam Boilers: Types of boilers, Fire tube boiler - Cochran boiler, Water tube boiler - Babcock and Wilcox, Boiler Mountings and Accessories.</p> <p>Steam nozzles: -Types of nozzles, Velocity, Effect of friction, nozzle efficiency and its effects - Simple numerical problems, Super saturated flow.</p>	11	1
2	<p>Steam turbines: Classification, compounding of turbines- pressure velocity variation. Velocity diagrams, work done, efficiency, Condition for maximum efficiency (Derivation not required). Graphical Method for solving velocity triangle problems on impulse and reaction turbines.</p> <p>Multistage turbines -Condition line, stage efficiency, reheat factor and degree of reaction. Governing of turbines – Centrifugal governing and Nozzle governing.</p>	11	2
3	<p>Fundamentals of IC Engines: Air standard cycles, their analysis, and applications - Otto cycle, Diesel cycle, Dual cycle, Atkinson cycle (No numerical problems and derivations)</p> <p>Reciprocating type SI and CI engines: Ideal and Actual cycle for IC engines– Deviation from ideal cycle and associated factors. Super charging, and turbo charging.</p> <p>Engine Testing and Performance of SI and CI engines: Torque, Engine power- BHP, IHP, Efficiencies of IC engines, Specific fuel consumption, Mean effective pressure. Morse test, Heat balance test and Retardation test – Simple Numerical problems.</p>	11	3
4	<p>Combustion in IC Engines: Fuels for IC engines, Ignition limits, air-fuel ratio, equivalence ratio.</p> <p>S.I. engines: Stages of combustion in S.I. Engines, Ignition lag, abnormal combustion in S.I. Engine and its effects, Effects of engine variables on detonation and Octane rating of fuels.</p> <p>C.I. Engines: Stages of combustion in C.I engines, Delay period, variables affecting delay period; knocking, Cetane rating of fuels.</p> <p>Major pollutants from S.I. and C.I. Engines, Measurement of exhaust emissions, Emission Control techniques – Catalytic convertors, Particulate traps, Exhaust Gas Recirculation, Selective Catalytic Reduction (SCR),</p> <p>Advanced technologies in IC engines (briefly): MPFI, GDI, HCCI, VVT and VVL, CRDi, VGT.</p>	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Project	Internal Exam 1	Internal Exam 2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)	<ul style="list-style-type: none"> 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. (4x6 = 24 marks)	40

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

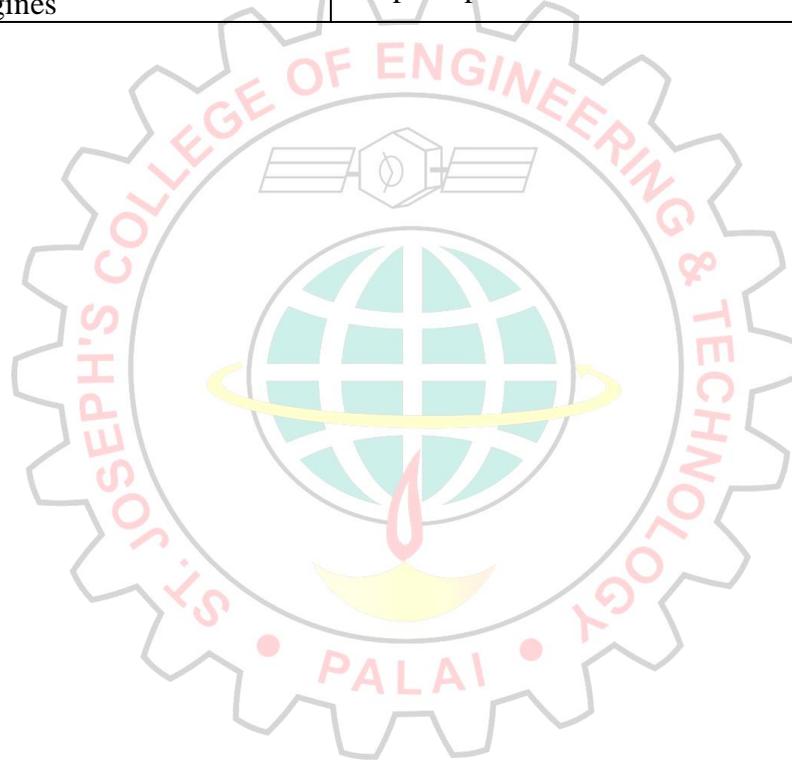
Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

- 1. Project Planning and Proposal (5 Marks)**
 - Clarity and feasibility of the project plan
 - Research and background understanding
 - Defined objectives and methodology
- 2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
 - Individual contribution to the presentation
 - Effectiveness in answering questions and handling feedback
- 3. Involvement in the Project Work and Team Work (3 Marks)**
 - Active participation and individual contribution
 - Teamwork and collaboration
- 4. Execution and Implementation (10 Marks)**
 - Adherence to the project timeline and milestones
 - Application of theoretical knowledge and problem-solving
 - Final Result
- 5. Final Presentation (5 Marks)**
 - Quality and clarity of the overall presentation
 - Individual contribution to the presentation
 - Effectiveness in answering questions
- 6. Project Quality, Innovation, and Creativity (3 Marks)**
 - Overall quality and technical excellence of the project
 - Innovation and originality in the project
 - Creativity in solutions and approaches

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Thermal Engineering	Rudra Moorthy	McGraw Hill Education India	2003
2	Thermal Engineering	R.K Rajput	Laxmi publications	2010
3	Fundamentals of IC engines	V. Ganesan	Tata McGraw-Hill	2002
4	Fundamentals of IC engines	H N Gupta	PHI	Second Edition, 2018
5	Internal Combustion Engines	V Sajith and Shijo Thomas	Oxford University Press	2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	I.C engine fundamentals	J.B.Heywood	McGraw-Hill	2011
2	Thermal Engineering	Mahesh Rathore	McGraw Hill Education India	2010
3	Diesel Engine Management	Robert Bosch	Wiley	2014
4	Gasoline-Engine management	Robert Bosch	Bentley Publishers	2006
5	Engine Emissions: Pollutant Formation and Advances in Control Technology	B.P.Pundir	Narosa	2007

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1,2	Rankine Cycle, Boiler, Steam Nozzle, Steam Turbine	http://digimat.in/nptel/courses/video/112103277/L03.html
3	Otto and Diesel cycles	https://www.youtube.com/watch?v=G02aeguJBwc
3	IC Engine Testing and Performance Parameters	https://www.youtube.com/watch?v=DjbbItLWNVQ
4	Combustion in SI Engines	https://www.youtube.com/watch?v=F24UWsOkMSI
4	Combustion in CI Engines	https://www.youtube.com/watch?v=dYM-T1c-65g
4	Pollutant formation in SI and CI engines	https://www.youtube.com/watch?v=V83pI7WbSpM
4	Pollutants from SI and CI engines	https://nptel.ac.in/courses/112104033



DESIGN THINKING AND PRODUCT DEVELOPMENT

Course Code	24SJGCEST605	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	60
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

- To guide students through the iterative stages of design thinking, including empathizing with users, defining problems, ideating solutions and developing Proof of Concepts (PoC) and technical feasibility studies.
- To promote the development of critical thinking skills by engaging students in integrative inquiry, where they ask meaningful questions that connect classroom knowledge with real- world applications.
- To equip students with the ability to involve in product design considering the sustainability, inclusivity, diversity and equity aspects.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Empathize to capture the user needs and define the objectives with due consideration of various aspects including inclusivity, diversity and equity	K5
CO2	Ideate using divergent and convergent thinking to arrive at innovative ideas keeping in mind the sustainability, inclusivity, diversity and equity aspects.	K6
CO3	Engage in Human Centric Design of innovative products meeting the specifications	K5
CO4	Develop Proof of Concepts (PoC), prototypes & pilot build of products and test their performance with respect to the Specification Requirement Document.	K4
CO5	Reflect on professional and personal growth through the learnings in the course, identifying areas for further development	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	2	-	2	3	3	2	2	-	3	-	2
CO2	3	2	3	-	2	3	3	2	2	-	3	1	3
CO3	3	2	3	-	2	3	2	2	2	-	3	3	3
CO4	3	2	2	-	3	3	2	2	2	-	3	3	3
CO5	3	-	-	-	-	3	2	2	2	-	3	2	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

SYLLABUS

Module No.	Syllabus Description	Contact Hours	CO
1	<p>Fundamentals of design thinking and product development: Overview of stages of product development lifecycle; Design thinking - Definition-Design thinking for product innovation; Bringing social impact in ideation-Identifying societal needs-understanding multi-faceted issues-community engagement and empathetic design-technological innovation meeting societal needs; Understanding and Bridging the divide using Human Centered Design (HCD); Designing for inclusivity in product development-embracing user diversity - Long term impact - sustainability encompassing environmental, economic and social dimensions; Technology Readiness Level in the Innovation Life-cycle;</p> <p>Performing a self-check on innovative ideas - Originality of idea-understanding innovation landscape - patentability - understanding the economic landscape - Unique Selling Proposition (USP) - Repeatability and Manufacturability - Sustainability - Leveraging business models for comprehensive analysis.</p>	6	1, 5
2	<p>Empathize: Design thinking phases; Role of empathy in design thinking; Methods of empathize phase - Ask 5 Why/ 5 W+H questions; Empathy maps - Things to be done prior to empathy mapping - Activities during and after the session; Understanding empathy tools - Customer Journey Map - Personas.</p> <p>Define: Methods of Define Phase: Storytelling, Critical items diagrams, Define success.</p>	6	2, 5
3	<p>Ideation : Stages of ideation; Techniques and tools - Divergent thinking tools - Convergent thinking tools - Idea capturing tools; Cross-industry inspiration; Role of research in ideation - Market research - consumer research - leveraging research for informed ideation; Technological trends - navigating the technological landscape - Integrating emerging technologies; Feasibility studies - technical, economic, market, operational, legal, and ethical feasibility; Ideation session- techniques and tips.</p> <p>Proof of Concept (PoC): Setting objectives; Risk assessment; Technology scouting; Document and process management; Change management; Knowledge Capture; Validating PoC; Story telling in PoC presentation</p>	6	3, 5
4	<p>Design: Navigating from PoC to detailed design; Developing Specification Requirement Document (SRD); Design for manufacturability; Design to cost; Pre-compliance; Design Failure Mode and Effects Analysis (DFMEA); Forecasting future design changes.</p> <p>Prototyping: Alpha prototypes; Beta prototypes; Transition from design to prototype; Goals and expectations for Alpha and Beta prototypes; Effective strategies for maintaining timeline in prototyping; Testing and refining Alpha prototypes; Transitioning to Beta prototypes.</p> <p>Pilot build: Definition and purpose of a pilot build; setting objectives; Identification and selection of manufacturing partner for pilot build; Testing procedures in pilot build; Scaling from pilot build to full-scale production / implementation.</p>	6	4, 5

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment/ Microproject	Internal Examination -1 (Written)	Internal Examination - 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3marks (8x3 =24marks) 	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks) 	60

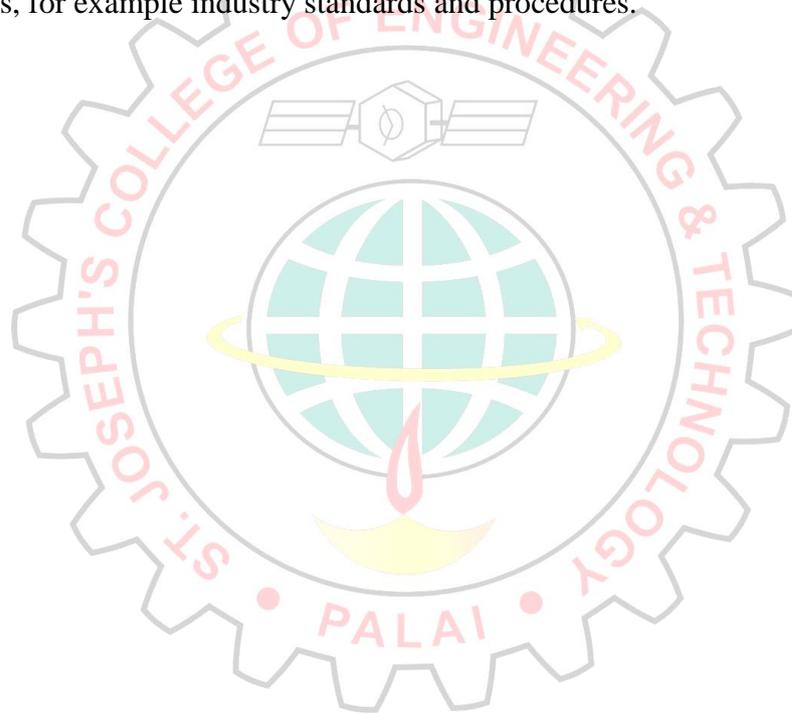
Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Product Sense: Engineering your ideas into reality	Dr. K R Suresh Nair	NotionPress.com	2024
2	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation	Tim Brown	Harper Collins Publishers Ltd.	2009
3	Design Thinking for Strategic Innovation	Idris Mootee	John Wiley & Sons Inc.	2013

Sample Assignments:

1. Evaluate and prepare a report on how the aspects including inclusivity, diversity and equity are taken into consideration during the empathize and define phases of the Miniproject course.
2. Evaluate and prepare a report on how the aspects including sustainability, inclusivity, diversity and equity are taken into consideration during the ideate phase of the

Miniproject course.

3. Evaluate and prepare a report on how User-Centric Design (UCD) is used in the design and development of PoC of the product being developed in the Miniproject course.
4. Prepare a plan for the prototype building of the product being developed in the Miniproject course.
5. Report on the activities during the empathize phase including the maps & other materials created during the sessions.
6. Report on the activities during the define phase including the maps & other materials created during the sessions.
7. Report of all the ideas created during the ideation phase of the Miniproject course through the tools including SCAMPER technique, SWOT analysis, Decision matrix analysis, six thinking hats exercise
8. Prepare a full-scale production plan for the product being developed in the Miniproject course.
9. Create a Stanford Business Model Canvas related to the Miniproject.
10. An industrial visit of at least a day for experiential learning and submit a report on the learnings, for example industry standards and procedures.



COMPUTER AIDED DESIGN AND ANALYSIS LAB

Course Code	24SJPCMEL607	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Computer Aided Machine Drawing and Modelling (24SJPCMEL307)	Course Type	PCL

Course Objectives:

- **To become proficient** in using CAD and FEA tools to design and simulate mechanical systems such as the Whitworth quick return mechanism and four-bar linkage, and to analyze structural elements like bars and trusses.
- **To develop the ability** to perform dynamic simulations and evaluate mechanical systems under various loading conditions, including studies of kinematics, fatigue, and heat transfer in both steady-state and transient states.
- **To gain competence** in applying computational fluid dynamics (CFD) tools to analyze fluid flow over airfoils and to improve designs by minimizing flow separation and recirculation zones.

Course Outcomes (COs)

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

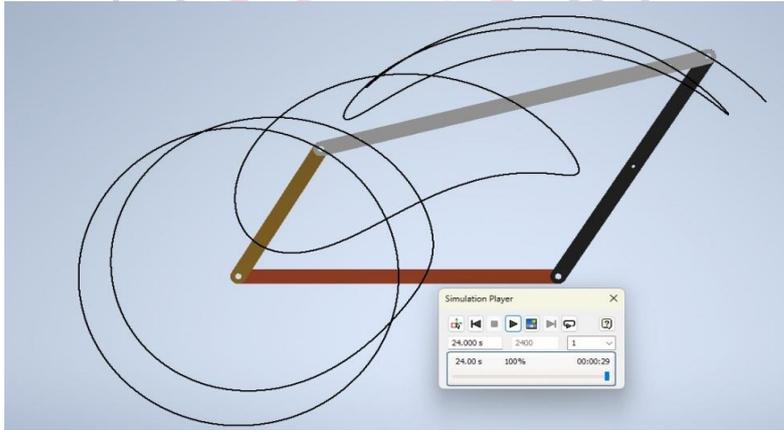
Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply CAD and FEA tools to design and simulate mechanical systems	K3
CO2	Perform dynamic simulations of mechanical systems and analyze their kinematic behavior	K4
CO3	Conduct thermal and stress analysis on mechanical components under different loading conditions.	K5
CO4	Design optimized mechanical components and airflow systems using Computational Fluid Dynamics (CFD) software.	K6

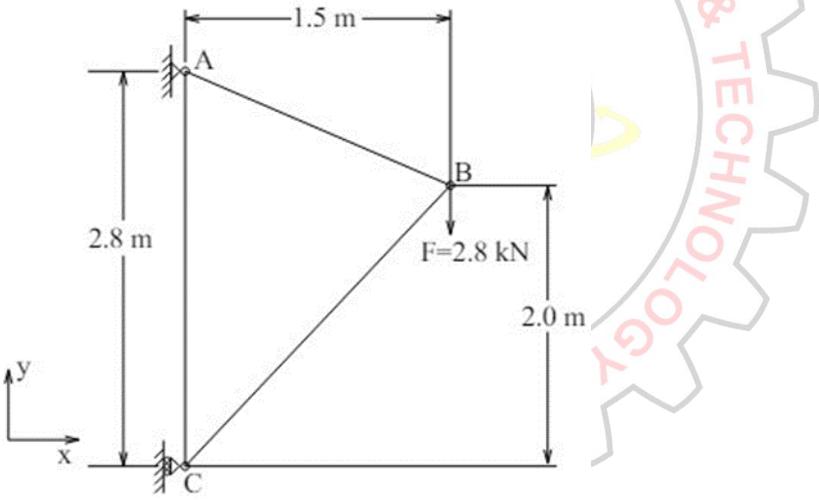
K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	3	2	3	1	2	1	2	2	2	2	2
CO2	3	3	3	3	3	1	1	1	3	2	2	2	2
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2
CO4	3	3	3	3	3	2	3	1	3	2	2	2	2

List of Experiments

Expt. No.	Experiments	CO's
1	<p>Perform a dynamic simulation of a four-bar mechanism.</p> <p>Example Problem Description.</p> <p>Perform a dynamic simulation of a four-bar mechanism using dynamic simulation. The dimensions of the mechanism are as follows: Crank = 100 mm, Coupler = 275 mm, Follower = 150 mm, and Fixed Link = 200 mm. Your objectives are to find the coupler curve at the center point of the coupler, 100 mm towards the crank, and 100 mm towards the follower. Additionally, determine the velocity and acceleration curves of the follower with respect to the fixed link, and specifically find the acceleration and velocity of the follower at crank angles of 30°, 60°, and 90°. Begin by modeling the four-bar mechanism, setting up the simulation with appropriate joints, and running the simulation over a complete cycle of the crank. Trace and document the specified coupler curves, plot the velocity and acceleration curves of the follower, and tabulate the velocity and acceleration values at the specified crank angles. Submit a comprehensive report including the 3D model, plots, and a brief discussion on the findings.</p> 	1, 2
2	<p>Design and Simulation of a Whitworth Quick Return Mechanism</p> <p>Design and simulate a Whitworth quick return mechanism with a specified quick return ratio. Analyze and plot the Coriolis component of acceleration, as well as the position of the slider in the slotted lever, acceleration and position of the tool ram throughout the mechanism's cycle.</p>	1, 2

3	<p>Perform a structural analysis of an axial bar with varying cross-sectional areas under axial load using FEA software to determine the stress distribution, strain distribution, and total deformation.</p> <p>Example Problem Description:</p> <p>An axial bar of length $L=1\text{m}$ is subjected to an axial tensile load $P=10\text{kN}$. The bar has three different cross-sectional areas along its length: Section 1: From $x=0$ to 0.3m, the cross-sectional area is $A_1=50\text{mm}^2$, Section 2: From $x=0.3\text{m}$ to $x=0.7\text{m}$, the cross-sectional area is $A_2=75\text{mm}^2$, Section 3: From $x=0.7\text{m}$ to $x=1.0\text{m}$, the cross-sectional area is $A_3=100\text{mm}^2$. The bar is fixed at the end with the smallest cross-sectional area (Section 1).</p>	1, 3
4	<p>Perform a structural analysis of a truss using FEA software to determine the force in each member, identify if the members are in tension or compression, and calculate the support reactions.</p> <p>Example Problem Description:</p> <p>Analyze the given truss structure.</p> <p>The cross-sectional area of each truss member is 0.01m^2, the material of the truss members is steel with a Young's Modulus $E=2.1\times 10^5\text{MPa}$.</p>  <p>Figure 1: Geometry of the truss.</p>	1, 3
5	Perform the structural analysis of a thin plate (plane stress case) subjected to in plane loads.	1, 3
6	Perform the modal analysis of a cantilever beam	1, 3
7	Perform the harmonic analysis of a cantilever beam	1, 3
8	<p>Perform an Eigen-buckling analysis using FEA software. Example Problem Description:</p> <p>Conduct an Eigenbuckling Analysis of a column with I-section using a FEM software to determine the shape numbers and load multipliers for the column. Compare the results obtained with Euler's critical buckling load formula. Additionally, provide the following results: the critical buckling load, the mode shapes,</p>	1, 3

	the corresponding displacements, and the stress distribution for each mode.	
9	<p>Perform a fatigue analysis using FEA software.</p> <p>Example Problem Description:</p> <p>Perform a fatigue analysis on a Formula SAE hub subjected to a torque of 300 N-m and a dead load of 700 N per wheel. Determine the number of cycles to fatigue failure for the hub under these specified loading conditions.</p>	1, 3
10	<p>Solve a steady-state heat conduction problem using FEA software to determine the temperature distribution within a solid material.</p> <p>Example Problem Description:</p> <p>Consider a rectangular solid plate with dimensions $L = 200$ mm (length), $W = 100$ mm (width), and $t = 10$ mm (thickness). Material Properties given, Thermal conductivity, $k = 50$ W /mK, Density, $\rho = 7800$ kg/m³, Specific heat capacity, $C = 500$ J/kgK.</p> <p>Boundary Conditions:</p> <p>Left edge ($x = 0$ mm): Maintained at a constant temperature $T_1 = 100$ C. Right edge ($x = 200$ mm): Maintained at a constant temperature $T_2 = 50$ C. Top and bottom surfaces ($y = 0$ mm and $y = 100$ mm): Insulated (no heat flux).</p> <p>Front and back surfaces ($z = 0$ mm and $z = 10$ mm): Insulated (no heat flux).</p>	1, 3
11	<p>Perform a transient heat transfer analysis of a solid fin subjected to natural convection using FEA software to determine the temperature distribution and heat transfer over time.</p> <p>Example Problem Description:</p> <p>Consider a rectangular solid fin made of aluminum with dimensions: length $L = 100$ mm, width $W = 50$ mm, and thickness $t = 5$ mm. The fin is made of aluminum, having a thermal conductivity of $k = 237$ W /mK, density of $\rho = 2700$ kg/m³, and a specific heat capacity of $C = 900$ J/kgK. Initially, the fin is at a uniform temperature of $T_0 = 25^\circ\text{C}$. One end of the fin ($x = 0$ mm) is subjected to a constant heat flux of $q = 2000$ W /m², while the surrounding air temperature is $T_{\text{sur}} = 25^\circ\text{C}$ with a convective heat transfer coefficient $h = 10$ W/m² K on all other surfaces. Perform a transient thermal analysis for a duration of $t = 3600$ s (1 hour) with appropriate time steps. The analysis aims to determine the temperature distribution and heat transfer in the fin at various time intervals, including contour plots showing the temperature distribution at different intervals and values of temperature at key points, the base (near 0 mm), the tip ($x = 100$ mm), and the midpoint ($x = 50$ mm). The results should include the total heat transfer rate from the fin to the surrounding air and heat flux distribution plots at the specified time intervals.</p>	1, 3
12	Perform the 2D flow analysis of an airfoil	1, 4

Perform a flow analysis to improve the design of an air intake manifold for a pneumatic device by analyzing flow separations and recirculation zones using flow analysis software

13

1, 4

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by External Examiner: The external examiner shall endorse the record*

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Design with SolidWorks 2019	David C. Planchard and Marie P. Planchard	SDC Publication	2019
2	Creo Parametric 6.0 for Engineers and Designers	Prof. Sham Tickoo	BPB Publications	2018
3	Finite Element Analysis: Theory and Application with ANSYS	Saeed Moaveni	Pearson	1999
4	Fundamentals of Heat and Mass Transfer	Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, and David P. DeWitt	John Wiley & Sons	2017
5	Introduction to Computational Fluid Dynamics	Anil W Date	Cambridge University Press	2005

Video Links (NPTEL, SWAYAM...)		
Exp. No.	Topic	Link ID
1 - 2	SolidWorks tutorial's	https://www.solidworks.com/support/training/training-files/
3 - 13	FEA analysis – Ansys tutorial's	https://www.ansys.com/en-in/academic/learning-resources

MINI PROJECT

Course Code	24SJPCMEP608	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:0:3	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PWS

Preamble

The Mini Project requires students, in consultation with their guides, to select a topic from research literature or propose suitable topics themselves.

Course Objectives:

- To enable students to undertake an investigative study in the broad field of Mechanical Engineering
- Conduct a study which can be fully theoretical, fully practical, or involve both theoretical and practical work.
- Assign the project to a group of three or four students under the guidance of a supervisor.
- The work is intended to provide a good initiation into R&D work in socially relevant areas.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify and synthesize problems and propose solutions to them.	K3
CO2	Prepare work plan and liaison with the team in completing as per schedule.	K3
CO3	Validate the above solutions by theoretical calculations and through experimental	K3
CO4	Write technical reports and develop proper communication skills, present the data and defend ideas.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	3	3	-	-	-	-	3	3	3	3	3
CO2	3	-	-	3	-	-	-	3	3	3	3	3	3
CO3	3	3	3	3	3	-	-	-	-	3	-	3	3
CO4	-	-	-	-	3	-	-	3	3	3	-	1	1

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation (CIE)**

The CIE is conducted by evaluating the progress of the mini project through a **minimum of two reviews**. The final CIE mark is the average of the 1st and 2nd review marks. A zeroth review may be conducted before the project begins but is not part of the CIE evaluation.

Continuous Internal Evaluation Marks (CIE):

Attendance	Marks by Guide	Project Report	Evaluation by Committee	Total
5	15	10	20	50

Review Details:

- **Review:** Students propose a new system/design/idea after completing a thorough literature study of existing systems.
- **Review:** Students highlight the implementation details of the proposed solution. The review committee assesses the extent to which the implementation reflects the proposed design. A well-coded, assembled, and completely functional product is the expected output at this stage.

End Semester Examination Marks (ESE):

The ESE is an internal evaluation conducted by a 3-member committee appointed by the Head of the Department. The committee includes the HoD or a senior faculty member, the academic coordinator, and the project guide/coordinator.

Demonstration	Presentation	Viva	Total
20	20	10	50

The ESE is based on the **product demonstration, the report, and a viva-voce examination**. The committee evaluates:

- Level of completion and demonstration of functionality/specifications.
- Presentation, oral examination, working knowledge, and involvement.
- The final product must be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, and aesthetics/ergonomic aspects are given due weight.

THERMAL ENGINEERING LAB - 2

Course Code	24SJPCMEL609	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:2:0	ESE Marks	50
Credits	1	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	24SJPCMET403: Engineering Thermodynamics	Course Type	PCL

Course Objectives:

- To familiarize the various systems and subsystems of IC engines
- To conduct the performance test on IC engines, compressors / blowers

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify various systems and subsystems of Diesel and petrol engines.	K1
CO2	Analyse the performance and heat balance characteristics of IC engines to evaluate their overall energy performance.	K4
CO3	Interpret the performance characteristics of air compressors / blowers	K4
CO4	Determine the calorific value, flash point, and fire point of various fuels and analyse their suitability for thermal systems	K4

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	3	3	-	-	2	2
CO2	3	2	-	-	-	-	-	3	3	-	-	2	2
CO3	3	2	-	-	-	-	-	3	3	-	-	2	2
CO4	3	2	-	-	-	-	-	3	3	-	-	2	2

EXPERIMENTS

Expt. No.	Experiments	CO
Study	a) Familiarisation of various systems and subsystems of petrol engine / MPFI engine b) Familiarisation of various systems and subsystems of Diesel engine / Turbocharged engine	1
1	Performance test on petrol engines / MPFI engine	2
2	Performance test on Diesel engines / Turbocharged engine	2
3	Heat Balance test on petrol/Diesel engines	2
4	Determination volumetric efficiency and Air-fuel ratio of IC engines	2
5	Cooling curve of IC engines	2
6	Valve timing diagram of IC engines	1, 2
7	Economic speed test on IC engines	2
8	Retardation test on IC engines	2
9	Morse test on petrol engine	2
10	Analysis of automobile exhaust gas and flue gas using exhaust gas analyser	2
11	Performance test on reciprocating compressor	3
12	Performance test on rotary compressor/blower	3
13	Determination of calorific value of gaseous fuels- Gas calorimeter	1
14	Determination of calorific values of solid and liquid fuels- Bomb calorimeter	1
Note: 8 Experiments are mandatory		

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/Programming.	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of IC engines,	V. Ganesan	Tata McGraw-Hill	4, 2017
2	I.C engine fundamentals,	J.B. Heywood	McGraw-Hill	2, 2018
3	Engineering Fundamentals of the Internal Combustion Engine	Pulkrabek, W.W.	Pearson Education	2,2003

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	An Introduction to Combustion: Concepts and Applications	Stephen R Turns	McGraw-Hill	3, 2011
2	Thermal Engineering	R.K. Rajput	Laxmi Publications	7, 2013

Sl. No	Topic	NPTEL, Video Links
1	Fundamentals of IC Engines	https://www.youtube.com/watch?v=jmQinAa0AP0&list=PLh_Qa0GX8LCCjBgZdyASLWqhde-KokWUt&index=1
2	Fundamental of Automotive Systems	https://www.youtube.com/watch?v=H_RgFXjg-5s&list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F
3	Fundamentals of Reciprocating Compressors	https://www.youtube.com/watch?v=AwbhbN20x18&list=PLwdnzlV3ogoVJnW1S9GgOKYj5heOzl1dn

PROGRAM ELECTIVE 3

POWER PLANT ENGINEERING

Course Code	24SJPEMET631	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	-	Course Type	PE

Course Objectives:

- To develop a comprehensive understanding of steam, gas, hydro and nuclear power plants and various energy storage systems.
- To familiarize various terms related to power plant economics.

Course Outcomes (COs)

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

Course Outcome	Description	Bloom's Knowledge Level (KL)
CO1	Calculate the performance parameters of simple and modified Rankine cycles.	K3
CO2	Calculate the performance parameters of steam turbines and steam nozzles.	K3
CO3	Explain the layout, components and working of steam, gas, hydro, and nuclear power plants.	K2
CO4	Discuss the working of various energy storage systems, economics of power generation and pollution from power plants and their effect on the environment	K2

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	2	3	1
CO2	3	3	3	-	-	-	-	-	-	-	2	3	1
CO3	3	2	2	-	-	-	-	-	-	-	2	3	1
CO4	3	2	2	-	-	-	-	-	-	-	2	3	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Analysis of Steam Cycle Steam engineering-temperature entropy diagram- Mollier diagram-Rankine cycle-steam power plant, internally irreversible and externally irreversible Rankine cycle-Mean temperature of heat addition-Effect of superheat and inlet pressure-Reheating of steam, Regeneration-Regenerative feed water heating-Feed water heaters- Efficiencies in a steam power plant-binary vapor cycle</p>	9	1
2	<p>Steam generator classifications Cochran boiler-Lancashire boiler-Cornish boiler-locomotive boiler-Babcock and Wilcox boiler Stirling boiler-high pressure boilers- boiler mountings and accessories</p> <p>Steam nozzles Flow through steam nozzles-throat pressure for maximum discharge-effect of friction-super saturated flow</p> <p>Steam turbines Impulse and reaction turbines-velocity diagram-condition for maximum efficiency-compounding-reheat factor-blade height- governing of steam turbines-cogeneration and combined cycle power generation</p>	9	2
3	<p>Thermal power plants: General layout-site selection-fuel handling, storage and burning systems-dust and ash handling system-chimney draught</p> <p>Nuclear power plants: Classification-components-safety measures-effects of nuclear radiation-nuclear waste disposal.</p> <p>Gas turbine power plants: Classification-closed open and other systems</p> <p>Hydro Electric Power Plants: Classification- Typical Layout and associated components</p>	9	3
4	<p>Energy Storage Pumped hydro, Compressed air energy storage, flywheel energy storage, Electrochemical energy storage, magnetic energy storage, Thermal energy storage, Chemical energy storage</p> <p>Economics of power generation Estimation of load-load curve-load factor-diversity factor-capacity factor-use factor-economics in plant selection-economics of generation and distribution of power-useful life-tariff for electrical energy.</p> <p>Environmental pollution and its control Pollutants from power plants-control of pollutants-control of particulate matter -Control of SO₂- control of wastewater from steam power plants-pollution from nuclear power plants-noise pollution and noise control</p>	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Plant Technology	M. M. El Wakil	McGraw Hill Education	1 st , 2017
2	Power Plant Engineering	P. K. Nag	McGraw Hill Education	4 th , 2017

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Plant Engineering	G. R. Nagpal, S. C. Sharma	KHANNA Publishers	16 th , 2012
2	Power Plant Engineering	Manoj Kumar Gupta	PHI Learning Pvt. Ltd	1 st , 2012

Video Links (NPTEL, SWAYAM...)

Module No.	Topic	Link ID
1	Analysis of Steam Cycle	https://nptel.ac.in/courses/112107291
2	Steam generator classifications, Steam nozzles & Steam turbines	https://nptel.ac.in/courses/112107291
3	Thermal, nuclear, gas turbine, hydro and electric power plants	https://nptel.ac.in/courses/112107291
4	Economics of power generation, environmental pollution and its control	https://nptel.ac.in/courses/112107291

COMPRESSIBLE FLUID FLOW

Course Code	24SJPEMET632	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	24SJPCMET303	Course Type	PE

Course Objectives:

- To provide a foundation in compressible fluid mechanics, focusing on steady, one-dimensional flow problems.
- Understand the fundamental concepts and governing equations of Rayleigh flow in constant area ducts.
- Analyze compressible flow problems involving ducts with friction, heat transfer.
- To familiarise property variations across normal and oblique shock waves.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the basic concepts of compressible fluid mechanics to analyze one-dimensional isentropic flow problems.	K3
CO2	Apply the principles of compressible flow to analyze Fanons flow and the effects of friction in ducts	K3
CO3	Apply the principles of compressible flow to analyze Rayleigh flow and the effects of heat transfer in constant area ducts.	K3
CO4	Apply compressible flow principles to analyze shock waves and supersonic flow properties.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	2
CO2	3	2	2	2	-	-	-	-	-	-	-	2	2
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2
CO4	3	3	-	2	-	-	-	-	-	-	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Fundamentals of compressible flow: Various regimes of flow, Reynolds transport theorem-Governing equations for compressible flows. Mach number, Mach waves, Mach cone and Mach angle, Sonic boom. Concept of stagnation state, stagnation properties. Adiabatic energy equation, various regions of flow, adiabatic ellipse One Dimensional isentropic flow: adiabatic and isentropic flow of a perfect gas, isentropic flow in ducts of varying cross-sections, nozzles, mass flow rate, critical properties, choking, impulse function, operation of nozzle under varying pressure ratios-Use of gas tables.10	10	1
2	Flow in constant area duct with friction: Assumptions, Governing equations, Fanno curve on h-s and P-v diagram, Fanno flow relations for a perfect gas, variation of Mach number with duct length, choking due to friction, Use of gas tables for Fanno flow. Isothermal flow (elementary idea only)	8	2
3	Flow through constant area duct with heat transfer (Rayleigh Flow): Assumptions, Governing equations, Rayleigh line on h-s and P-v diagram, Rayleigh relation for perfect gas, maximum possible heat addition, location of maximum enthalpy and entropy points, thermal choking, Use of gas tables for Rayleigh flow.	9	3
4	Irreversible discontinuity in supersonic flow: Development of shock wave, types of shock waves, governing equations, strength of shock waves, normal Shock on T-S diagram, Prandtl-Mayer relation, Rankine-Huguenot relation, Mach number downstream of normal shock, variation of flow parameters across the normal shock, normal shock in Fanno and Rayleigh flows, Use of gas tables for normal shocks. Oblique shock waves - supersonic flow over compression and expansion corners (elementary idea only). Wind tunnel types, measurement of velocity, pressure, and temperature	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Dynamics and Thermodynamics of Compressible Fluid Flow. Vol I	Shapiro A.H	John Wiley & Sons	1977
2	Fundamental of Compressible flow	S. M. Yahya	New age international Publication	7 th edition, 2023
3	Gas Dynamics	E. Rathakrishnan	PHI Learning	7 th edition, 2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Compressible Flow: With Historical Perspective.	John D. Anderson	McGraw-Hill, Inc	4 th edition, 2021
2	Fundamentals of compressible fluid dynamics	P. Balachandran	PHI Learning Pvt. Ltd.	2006
3	Elements of Gas Dynamics	Liepmann and Roshako	Dover Publications Inc.	2002

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Wave propagation in compressible medium	https://youtu.be/BYqZPwQPU_4
2	One dimensional isentropic flow	https://youtu.be/TYqxQS6ZPC4
3	Compressible flow with friction and Heat transfer	https://youtu.be/C2JIBOmEZ4k
4	Normal shock waves	https://youtu.be/Jrdm7Pwssto

INDUSTRIAL TRIBOLOGY

Course Code	24SJPEMET633	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- To provide a comprehensive understanding of the fundamental concepts of tribology
- To prepare students to integrate tribological knowledge into the design and analysis of engineering systems.
- To equip students with the analytical skills necessary to assess and solve tribological problems

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain fundamental principles of Tribology	K2
CO2	Understand Surface characterisation techniques for tribological investigations	K2
CO3	Explain Wear Measurement Techniques:	K2
CO4	Select and Evaluate Lubricants and Surface Treatments:	K2

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1
CO3	3	2	-	-	-	1	1	-	-	-	-	1	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Introduction to Tribology: Definition and Scope, Historical development and significance in engineering.</p> <p>Contact Mechanics: Types of contact: point, line, and surface contacts, Hertzian contact theory, Deformation of solid bodies under load</p> <p>Friction: Laws of friction, Types of friction: static, kinetic, and rolling friction Factors affecting friction. Theories of friction: adhesion, deformation, and plowing.</p>	9	1
2	<p>Wear: Types of wear: adhesive, abrasive, corrosive, and surface fatigue wear.</p> <p>Surface Topography: Statistical Parameters (Ra,Rz,RMS) Techniques of Surface Examination: Optical Microscopy, Electron Microscopy, Atomic Force Microscopy, Profilometry. Wear measurement techniques: Pin-on disk Tester and the Four Ball Tester.</p>	9	2
3	<p>Principles of Lubrication: Hydrodynamic lubrication, Boundary lubrication, Elasto-hydrodynamic lubrication (EHL)</p> <p>Lubrication Regimes: Thick film and thin film lubrication, Mixed lubrication, Stribeck curve and its significance</p> <p>Lubricant Properties and Classification: Physical and chemical properties of lubricants, Types of lubricants: oils, greases, and solid lubricants, Additives and their functions Criteria for selecting lubricants</p>	9	3
4	<p>Surface Treatments and Coatings:Heat treatments, surface hardening, and nitriding, Coatings: PVD, CVD, thermal spray coatings, and electroplating</p> <p>Tribology in Industries: Tribological challenges in engines, transmissions, and braking systems, Role of tribology in machining, forming, and finishing processes, Tribological issues in tool wear and lubrication in manufacturing</p> <p>Recent Advances and Future Trends: Emerging materials and technologies in tribology, Smart lubricants and self-lubricating materials, Sustainable tribology practices, Micro and Nano Tribology (Applications in MEMS/NEMS devices).</p>	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Tribology	G. W. Stachowiak and A. W. Batchelor	Butterworth-Heinemann,	Second, 2000.
2	Introduction to Tribology	Bharath Bhushan	Wiley-Blackwell	First, 2013
3	Engineering Tribology	John Williams	Cambridge University Press,	First, 2005
4	Tribology: Friction and Wear of Engineering Materials	I. M. Hutchings	Butterworth-Heinemann	Second, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Surface Engineering for Corrosion and Wear Resistance	J.R. Davis	ASM International	First, 2001
2	Lubrication and Lubricant Selection: A Practical Guide	A. R. Lansdown	ASME	Third, 2003
3	Tribology for Scientists and Engineers	Pradeep L. Menezes, Siddhartha Ghosh, and Bijoy Bhushan	Springer	First, 2013
4	Advanced Tribology: Proceedings of CIST2008 & ITS-IFT to MM2008	Jianbin Luo, Yonggang Meng, Tianmin Shao, and Qian Zhao	Springer	2010

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Introduction to Tribology	http://www.digimat.in/nptel/courses/video/112102014/L01.html
2	Wear & Surface Topography	http://www.digimat.in/nptel/courses/video/112102014/L01.html
3	Principles of Lubrication	http://www.digimat.in/nptel/courses/video/112102014/L01.html
4	Surface Treatments and Coatings	http://www.digimat.in/nptel/courses/video/112102014/L01.html

FINITE ELEMENT METHODS

Course Code	24SJPEMET634	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	24SJPCMET302 - Mechanics of Solids	Course Type	PE

Course Objectives:

- To study the basic procedure of FEM and stiffness formulation of simple element using direct method.
- To study the formulations of shape functions, strain displacement matrix and stress matrix.
- To study the energy method and Galerkin weight residual formulations.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand the governing equations of various physical phenomena and basic procedure of FEM.	K2
CO2	To apply the coordinate transformation and formulation of shape functions of various element and to formulate shape functions and element strain displacement matrix of various element	K3
CO3	Evaluate element stress using energy method and study Galekin weight residual formulations	K3
CO4	Study the concept of iso parametric elements and analyze iso parametric formulations	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	2	3	3
CO2	3	3	3	3	3	-	-	-	-	-	2	3	3
CO3	3	3	3	3	3	-	-	-	-	-	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	2	3	3

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction FEM, Mathematical Modelling of field problems in Engineering, Governing Equations – Discrete and continuous models, discretization-convergence behaviour. General procedure of Finite Element analysis, Types of elements, Formulation of stiffness matrix- one dimensional spring, bar element assembly and solution procedure	9	1
2	Types of coordinate system in FEM, coordinate transformation Plane truss stiffness formulation and its assembly. Shape functions, Derivation of shape functions using polynomial of One-Dimensional bar, 2-Dimensional CST and 1- Dimensional beam element. Convergence requirement of shape functions, Pascal triangle. Shape functions using Langrange polynomial.	9	2
3	Derivation of strain -displacement relation- B matrix- bar, CST and beam element. Potential energy and equilibrium, principle of minimum potential energy, Variational formulation in FEM. Element stiffness- bar, beam and CST element, consistent loads.	8	3
4	Strong and Weak form, Galerkin's weighted residual FEM formulation; One dimensional axially loaded bar, heat flow in a bar, natural coordinate system, Iso-parametric elements, Quadrilateral elements- Serendipity elements Iso-parametric formulations, Jacobian matrix, stiffness matrices, Numerical integration: Gaussian quadrature.	10	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	An introduction to Finite Element Method	J N Reddy	McGrawHill Education	Third Edition, 2009
2	Concept and application of Finite Element method	Robert D Cook	Wiley	Third Edition, 2008
3	Finite Element Analysis,	S S Bhavikatti	New Age Publisher	Third edition,2008
4	A First Course in Finite Elements	Jacob Fish Rensselaer, Ted Belytschko	John Wiley & Sons, Ltd	Second edition,2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Applied Finite Element Analysis	Larry J Segerlind	Johny Wiley and sons	Second Edition, 2010
2	Applied Finite element Analysis	G Ramamurthi	I K International Publishing House Pvt. Ltd	Second Edition
3	Fundamentals of Finite Element Methods	David V Hutton	McGraw Hill Education	Third Edition, 2009

Module No.	Link ID
1, 2, 3, 4	https://nptel.ac.in/courses/112106135

NON-DESTRUCTIVE TESTING

Course Code	24SJPEMET636	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

To comprehend the fundamental ideas, methodologies, tools, applications and constraints of NDT approach.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Have a basic knowledge of NDT Techniques which enables to carry out various inspections in accordance with the established procedures.	K2
CO2	Familiarize with basic principles of electromagnetic NDT methods	K2
CO3	Apply the principles of signal processing of ultrasonic signals and image processing of radiographic images.	K3
CO4	Have a better knowledge in the field of advanced techniques in NDT	K2

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	1	-	-	-	-	-	-	-	-	-	2	1
CO2	3	1	-	-	-	-	-	-	-	-	-	2	1
CO3	3	1	-	-	-	-	-	-	-	-	-	2	1
CO4	3	1	-	-	-	-	-	-	-	-	-	2	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>Visual Inspection: Fundamentals of visual testing, tools, applications and limitations. Vision, lighting, material attributes, environmental factors. Visual perception, direct and indirect methods, mirrors, magnifiers, boroscopes, fibrosopes, closed circuit television, light sources special lighting, a system, computer enhanced system.</p> <p>Liquid penetrant Testing: properties required for a good penetrants and developers - Types of penetrants and developers. LPI technique/ test procedure interpretation and evaluation of penetrant test indications, false indication and safety precaution required in LPI.</p>	9	1
2	<p>Magnetic Particle Testing: Methods of magnetization, magnetization techniques such as head shot technique, cold shot technique, central conductor testing, and magnetization using yokes. Direct and indirect method of magnetization, continuous testing of MPI, residual technique of MPI, system sensitivity, checking devices in MPI.</p> <p>Eddy Current Testing: physics aspects of ECT. Field factor and lift of effect, edge effect, end effect, impedance plane diagram in brief, depth of penetration of ECT, relation between frequency and depth of penetration in ECT. Equipment and accessories, Various application of ECT such as conductivity measurement, hardness measurement, defect detection coating thickness measurement</p>	9	2
3	<p>Ultrasonic Testing: UT testing methods, contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, ultrasonic testing techniques, resonance testing, through transmission technique, pulse echo testing technique, instruments used UT, accessories such as transducers, types, frequencies, and sizes commonly used. Reference blocks with artificially created defects, calibration of equipment.</p> <p>Radiography Testing (RT): Electromagnetic radiation sources. Inspection techniques like SWSI, DWSI, DWDI, panoramic exposure, real-time radiography, films used in industrial radiography, types of film, speed of films, qualities of film screens used in radiography, quality of a good radiograph, film processing, interpretation, evaluation of test results, safety aspects required in radiography.</p>	11	3
4	<p>Advanced NDI Techniques: Principle and Procedure of Digital Signal and image Processing & Digital Image correlation, Acoustic emission Inspection, Thermography, Computed Tomography</p>	7	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Practical Non-destructive testing	Baldev Raj	Alpha Science International	2008
2	Non - destructive testing	Hull V and V John	McMillan	2012
3	Non-Destructive testing Techniques	Ravi Prakash	New Academic Science	2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Recent developments in the field of non-destructive testing, safety and material science	Elena Lysenko, Alexander Rogachev, Oldrich Stary	Springer	2022
2	New Technologies in electromagnetic non-destructive Testing	Songling Huang & Shen Wang	Springer	2016
3	Recent Advances in Non - Destructive Inspection	Carosena Meola	Nova Science publishers	2010

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Liquid penetrant Testing	http://digimat.in/nptel/courses/video/113106070/L03.html
2	Eddy current testing	https://www.youtube.com/watch?v=_CkK90CVARM
3	Ultrasonic Testing	https://www.youtube.com/watch?v=UM6XKvXWVFA
4	Advanced NDI Techniques	https://www.youtube.com/watch?v=qCYXldk8shE

INDUSTRIAL SAFETY ENGINEERING

Course Code	24SJPEMET637	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- To understand the fundamental principles of industrial safety, accident causation theories, and the roles of management, employees, and organizations in promoting workplace safety and developing effective safety policies.
- To gain knowledge of personal protection methods, machine and material handling safety, construction safety practices, and ergonomic principles to prevent workplace hazards and injuries.
- To develop the ability to identify, assess, and control workplace hazards through systematic hazard analysis techniques, safety performance evaluation, and risk management tools.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify workplace hazards, explain accident causation and safety organization principles, and apply appropriate personal protection and safety monitoring methods.	K2
CO2	Explain housekeeping and work permit systems, and apply safety and ergonomic practices in construction as per relevant standards.	K3
CO3	Identify machine and material handling hazards, and apply appropriate safety measures, guarding techniques, and hearing conservation practices in industrial operations.	K2
CO4	Identify and assess various workplace hazards, including fire, chemical, and process hazards, and apply risk assessment and control methods using standard tools and techniques.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1	-	-	2	3	-	-	-	1	3	2
CO2	2	1	1	-	-	3	2	-	-	-	1	3	2
CO3	3	1	2	-	-	2	3	-	-	-	1	3	2
CO4	3	1	2	-	-	2	3	-	-	-	1	3	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Safety introduction and Personal protection in work environment: Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages. Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate.	9	1
2	Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces. Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.	9	2
3	Safety Hazards In Machines: Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.	9	3
4	Hazard Identification and Analysis - Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis, Hazard and	9	4

	Operability study (HAZOP)) – methodology, criticality analysis, corrective action and follow-up. Control of Chemical Hazards, Hazardous properties of chemicals, Material Safety Data Sheets (MSDS).		
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Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Safety, Health and Environment Management Systems	R.K. Jain	Khanna Publishers,	4th edition (2015)
2	Safety Management System and Documentation Training Programme Handbook	Paul S. V.	CBS Publications	4th Edition, 2019
3	Safety Management in Industry	N.V. Krishnan	Jaico Publishing House, Bombay	1993 (First Edition)
4	Safety Management	John V. Grimaldi and Rollin H. Simonds	All India Traveller Book Seller, Delhi	5th Edition, 1989
5	Industrial Safety	Ronald P. Blake	Prentice Hall, New Delhi	2nd Edition, 1973
6	Safety Management Systems	Alan Waring	Chapman & Hall, England	1st Edition, 1996
7	Construction Safety Management	K.N. Vaid	National Institute of Construction Management and Research (NICMAR), Mumbai	1st Edition, 1988

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Guidelines for Hazard Evaluation Procedures	Center for Chemical Process Safety (CCPS), American Institute of Chemical Engineers	American Institute of Chemical Engineers, New York	2nd Edition, 1992
2	Safety Management Systems	Alan Waring	Chapman & Hall, England	1st Edition, 1996
3	Construction Safety Management	K.N. Vaid	National Institute of Construction Management and Research (NICMAR), Mumbai	1st Edition, 1988

Video Links (NPTEL, SWAYAM...)		
Module	Topic	Link ID
1	Module1	https://nptel.ac.in/courses/110105094
2	Module2	https://nptel.ac.in/courses/105102206 https://www.youtube.com/watch?v=Z0o4zDL0Ngg
3	Module3	https://nptel.ac.in/courses/110105160
4	Module4	https://nptel.ac.in/courses/110105094

MARKETING MANAGEMENT

Course Code	24SJPEMET638	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- To evaluate the Marketing concepts and ideas.
- To analyse the consumer behaviour in the market.
- To interpret the ideas in pricing of products.
- To identify modern day advertisement and marketing methods.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To familiarise with the basic terms of marketing and evaluate the marketing concepts and ideas.	K2
CO2	Identify the consumer concepts in buying.	K2
CO3	Analysis of various pricing strategies in the market and understand the method of channelling product.	K3
CO4	Understand and analyse the modern-day advertising methods and digital marketing methods	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2	2	2	-	1	-	1	-	-	-	-	1	-
CO2	2	3	3	2	3	-	-	1	-	2	-	2	-
CO3	2	3	3	2	3	1	1	2	-	3	-	2	-
CO4	3	3	3	1	3	2	2	3	-	3	1	3	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	<p>INTRODUCTION: Definition of Marketing – Evolution - Marketing concept - Marketing mix - 4P's Frame Work - Marketing orientation and philosophies, Types of Markets - Different Market segmentation - Non-Segmented markets – Benefits - Limitations</p> <p>MARKETING RESEARCH & ENVIRONMENT. Stages in Marketing research - Types of Research Methods – Exploratory, Descriptive, Experimental, Survey Methods. Marketing Environment – Micro & Macro environment - Factors affecting – Economic, Technological, Political - Competitive Environment – Green Marketing concept.</p>	9	1
2	<p>CONSUMER BEHAVIOUR Consumer Psychology - Choice criteria - Order management cycle – Buying situation - Personal and social influence.</p> <p>PRODUCT DECISION Concept of a Product – Types of Products - Business, Consumer, Service product – Commodity – Technology and Customised product. New product development - Product Idea - Product Life Cycle. Brand - Brand attributes - Building a brand name - strategies of corporate Branding.</p>	9	2
3	<p>PRICING STRATEGIES Setting the price of a product - Pricing policies and constraints - Factors influencing pricing decision - Methods of pricing - Cost oriented, Competitor oriented, Marketing oriented pricing - Tactics of price adjustment. Price wars - price sensitivity</p> <p>CHANNEL DECISION Nature of Marketing Channels – Types of Channel flows – Consumer - Industrial-Service channels. Functions of Distribution Channel – Structure and Design of Marketing Channels - Channel co-operation, Conflict and competition – Channel Intermediaries - Franchising, Retailers and wholesalers - Theory of retailing.</p>	10	3
4	<p>ADVERTISEMENTS Advertisements - Identifying audience - Types of Advertisements - Impact of advertisements. Role of Media in advertisements - Advertisement restrictions & legal actions.</p> <p>DIRECT & INTERNET MARKETING Direct marketing Techniques - Direct mail-Tele marketing – Catalogues - Direct response. Internet Marketing - Types of Networks – E-business practices in post Covid era. B2B-B2C-C2C-C2B exchanges.</p>	8	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Marketing Management	Phillip Kotler, Kevin Lane Keller	Pearson Publication	15th Edition (2018)
2	Marketing Management	Arun Kumar, N Meenakshi	Vikas Publishing house	2nd Edition (2013)
3	Research for Marketing decisions	Paul E Green, Donald S Tull, Gerald Albaum	PHI learning	5 th Edition (2010)
4	Managing Marketing	Noel Capon, Sidharth Shekhar Singh	Wiley Publications	1 st Edition (2014)

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Marketing Analytics	Wayne L Winston	Wiley publication	2nd Edition 2018
2	Strategic Market Management- Global perspective	David A Aaker, Damien McLoughlin	Wiley Publications	3rd Edition 2016

Module No.	Link ID
1, 2, 3	https://nptel.ac.in/courses/110104068 https://nptel.ac.in/courses/110108141
4	https://nptel.ac.in/courses/110107168

ADVANCED MATERIALS

Course Code	24SJPEMET635	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	5 or 3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- Develop the understanding of materials
- Apply materials science and engineering solutions to enhance existing technology

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Get introduction to different types of advanced materials	K4
CO2	Understand properties of alloys and self healing materials	K4
CO3	Understand and identify the applications of smart materials	K4
CO4	Learn the application and scope of nano-materials	K4

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	2	-	-	-	-	-	-	-	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to advanced materials, Advanced materials and alloys, Super alloy: Metallurgy and strengthening mechanisms, Types of super alloy and application. Bulk metallic glasses: Mechanism of formation, properties, and application. High Entropy Alloys (HEA): Thermodynamics, applications, Core effects of HEA, Phase selection in HEA. Self-healing materials: different self-healing processes. Materials for self- healing process.	9	1
2	Shape-Memory Materials: Shape memory effect and phase transformation effect, Superelasticity or Pseudoelasticity, Shape Memory Polymer (SMP), Thermo-Stimulated SMP, Electric-Stimulated SMP, Light-Stimulated SMP, Shape Memory Ceramic, Shape Memory Hybrids. Piezoelectric Materials: Direct and inverse Piezoelectric Effect, Materials used for piezoresistivity (Ceramics, Polymer and Composites), Single Crystal Piezoelectric. Smart Fluids: Electro-Rheological Fluids, Magneto -Rheological Fluid, Ferro Fluids, Photo-Rheological fluids, Materials used for ER, MR and PR fluids.	9	2
3	Nanomaterials: Size effect, synthesis and properties of Nanomaterials. Application of Nanomaterials. Carbon based nanomaterials- Graphene, CNT, Carbon dots, Fullerene. Pyrolyzed nanocarbon materials, properties and applications Emerging 2D materials (Hexagonal boron nitride (h-BN), metal chalcogenides, metal oxides, metal halides, metal carbides/nitrides (MXenes), and organic semiconductors (OSCs)), properties and applications. Emerging photovoltaic materials	9	3
4	Ultralight materials: Aerogels, metallic and ceramic foams Biomaterials: Biocompatibility, Classification of biomaterials and applications. Surface modification of biomaterials-biocompatible coating, surface treatment, Advanced plastic materials, High temperature and conducting plastics, Biodegradable and Biorenewable Polymers/Plastics, Applications	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Advanced Materials - An Introduction to Modern Materials Science	Ajit Behera	Springer	2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Biomaterials Principles and Practices	Donald R. Peterson, Joseph D. Bronzino, Joyce Y. Wong	Taylor & Francis	2012
2	Carbon Nanomaterials	Volker Presser, Yury Gogotsi	CRC Press	2006
3	Advanced Materials	Ivan A. Parinov, Shun- Hsyung Chang, Vitaly Yu. Topolov	De Gruyter	2020

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Introduction to advanced materials	https://onlinecourses.nptel.ac.in/noc19_mm13/preview
2	Piezoelectric Materials	https://onlinecourses.nptel.ac.in/noc19_mm13/preview
3	Nanomaterials	https://onlinecourses.nptel.ac.in/noc19_mm13/preview
4	Biomaterials	https://nptel.ac.in/courses/113104009