Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Syllabus Structure

Final Year B.Tech in Mechanical Engineering

(Auto Scheme) with effect from Year 2023-24
(only TA policy revised for Year 2024-25)

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405 Ph: 02563 259 802,
Web: www.rcpit.ac.in/mechanical-engineering-syllabus

Institute Vision and Mission

Vision of the Institute

"To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society."

Mission of the Institute

To impart high quality Technical Education through:

M1: Innovative and Interactive learning process and high quality globally recognized instructional programs.

M2: Fostering a collaborative scientific temper among students with ethical responsibility towards the society.

M3: Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of Professionalism.

M4: To contribute to nation's sustainable development.

Mechanical Engineering Department

Vision Statement

"To achieve excellence in Mechanical Engineering education through innovation, research, and strong ethical values for sustainable societal development."

Mission Statements

M1: To deliver innovative and practical mechanical engineering education through quality instruction and hands-on learning.

M2: To promote teamwork, ethical values, and scientific curiosity through collaborative and socially relevant projects.

M3: To develop competent engineers with technical expertise, research aptitude, and entrepreneurial spirit for sustainable national growth.

Programme Educational Objectives (PEOs)

PEO 1: Graduates will apply scientific, mathematical, and engineering principles to solve complex mechanical problems ethically and sustainably.

PEO 2: Graduates will design and implement efficient mechanical solutions addressing societal needs through innovation, collaboration, and environmental stewardship.

PEO 3: Graduates will demonstrate professional competence, communication, teamwork, and lifelong learning for career growth, entrepreneurship, and higher education.

Programme Specific Outcomes (PSOs)

PSO 1: Students will be able to apply Mechanical Engineering principles and modern tools to design and improve mechanical systems with innovative solutions.

PSO 2: Students will demonstrate ethical practice, teamwork, and communication to develop engineering solutions for societal and sustainable development.

Department of Mechanical Engineering

(Autonomous)

Semester – VII (w.e.f.2024-25)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme (hrs.)			Evaluation Scheme (CA) (marks)				ESE (marks)	Total	Credit	
				L	T	P	TA [A]	Term Test 1 (TT1)	Term Test 2 (TT2)	Average (TT1 & TT2) [B]	[C]	[A+B+C]		
1	PC	PCME7010T	Machine Design II	3	-	-	25	10	10	10	65	100	3	4
		PCME7010L	Machine Design II Laboratory	-	-	2	25	-	-	-	25	50	1	
2	PC	PCME7020T	Finite Element analysis	3	-	-	25	10	10	10	65	100	3	4
		PCME7020L	Finite Element analysis Laboratory	-	-	2	25	-	-	-	25	50	1	
3 #	PE	PEME7031T	Production Planning and Control	3	-	-	25	10	10	10	65	100	3	3
		PEME7032T	Additive Manufacturing	3	-	-	25	10	10	10	65	100	3	
		PEME7033T	Computational Fluid Dynamics	3	-	-	25	10	10	10	65	100	3	
		PEME7034T	Machine Health Monitoring Management	3	-	-	25	10	10	10	65	100	3	
		PEME7035T	Big Data Analysis	3	-	-	25	10	10	10	65	100	3	
		PEME7036T	Robotics	3	-	-	25	10	10	10	65	100	3	
		PEME7037T	Tribology	3	-	-	25	10	10	10	65	100	3	
		PEME7038T	Automobile Engineering	3	-	-	25	10	10	10	65	100	3	
4 *	OE	OEME7041T	Product Lifecycle Management	3	-	-	25	10	10	10	65	100	3	3
		OEME7042T	Management Information System	3	-	-	25	10	10	10	65	100	3	
		OEME7043T	Operations Research	3	-	-	25	10	10	10	65	100	3	
		OEME7044T	Cyber Security and Laws	3	-	-	25	10	10	10	65	100	3	
		OEME7045T	Personal Finance Management	3	-	-	25	10	10	10	65	100	3	
		OEME7046T	Energy Audit and Management	3	-	-	25	10	10	10	65	100	3	
		OEME7047T	Disaster Management and Mitigation Measures	3	-	-	25	10	10	10	65	100	3	
		OEME7048T	Science of Well-being	3	-	-	25	10	10	10	65	100	3	
		OEME7049T	Research Methodology	3	-	-	25	10	10	10	65	100	3	
		OEME70410T	Public Systems and Policies	3	-	-	25	10	10	10	65	100	3	
5	PJ	PJME7050L	Project Stage II	-	-	8	25	-	-	-	25	50	4	4
			Total	**12**	**0**	**12**	**175**	**40**	**40**	**40**	**335**	**550**	**18**	**18**

PC-Professional Course, PE – Professional Elective, OE- Open Elective, PJ- Project.

Any 1 Professional Elective from given list. * Any 1 Open Elective I from given list.

Prepared by	Checked by	BOS Chairman	Dean Academic &Dy. Director	C.O.E.	Director
Mr. R. R. Ozarkar	Mr. S. V. Yeole	Prof. Dr. P. L. Sarode	Prof. Dr. P. J. Deore	Mr. S. P. Shukla	Prof. Dr. J. B. Patil

Mechanical Department R.C.P.I.T. OFFICE SEAL SHIRPUR

Department of Mechanical Engineering
(Autonomous)

Semester – VIII (w.e.f.2024-25)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme (hrs.)			Evaluation Scheme (CA) (marks)				ESE (marks)	Total	Credit	
				L	T	P	TA [A]	Term Test 1 (TT1)	Term Test 2 (TT2)	Average (TT1 & TT2) [B]	[C]	[A+B+C]		
1 @	PE	PEME8011T	Design of Mechanical Systems*	3	-	-	25	10	10	10	65	100	3	3
		PEME8012T	Industrial Engineering*	3	-	-	25	10	10	10	65	100	3	
		PEME8013T	CAD/CAM/CIM*	3	-	-	25	10	10	10	65	100	3	
		PEME8014T	Smart Industries*	3	-	-	25	10	10	10	65	100	3	
		PEME8015T	Sustainable Energy Management*	3	-	-	25	10	10	10	65	100	3	
		PEME8016T	Industrial Waste Management*	3	-	-	25	10	10	10	65	100	3	
			NPTEL/SWAYAM Course #	3	-	-	25	10	10	10	65	100	3	
2 &	PE	PEME8021T	Business Analytics*	3	-	-	25	10	10	10	65	100	3	3
		PEME8022T	IoT and Applications*	3	-	-	25	10	10	10	65	100	3	
		PEME8023T	Process Equipment Design*	3	-	-	25	10	10	10	65	100	3	
		PEME8024T	Motor Sports Engineering*	3	-	-	25	10	10	10	65	100	3	
		PEME8025T	Advanced Quantitative Techniques*	3	-	-	25	10	10	10	65	100	3	
		PEME8021T	Business Analytics*	3	-	-	25	10	10	10	65	100	3	
			NPTEL/SWAYAM Course #	3	-	-	25	10	10	10	65	100	3	
3	INT	INTME8030L	Internship	-	-	20	150	-	-	-	150	300	10	10
			Total	**6**	**0**	**20**	**200**	**20**	**20**	**20**	**280**	**500**	**16**	**16**

PE-Professional Elective, INT- Internship.

@ , & Any 1 Professional Elective V and VI from given list.

1. *Professional Elective Courses offered for the students doing In-house Internship at institute level.
2. #Professional Elective Courses offered for the students doing Out-house Internship at Industry. These courses are to be studied in self-study mode using NPTEL/SWAYAM platform.
3. Students doing internship at industry shall submit certificate of NPTEL examination OR they have to appear examinations conducted by institute like TT1, TT2 and ESE.
4. Students undergoing internship have the option to appear for both the NPTEL examination and End Semester Examination (ESE) conducted by institute for respective course. In such cases, the better of the two scores (NPTEL or ESE) shall be considered for final grading.
5. List of NPTEL courses will be declared by concerned BOS at the beginning of semester VIII.

Mechanical Department R.C.P. OFFICE SEAL SHIRPUR

Prepared by	Checked by	BOS Chairman	Dean Academic &Dy. Director	C.O.E.	Director
Mr. R. R. Ozarkar	Mr. S. V. Yeole	Prof. Dr. P. L. Sarode	Prof. Dr. P. J. Deore	Mr. S. P. Shukla	Prof. Dr. J. B. Patil

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Syllabus Details of Semester-VII

Final Year B.Tech in Mechanical Engineering

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Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Machine Design II (PCME7010T)		
Machine Design II Laboratory (PCME7010L)		

Prerequisites:

1. Basic Knowledge of Strength of Materials
2. Basic concepts of Design of machine element with different modes of failures.

Course Objectives:

1. To acquaint with functional and strength design principles of important machine elements.
2. To familiarize selection of standard elements such as rolling contact bearings, chains etc.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Select appropriate gears for power transmission on the basis of given power and speed.	L4	Analyze
CO2	Design gears based on the given conditions.	L6	Create
CO3	Select bearings for a given application from the manufacturers catalogue.	L4	Analyze
CO4	Design the flywheel for given applications.	L6	Create
CO5	Design cam and follower mechanisms.	L6	Create
CO6	Design clutches and brakes.	L6	Create

Machine Design II (PCME7010T)

Course Contents

Unit-I **13 Hrs.**

Design of Gears

Gears: Design of spur, helical, bevel and worm gears with strength, wear and thermal considerations. Gear Box: Two stage Gear box with fixed ratio consisting of spur, helical and bevel gear pairs: gear box housing layout and housing design.

Unit-II **05 Hrs.**

Rolling Contact Bearings

Types of bearing, designation, selection of rolling contact bearings based on constant / variable load & speed conditions (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing)

Unit-III **05 Hrs.**

Sliding Contact Bearings

Design of hydro dynamically lubricated bearings (self- contained), Introduction to hydro static bearings, Types and selection of Mechanical seals.

Unit-IV **09 Hrs.**

Design of Cams, Followers and Breaks

Design of Cams and Followers: Design of Cam and Roller follower Mechanisms with spring and shaft. Design and selection of standard roller chains.
Design of Brakes: Shoe and drum type, disk type. Design of lever arm.

Unit-V **10 Hrs.**

Design of Flywheel and Clutches

Design of Flywheel – Introduction, Fluctuation of energy and speed, turning moment diagram, estimating inertia of flywheel for reciprocating prime movers and machines, Weight of the flywheel, flywheel for punches, rim constructions, stresses in rims and arms, Construction of flywheel.
Design of Clutches: Introduction, types, Basic theory of plate and cone type clutches, Design of single plate, multi-plate and cone clutches with spring, lever design.

Machine Design II Laboratory (PCME7010L)

Suggested Experiments

A Part A:

1 Design Exercises : Design and detailed assembly drawing of minimum two from the following list (Computer aided drawing on A3 size sheets)

1 Design of Gears and gear box
2 Design of cam and followers
3 Design of clutches
4 Design of brakes

2 Course Project : Students in a group of two to four will design and prepare working drawings of any system having minimum 5 to 6 components by applying the knowledge gained during the course.

B Part B: Each assignment containing at least 2 problems of design calculations with sketches on following topics.

1 Rolling contact bearings
2 Sliding contact bearing
3 Chain and flywheel

Oral examination will be based on the entire syllabus including, the design exercises performed during laboratory sessions.

Books Recommended

Textbooks

1 Design of Machine Elements - V.B. Banadari - Tata McGraw Hill Publication
2 Design of Machine Elements - Sharma, Purohil - Prentice Hall India Publication
3 Machine Design -An Integrated Approach - Robert L. Norton - Pearson Education
4 Mechanical Engineering Design by J.E.Shigley - McGraw Hill
5 Fundamentals of Machine Elements - Hawrock, Jacobson - McGraw Hill
6 Design of Machine Elements - V.M.Faires
7 Design of Machine Elements - Spotts

Reference Books

1 Machine Design - Pandya & Shah - Charotar Publishing
2 Machine Design – Reshetov - Mir Publication
3 Machine Design - Black Adams - McGraw Hill
4 Machine Design - R.C.Patel, Pandya, Sikh, Vol-I & II - C. Jamnadas & Co
5 Design Data book - P.S.G. College of Technology, Coimbatore.
6 Design Data Book - Mahadevan

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Finite Element analysis (PCME7020T)		
Finite Element analysis Laboratory (PCME7020L)		

Prerequisites:

1. Knowledge of Matrices, Differential Equations and Numerical Integrations.

Course Objectives:

1. To familiarize learners with concepts of FEA
2. To study the applicability of FEA to engineering problems
3. To familiarize learners with the FEA software to solve Engineering Problems.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Summarize the finite element method and analyze the algorithms for the analysis of mechanical systems.	L4	Analyze
CO2	Evaluate differential equations using weak and Non-weak form methods.	L5	Evaluate
CO3	Implement the basic finite element formulation techniques to solve one dimensional engineering problems using elements such as bar/beam/link element.	L3	Apply
CO4	Implement the basic finite element formulation techniques to solve two dimensional engineering problems using elements such as triangular and quadrilateral elements.	L3	Apply
CO5	Implement the basic finite element formulation techniques to find natural frequency of dynamic system.	L3	Apply
CO6	Use commercial FEA software, to solve problems related to mechanical engineering.	L3	Apply

Finite Element analysis (PCME7020T)

Course Contents

Unit-I **08 Hrs.**

Introduction to FEA

Introductory Concepts: Introduction to FEM, Historical Background, General FEA procedure, Applications of FEM in various fields, Advantages and disadvantages of FEA.
Definitions of Various Terms used in FEA: Element, order of the element, internal and external node/s, degree of freedom, primary and secondary variables and boundary conditions.
Mathematical Modelling of field problems in engineering, Governing equations, Differential equations in different fields. Approximate solution of differential equations.

Unit-II **08 Hrs.**

Weak and Non-Weak Form Methods

Weak and Non-Weak Form Methods: Discrete and Continuous Models, Weighted Residual Methods and Ritz Technique.
Minimization of a Functional: Principle of minimum total potential, Piecewise Rayleigh-Ritz method, Formulation of stiffness matrix, transformation and assembly concepts.

Unit-III **10 Hrs.**

1-D FEA

One Dimensional Finite Element Formulations: One dimensional second order equations - discretization-element types - linear and higher order elements -derivation of shape functions and stiffness matrices and force vectors.
Assembly of Matrices: solution of problems in one dimensional structural analysis, heat transfer and fluid flow (stepped and taper bars, fluid network and Spring-Cart Systems). Analysis of Plane trusses and Analysis of Beams.

Unit-IV **08 Hrs.**

2-D FEA

Two Dimensional Finite Element Formulations: Three node triangular element, four-node rectangular element, four-node quadrilateral element and eight node quadrilateral element. Global, Local, Natural coordinates and coordinates transformations: serendipity and Lagrange's methods for deriving shape functions for triangular and quadrilateral element. Sub parametric, Iso-parametric, super parametric elements, Compatibility conditions, Patch test, Convergence criterion and sources of errors in FEA.

Unit-V **08 Hrs.**

FEA of Dynamic Systems

Stress Analysis of Two Dimensional Elements: Equations of Elasticity-Plane stress, plane strain and axisymmetric problems. Jacobian matrix, stress analysis of CST and four node Quadratic element.
Finite Element Formulation of Dynamic Systems: Applications to free vibration problems of rod and beam, Lumped and consistent mass matrices.
Solutions techniques to Dynamic problems, longitudinal vibration frequencies and modes shapes, Fourth order beam equation, transverse deflections and natural frequencies of beams.

Finite Element analysis Laboratory (PCME7020L)

Suggested Experiments

A
1. Any two problems using 1D element: Analysis of axially loaded stepped/Tapered bar and beam.
2. Any two problems using truss element: Analysis of plane trusses.
3. Any two problems using 2D element: Analysis of plate with hole/notch.
4. Any one problem on steady state heat conduction.
5. Any one problem using axisymmetric element: Analysis of pressure vessel.
6. Any one problem of free vibration analysis for dynamic system.
   Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

B Course Project

A group of not more than four students, shall do Finite Element Analysis of any mechanical engineering component /system, which involves element selection, assigning properties, meshing, assigning loads, and boundary conditions, analysis and result interpretation.

Students should use the commercial software (ANSYS/ABAQUS/NASTRAN/HYPERWORKS) or programmes from the text-books or self-developed programs to verify the results obtained by manual calculations.
While performing the analysis the students should understand the concepts of selection of element type, meshing and convergence of solution.
Oral and Practical examination will be based on the entire syllabus and the practicals performed during laboratory sessions.

Books Recommended

Textbooks

1. Text book of Finite Element Analysis – P. Seshu - Prentice-Hall of India Pvt. Ltd.
2. The Finite Element Method Engineering- S S Rao-Butter Worth Heinemann.

Reference Books

1. Finite Element Method - J N Reddy - Tata McGraw Hill.
2. Finite Element Methods - R Dhanraj and K Prabhakaran Nair - Oxford University Press.
3. A first course in Finite Element Method - D. L. Logan - Asia Pvt Ltd.
4. Concepts and Applications of Finite Element Analysis - R. D. Cook, D. S. Malkus, M. E. Plesha - John Wiley Sons.
5. Introduction to Finite Elements in Engineering - Chandrupatla and Belegundu - Prentice Hall of India Pvt. Ltd.
6. Fundamental Finite Element Analysis and Application with Mathematica and MATLAB Computations - M. Asghar Bhatti - Wiley India Pvt. Ltd.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Production Planning and Control (PEME7031T)		

Prerequisites:

1. –

Course Objectives:

1. To provide an exposure to Production Planning & Control (PPC) and its significance in Manufacturing Industries
2. To give insight into the ongoing & futuristic trends in the Material Management and Inventory Control.
3. To appraise about need and benefits of planning functions related to products and the processes.
4. To give exposure to production scheduling and sequencing so as to optimize the resources
5. To give exposure to latest trend in PPC.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Describe knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Explain various approaches and techniques for designing and developing products.	L2	Understand
CO3	Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.	L3	Apply
CO4	Differentiate knowledge in applying virtual product development tools for components, machining and manufacturing plant.	L2	Understand

Production Planning and Control (PEME7031T)

Course Contents

Unit-I **08 Hrs.**

Introduction to PPC

Manufacturing systems- Components and types, Transformation from Industry 1.0 to Industry 4.0
Manufacturing Systems- projects jobbing products, batch, mass / flow production, continuous / process production, Introduction to JIT, Lean Production, FMS, Agile Manufacturing, etc.
PPC – Need and functions of PPC, relationship of PPC with other departments. Factors influencing PPC in the organization,
Organization of PPC- status of PPC department, internal structure, degree of centralization, PPC as an integrated approach. Prerequisites of PPC- data pertaining to design, equipment, raw materials, tooling, performance standards, labor & operating systems.
Order preparation- works order preparation for various manufacturing methods, subsidiary orders, shop or production orders, inspection orders and stores issue orders, etc.

Unit-II **08 Hrs.**

Forecasting, Aggregate and Capacity Planning

Forecasting for operations- requirements for forecasting, importance of forecasting, basic categories of forecasting methods, qualitative methods, quantitative methods, accuracy and control of forecasts,
Aggregate planning: Concept of aggregate planning, decision rules, strategies and methods
Capacity Planning: Measurement of capacity, Measures of capacity, Factors influencing effective capacity, short range, medium range and long-range capacity planning, rough cut capacity planning.

Unit-III **08 Hrs.**

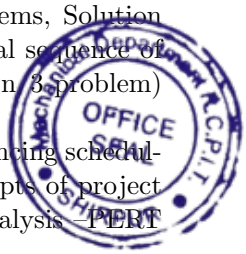
Material Planning and Inventory Models

Material Planning Role of Materials Management- materials and profitability, Purchase functions, Procurement procedures including bid systems, Vendor selection and development, Vendor rating, ethics in purchasing. Roles and responsibilities of purchase professionals. Concepts of lead time, purchase requisition, purchase order, amendments, forms used and records maintained.
Independent Demand Inventory Models - The nature and importance of inventories, requirements for effective inventory management, types of inventory models, Deterministic models, Quantity discount models, re-order point, concept of safety stock, Dynamic Models, Probabilistic models
Dependent Demand Inventory models–MRP–An overview of material requirements planning, MRP inputs, MRP outputs MRP processing, MRP in service, benefits, requirement of MRP and MRP II systems.

Unit-IV **12 Hrs.**

Job Shop and Project Scheduling

Job Shop Scheduling: Introduction to Job Sequencing, Objectives, Sequencing Problems, Solution to Sequencing Problem, processing of n Jobs on 1 machine, Johnson's Rule for optimal sequence of processing n jobs on 2 machines (n/2 problem), processing of n Jobs on 3 Machines (n/3 problem) and processing of 2 Jobs on m Machine (2/m) problem.
Project Scheduling: Inputs for scheduling, loading and scheduling devices, factors influencing scheduling, scheduling techniques, use of Gantt Charts and basic scheduling problems. Concepts of project planning, monitoring and control, Project scheduling by using elements of network analysis – PERT



& CPM, cost analysis & crashing, resource leveling.

Unit-V **06 Hrs.**

Enterprise Resource Planning

Enterprise Resource Planning (ERP) ERP Introduction, Benefits, Origin, Evolution and Structure, Conceptual Model of ERP, the Evolution of ERP, the Structure of ERP.
ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications. ERP Implementation Basics, ERP Implementation Life Cycle, ERP & E-Commerce, Future Directives- in ERP, ERP and Internet, Critical success and failure factors, Integrating ERP into organizational culture.

Books Recommended

Textbooks

1 Production Planning and Control – L C Jhamb - Everest Publishing House

2 Inventory Management – L C Jhamb - Everest Publishing House

3 Problems in Operations Research (Principles and Solutions) – Hira and Gupta- S Chand Publications

4 Enterprise wide Resource Planning: Theory and Practice – Rahul V. Altekar- PHI Publication.

Reference Books

1 Elements of Production Planning and Control– Samuel Eilon- Universal Publishing Corporation

2 Production Planning and Control, W. Boltan- Pearson Education Limited

3 Production Systems- Planning, Analysis & Control, James. L. Riggs-John Wiley & Sons

4 Manufacturing Planning and Control Systems, Thomas E. Vollman, William L. Berry & Others-Galgotia Publishers.

5 Manufacturing Process Planning and Systems Engineering, Anand Bewoor-Dreamtech Press

6 Production and Operations Management, S.N.Chary- TMH publishing company

7 Modernization & Manufacturing Management, L.C. Jhamb - Everest Publishing House

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Additive Manufacturing (PEME7032T)		

Prerequisites:

1. Knowledge of Production Processes and Material Technology

Course Objectives:

1. To familiarize with importance of Rapid Prototyping in Product Development.
2. To make students aware about latest additive manufacturing technology used in industry,
3. To make students aware about various additive manufacturing processes and material availability.
4. To enable students to understand, describe and evaluate the different post processing techniques currently used on Additive Manufacturing parts.
5. To make students aware about latest research in the area of additive manufacturing.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain importance of Rapid Prototyping in product development.	L2	Understand
CO2	Apply basic knowledge of additive manufacturing to decide type of additive manufacturing process and material according compo-nents design requirement.	L3	Apply
CO3	Analyze and justify the cost of a typical additive manufacturing operation including labour costs, overhead costs, and consumable costs.	L4	Analyze
CO4	Evaluate the different post processing techniques used on AM parts, including those required for removal of support structures, improvement of surface characteristics and structural integrity.	L5	Evaluate
CO5	Formulate research work and research writing in the field of additive manufacturing.	L6	Create

Additive Manufacturing (PEME7032T)

Course Contents

Unit-I **08 Hrs.**

Introduction

Product Development Cycle and the product Life Cycle. Problems in Product Development. Relationship between Product Development Cost and the Selling Price. Rapid prototyping need, Classification of RP systems, advantages and limitations of RP, Applications and scope of RP, Introduction to additive manufacturing.

Unit-II **12 Hrs.**

Classification of Additive Manufacturing Processes

Seven Classes of Additive Manufacturing, Binder jetting, Directed Energy Deposition, Powder Bed Fusion, Sheet Lamination, Material Extrusion, Material Jetting, Vat Photo Polymerization Detailed discussion on latest technique available on each type of additive manufacturing processes. Specification, working principal, material compatibility and Post processing.

Unit-III **08 Hrs.**

Additive Manufacturing System Design

Process selection, Material selection, labor cost involved, overhead cost calculation, consumables cost, machine maintenance, Project Planning, Sensors used , Jigs and fixtures, Thermal management , Manufacturing Quality management.

Unit-IV **08 Hrs.**

Applications of Additive Manufacturing

Aerospace Applications, Medical applications, Art and Design applications, Energy applications, architecture applications.

Unit-V **06 Hrs.**

Intellectual Property Rights, IPR in Additive Manufacturing

Case studies on Latest patents in the field of additive manufacturing, Case studies based on latest article Published in Scopus, SCI, and ESCI indexed journal.

Books Recommended

Textbooks

1 Additive Manufacturing Technologies – Ian Gibson, David W Rosen, Brent Stucker, Mahyar Khorasani – Springer.

2 Additive Manufacturing – Juan Pou, Antonio Riveiro and J. Paulo Davim – Elsevier.

Reference Books

1 Multi-dimensional Additive Manufacturing – Soshu Kiriharal, Kazuhiro Nakata – Springer

2 Additive Manufacturing Processes – SanjayKumar – Springer

3 Polymer Based Additive Manufacturing – Declan M. Devine – Springer

4 Materials for Additive Manufacturing – Yusheng Shi, Chunze Yan, Yan Zhou, Jiamin Wu, Yan Wang, Shengfu Yu,Ying Chen – Academic Press, Elsevier

5 Additive Manufacturing (A Tool for Industrial Revolution 4.0) – M. Manjaiah, K. Raghavendra, N. Balashanmugam, J. Paulo Davim – Woodhead Publishing

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Computational Fluid Dynamics (PEME7033T)		

Prerequisites:

1. Knowledge of physical science related to heat and Basic concepts learnt in fluid mechanics with respect to boundary conditions.

Course Objectives:

1. To Study the working of CFD, governing Equations and discretizations techniques
2. To Study basic heat transfer concepts numerically applicable for steady state and transient conditions

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Analyze the working of a CFD code.	L4	Analyze
CO2	Explain the various Governing Equations.	L2	Understand
CO3	Explain turbulence modelling and various algorithms used in numerical techniques.	L2	Understand
CO4	Apply Finite Volume Method to solve numerical problems.	L3	Apply
CO5	Explain the software used for simulation of numerical problems.	L2	Understand

Computational Fluid Dynamics (PEME7033T)

Course Contents

Unit-I **05 Hrs.**

Introduction

What is CFD, Scope and Application of CFD, Methods of Predictions like Experimental and theoretical, Working of Commercial CFD Software's, Solution methodology-Preprocessing, Solver, Post processing.

Unit-II **08 Hrs.**

Mathematical description of Physical Phenomenon

Governing Differential Equations, Meaning of Differential equation, The Continuity Equation, A Momentum equation, The Energy Equation, The General Differential Equation, Boundary Conditions, Initial and Boundary Conditions, Initial and Boundary Value problems.

Unit-III **08 Hrs.**

Turbulence Modelling

Basic Theories of Turbulence, The Time-Averaged Equation for Turbulent Flow, The SIMPLE, SIMPLER Algorithm, Introduction to Finite Difference Method.

Unit-IV **16 Hrs.**

Finite Volume Method applied to Heat Conduction, Convection and Diffusion

Steady One-dimensional Conduction, Convection, Diffusion, Unsteady One-dimensional Conduction, Two and Three-dimensional Situations introduction.

Unit-V **05 Hrs.**

Simulation Software

Introduction to the software used for Simulating numerical problems. Demonstrating the use of Python for solving basic fluid problems.

Books Recommended

Textbooks

1 An introduction to computational fluid dynamics-The finite volume method, Versteeg.H.K., Malalasekera.W., Prentice Hall

Reference Books

1 Computational Fluid Mechanics and Heat Transfer, Anderson, D.A., Tannehill, I.I., and Pletcher, R.H., Hemishphere Publishing Corporation, New York, USA, 1984

2 Introduction to Computational Fluid Dynamics, Niyogi P. ,Laha M.K., Chakrabarty S.K., Pearson Education, India

3 Computational Fluid Flow and Heat Transfer, Muralidhar, K.,andSundararajan,T., Narosa Publishing House, New Delhi

4 Computer Simulation of flow and heat transfer, Ghoshdasdidar, P. S., Tata McGraw-Hill Publishing Company Ltd

5 Finite Element Programming of the Navier Stoke's Equation, Taylor, C and Hughes J.B., Pineridge Press Ltd.U.K.

6 Computational Techniques for Fluid Dynamics: Fundamental and General Techniques, Fletcher, C.A.J., Springer- Verlag

7 Numerical Fluid Dynamics, Bose, T. K., Narosa Publishing House

8 T. J. Chung, Computational Fluid Dynamics, Cambridge University Press

9 Anderson, J.D. Computational Fluid Dynamics, McGraw Hill

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Machine Health Monitoring Management (PEME7034T)		

Prerequisites:

1. Knowledge of Mechanical Vibrations

Course Objectives:

1. To introduce parameters involved in machine health monitoring management.
2. To make students aware about Instrumentation and Signal Processing in machine health monitoring management.
3. To introduce importance of pattern recognition in machine health monitoring management.
4. To impart knowledge about the application of artificial intelligence techniques in Condition Monitoring
5. To impart knowledge about the application of Machine learning techniques in Condition Monitoring

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain basics of machine health monitoring management.	L2	Understand
CO2	Apply basic Instrumentation and signal processing technique in machine health monitoring management.	L3	Apply
CO3	illustrate pattern in problems involved in machine health monitoring.	L4	Analyze
CO4	Describe knowledge about the application of artificial intelligence techniques in Condition Monitoring.	L2	Understand
CO5	Describe knowledge about the application of Machine learning techniques in Condition Monitoring.	L2	Understand

Machine Health Monitoring Management (PEME7034T)

Course Contents

Unit-I **10 Hrs.**

Introduction to asset Management

Introduction to asset Management: Digital Asset Management, Fixed Asset Management, IT Asset Management, Enterprise Asset Management, Financial Asset Management, Infrastructure Asset Management.
Introduction to maintenance strategies : Proactive Maintenance, Predictive Maintenance, Planned Maintenance, Condition-Based Maintenance, Responsive Maintenance, Emergency Maintenance

Unit-II **12 Hrs.**

Introduction to Machine Health Monitoring Managemen

Introduction to Machine Health Monitoring Management: Machine failures, Maintenance strategies, machine condition monitoring, Vibration signatures of faults in rotating and reciprocating machines, detection and diagnosis of faults.
Instrumentation and Signal Processing: Types of sensors used in machine health monitoring: vibration, acoustics and noise, acoustic emission, temperature, ultrasonic and infrared sensors - Signal processing: basic signal and systems concepts, time domain analysis, frequency domain analysis, time-frequency analysis.

Unit-III **08 Hrs.**

Pattern Recognition

Feature extraction and feature selection methods, feature reduction using PCA - discriminant functions and decision boundaries, decision trees, maximum likelihood and nearest neighbor. Application and case studies of machine health monitoring: Bearings, gear boxes, engines, structural health monitoring, machine tool condition monitoring etc.

Unit-IV **06 Hrs.**

Introduction to Condition Monitoring Using Artificial Intelligence

Approaches to Condition Monitoring, Components of Condition Monitoring, Measurement System and Preprocessing, Feature Extraction, Statistical Features, Vibration-based Condition Monitoring, Dissolved Gas Analysis, Artificial Intelligence Approaches, Single AI Approaches, Hybrid AI Approaches.

Unit-V **06 Hrs.**

Introduction to Machine Learning in Conditioning monitoring

Machine Learning Tools, Artificial Neural Network, Support Vector Machine, Extension Neural Network, Fuzzy ARTMAP.
Introduction to Incremental Learning and its Application to Condition Monitoring.

Books Recommended

Reference Books

1 Asset Management – Telli Van der Lei, Paulien Herder and Ype Wijnia – Springer

2 Machine Component Analysis with MATLAB – Dan B. Marghitu and Mihai Dupac – Butterworth-Heinemann, Elsevier.

3 Mechanical Vibrations and Condition Monitoring – Juan Carlos A. Jauregui Correa and Alejandro A. Lozano Guzman – Academic Press, Elsevier.

4 Intelligent Data-Analytics for Condition Monitoring – Hasmat Malik, Nuzhat Fatema and Atif Iqbal – Academic Press, Elsevier.

5 Predictive Maintenance of Pumps Using Condition Monitoring – Ray S. Beebe – Elsevier Science

6 Instrumentation and Control Systems – William Bolton – Newnes, Elsevier.

7 Emerging Trends in Image Processing, Computer Vision and Pattern Recognition – Leonidas Deligiannidis and Hamid R. Arabnia – Morgan Kaufmann, Elsevier.

8 Introduction to Pattern Recognition – Sergios Theodoridis, Aggelos Pikrakis, Konstantinos Koutroumbas and Dionisis Cavouras – Academic Press, Elsevier.

9 Neural Fuzzy Systems – Lin C. and Lee G. – Prentice Hall International Inc.

10 Intelligent Data-Analytics for Condition Monitoring – Hasmat Malik, Nuzhat Fatema and Atif Iqbal – Academic Press, Elsevier.

11 Fuzzy Logic and Expert Systems Applications – Cornelius Leondes – Academic Press, Elsevier.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Big Data Analysis (PEME7035T)		

Prerequisites:

1. Knowledge of Data Base Management System

Course Objectives:

1. To Provide an Overview of an exciting growing field of Big Data Analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql, Map Reduce.
3. To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the key issues in big data management.	L2	Understand
CO2	Explain fundamental enabling techniques using tools in big data analytics.	L2	Understand
CO3	Summarize adequate perspectives of big data analytics in various applications like sensor, recommender systems, social media applications etc.	L2	Understand

Big Data Analysis (PEME7035T)

Course Contents

Unit-I **12 Hrs.**

Introduction to Big Data Analytics & Hadoop Ecosystem

Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach.
Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.
Introduction to Hadoop. Core Hadoop Components, Physical Architecture, Hadoop limitations.
Introduction, Components of the Hadoop Ecosystem:HDFS (Hadoop Distributed File System), MapReduce, YARN, HBase, Pig, Hive, Sqoop, Flume, Kafka, Zookeeper, Spark.

Unit-II **09 Hrs.**

NoSQL

Introduction to NoSQL, NoSQL business drivers, NoSQL case studies.
NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns. Analysing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer.
Introduction to MongoDB, MongoDB commands.

Unit-III **07 Hrs.**

MapReduce

MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization.
MapReduce: The Map Tasks, grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping with Node Failures.
Matrix vector multiplication using MapReduce, Case studies on MapReduce using Java/Python

Unit-IV **07 Hrs.**

Big Data Analytics Applications

Recommendation Systems: Introduction, A Model for Recommendation Systems, Collaborative-Filtering System: Nearest Neighbor Technique, Example.
Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs, Applications.

Unit-V **07 Hrs.**

Understanding Analytics and Big Data

Analytical Approaches and Tool to Analyze Data, Exploring R, Reading Datasets and Exporting Data from R, Manipulating and Processing Data in R, Working with Functions and Packages in R, Performing Graphical Analysis in R, Integrating R and Hadoop.

Books Recommended

Textbooks

1 Radha Shankarmani and M Vijayalakshmi —Big Data Analytics, Wiley

2 Alex Holmes —Hadoop in Practice‖, Manning Press, Dreamtech Press.

3 Dan McCreary and Ann Kelly —Making Sense of NoSQL– A guide for managers and the rest of us, Manning Press.

Reference Books

1 Bill Franks, — Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Wiley

2 Chuck Lam, — Hadoop in Action, Dreamtech Press

3 Tom White “Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Robotics (PEME7036T)		

Prerequisites:

1. Knowledge of basic electronic devices like Diodes, BJT etc. and basic digital electronics.

Course Objectives:

1. To study the basics of robotics and its control
2. To study various design principles of robotics through kinematic analysis, workspace analysis, and trajectory planning
3. To study applications of robots in industrial inspection and material handling.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Demonstrate the basic functioning of a robot.	L3	Apply
CO2	Explain various components of robots.	L2	Understand
CO3	Carryout kinematic analysis, workspace analysis, and trajectory planning for a robot.	L4	Analyze
CO4	Apply the python skills for Mechanical problems.	L3	Apply
CO5	Explain an appropriate robot for given industrial inspection and material handling systems.	L2	Understand

Robotics (PEME7036T)

Course Contents

Unit-I **09 Hrs.**

Introduction

Definition of robot, Evolution of robots, Laws of robots, International Robotic Standards, Types of robots, Selection of robots, Robot Classifications, Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Actuators and sensors, Drives and transmission systems, End effectors, Applications of robots.

Unit-II **09 Hrs.**

Kinematics of Robots

Direct: Link coordinates D-H Representation, The ARM equation, Direct kinematic analysis for Four axis, SCARA Robot and three, five, and six axis Articulated Robots.
Inverse: The inverse kinematics problem, General properties of solutions, Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis Articulated robot.

Unit-III **08 Hrs.**

Root Intelligence and Robot task planning

Introduction, State space search, Problem reduction, use of predictive.
Logic, Means. Ends Analysis, Problem solving, Robot learning and Robot task planning.

Unit-IV **08 Hrs.**

Robot application in manufacturing

Robotic vision systems, Image representation, Object recognition and categorization, Depth measurement, Image data compression, Visual inspection, Software considerations .
Concepts of material handling, Principles and considerations in material handling systems design Conventional material handling systems - Industrial trucks, Monorails, Rail guided vehicles. Assembly & inspectors, robotic Cell design & control, Social issues & Economics of Robotics.

Unit-V **08 Hrs.**

Programming for Robots

Method, Robot Programme as a path in space, Motion interpolation,
Motion & task level Languages, Robot languages, Programming using Python and characteristics of robot .

Books Recommended

Textbooks

1 Robotics for engineers - Yoram Korean - McGrew Hill Co.

2 Industrial Robotics Technology programming and Applications- M.P. Groover, M. Weiss, R.N. Nagel, and N.G. Odrey -McGraw-Hill,

3 Ashitava Ghosal -Robotics: Fundamental Concepts and Analysis - Oxford University Press

Reference Books

1. Robotics and Control -R.K. Mittal and I.J. Nagrath- TMH Publications
2. Fundamentals of Robotics Analysis and Control - Robert J. Schilling - PHI Learning
3. Control in Robtics and Automation Sensor – Based integration - Bijay K. Ghosh, Ning Xi, T.J. Tarn, - Academic Press
4. Robotics Control Sensing, Vision and Intelligence - K.S.Fu, R.C.Gonzalex, and C.S.G.Lee - McGrew hill Book co.
5. Kinematics and Synthesis of linkages - Hartenberg and Denavit - McGrew Hill Book Co.
6. Kinematics and Linkage Design - A.S. Hall - Prentice Hall
7. Kinematics and Dynamics of Machinery - J.Hirchhorn - McGrew Hill Book Company

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Tribology (PEME7037T)		

Prerequisites:

1. Knowledge of Engineering Mechanics, Fluid Mechanics and Machine Design.

Course Objectives:

1. To provide overview of tribology and practical relevance in mechanical design.
2. To appreciate the behaviour of material, nature of surfaces, their profile and surface design procedure.
3. To understand the provenance of friction, the theories/laws.
4. To gain an understanding about wear and its mechanisms, theories of wear applied in machine elements.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Apply the principles of lubrication, lubrication regimes, and theories of hydrodynamic, elasto-hydrodynamic and mixed / boundary lubrication.	L3	Apply
CO2	Explain the principles of design considerations, principles of bearing selection and arrangement in machines.	L2	Understand
CO3	Design of mechanical components from the aspect of friction, wear and lubrication.	L6	Create
CO4	Explain the principles for selecting compatible materials for minimizing friction and wear in machinery.	L2	Understand

Tribology (PEME7037T)

Course Contents

Unit-I **08 Hrs.**

Introduction

Tribology in design- bearing material its properties and construction, Tribological design of oil seals and gasket, Tribology in industry, Lubricants selection for general application and special application such as low temperatures, high temperature, extreme pressure etc. Tribological considerations- Nature of surfaces and their contact; mechanical properties of surface layer, Geometrical properties of surfaces, methods of studying surfaces; Study of contact of smooth and rough surfaces.

Unit-II **08 Hrs.**

Friction and wear

Role of friction and laws of static friction, causes of friction, theories of friction, Laws of rolling friction, Friction of metals and non-metals, Friction measurements, Stick-slip motion and friction instabilities. Definition of wear, mechanism of wear, types and measurement of wear, Wear properties of friction and anti-friction metallic and non-metallic materials, Theories of wear. Design of mechanical components against wear. Design of friction surfaces used in clutches and brakes.

Unit-III **09 Hrs.**

Hydrodynamic theory of lubrication

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film. Two dimensional Reynold's equation and its limitations, Petroff's equation. Hydrodynamic thrust bearing-Introduction, types. Flat plate thrust bearing-Pressure equation, load, centre of pressure, frictional force equation. Hydrodynamic lubrication: design of plain fixed pad and tilting pad, slider bearing for steady and varying –loads. Full and partial journal bearing of infinite length, design of journal bearing for steady loads and varying loads.

Unit-IV **08 Hrs.**

Elastohydrodyanamic Lubrication

Introduction to design of aerostatic bearings and its applications, Elasto-hydrodynamic lubrication: Principle, application to antifriction bearings, cams and gears, Fault diagnosis in bearings and its solutions, bearing maintenance.

Unit-V **09 Hrs.**

Lubricants

Lubrication and lubricants: Introduction, Importance of Lubrication, Boundary lubrication, classic hydrodynamics, hydrostatic and elasto hydrodynamic lubrication, Functions of lubricants, Types of lubricants and their industrial uses; SAE classification, recycling, disposal of oils, properties of liquid and grease lubricants; lubricant additives, general properties and selection.
Special Topics: Diagnostic maintenance of Tribological components and considerations in IC engines and automobile parts, roller chains and wire rope, lubrication systems. Air/gas lubricated bearing and its Advantages and disadvantages

Books Recommended

Textbooks

1 Basu S K., Sengupta A N., Ahuja B. B., Fundamentals of Tribiology, PHI 2006

2 Mujumdar B. C., Introduction to Tribiology bearings, Wheelers and company pvt. Ltd 2001.

3 Cameron A., Basic Lubrication Theory, Wiley Eastern Ltd.

4 Andras Z. Szeri, Fluid film lubrication theory & design, 1st Edition, 2005

Reference Books

1 Fuller, D., Theory and Practice of Lubrication for Engineers, New York company 1998

2 Moore, Principles and applications of Tribiology, Pergamaon press 1998

3 Srivastava S., Tribiology in industries, S Chand and Company limited, Delhi 2002

4 Redzimovskay E I., Lubrication of bearings – theoretical principles and design, Oxford press company 2000

5 J. Bhatia, Advances in industrial Tribology

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Automobile Engineering (PEME7038T)		

Prerequisites:

1. Knowledge of manufacturing processes, mechanics, dynamics, basic electronics & fluid mechanics.

Course Objectives:

1. To describe the working of different mechanical systems of an automobile.
2. To illustrate the working of electrical systems of an automobile.
3. To discuss the advancements in automobile technology.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Describe the types and working of clutch and transmission system.	L2	Understand
CO2	Illustrate the working of steering and braking systems.	L3	Apply
CO3	Apply the role of vehicle suspension systems and vehicle body.	L3	Apply
CO4	Analyze the different automotive electrical systems.	L4	Analyze
CO5	Evaluate with recent developments in automobiles.	L5	Evaluate

Automobile Engineering (PEME7038T)

Course Contents

Unit-I **10 Hrs.**

Introduction

Introduction: Classification of automobiles, Importance of various sub-systems of an automobile, development of an automobile, aspects of automotive engineering.
Clutch: Requirements of Clutches, Types of Clutches; Single Plate, Multi-plate, Wet Clutch, Centrifugal clutch. Clutch materials. Clutch operating mechanisms; Mechanical, Electric, Hydraulic and Vacuum. Trouble shooting and remedies. Clutch-by-wire.
Transmission: Necessity of gear box. Sliding mesh, Constant mesh, and Synchromesh Gearbox. Gear selector mechanisms. Overdrives, under-gearing, over-gearing, tractive effort and hydrodynamic torque converter, Epicyclic gear train and automatic transmissions. Trouble shooting and remedies. Automated Manual Transmission (AMT) and Continuously Variable Transmission (CVT).
Final Drive and Differential: Types of Final drive; spiral, bevel, Hypoid and worm drives. Necessity of differential, Working of differential, Conventional and non-slip differential, Trouble shooting and remedies.

Unit-II **09 Hrs.**

Steering and Braking System

Propeller Shaft and Axle: Propeller shafts and universal joints: Types and construction, Different types of universal joints and constant velocity joints. Trouble shooting and remedies. Classification of axles, Loads on axles, Semi, Three quarter and Full floating axles.
Steering System: Steering geometry, Steering requirements, Steering linkages and steering gears. Over-steer and Under-steer, Cornering power, Reversibility of steering gears. Trouble shooting and remedies.
Braking System: Requirement of brakes, Classification of brakes, Brake Actuation Methods: Mechanical, Hydraulic, Pneumatic, Electro and vacuum brakes. Types of Disc brakes and Drum Brakes, Brake trouble shooting, Antilock braking system (ABS).

Unit-III **10 Hrs.**

Suspension System, Wheels and Frames

Suspension System: Objects of suspension, Basic requirements, Sprung and un-sprung mass, Types of Independent, semi-independent and rigid axle suspension. Air suspension and its features. Pitching, rolling and bouncing. Shock absorbers and its types, Trouble shooting and remedies. Electronically controlled active suspension system.
Wheels and Tyres: Requirements of wheels and tyres. Types of wheels, types of tyres and types of carcass. Tyre and wheel manufacturing processes. Trouble shooting and remedies. Airless tyres run flat tyres.
Body Engineering: Importance of vehicle body and its types. Loads on vehicle body, materials for body construction. Layouts of passenger cars, Bus and truck bodies.
Chassis types and structure types: Open, Semi integral and integral structures.
Frames: Types of frames and their functions, Loads on frames, Load distribution of structure. Vehicle aerodynamics, Importance of crumple zone in vehicles, Crash safety ratings in India.

Unit-IV **07 Hrs.**

Automotive Electrical System

Storage Systems: Lead-Acid Battery; construction, working, ratings, types of charging methods, Alkaline battery, ZEBRA and Sodium Sulphur battery. Lithium ion battery, battery pack for electric vehicles, Battery management system.
Charging System: Dynamo: Principle of operation, Construction and Working. Regulators, combined current and voltage regulator.
Alternator: Principle of operation, Construction, Working. Rectification from AC to DC.
Starting system: Requirements, Various torque terms used, Starter motor drives; Bendix drive, Pre-engaged drive, Overrunning Clutch. Starter motor solenoids, switches and relays.

Unit-V **06 Hrs.**

Recent developments in Automobiles

Active and Passive Safety systems in an automobile. Cruise Control, Adaptive Cruise Control (ACC), Electronic Stability Program (ESP), Electronic, Brake Distribution (EBD), Traction Control System (TCS). Integrated Starter Alternator (ISA), Hill assist, Launch control, Connected cars with V2V communication & pre-collision technology.

Books Recommended

Textbooks

1 Automobile Engineering, Dr. Kirpal Singh, Vol I & II, Standard publishers

2 Automobile Engineering, S. K. Gupta, S Chand Publications

3 Automobile Engineering, R. K. Rajput, Laxmi Publications

Reference Books

1 Automotive Engineering Fundamentals, Jeffrey Ball, Richard Stone, SAE International.

2 Encyclopaedia of Automotive Engineering, David Crolla, Wiley Publication

3 Automotive Electrical and Electronic Systems, Tom Denton, Routledge

4 Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad, Yimin, Sebastian, Ali, CRC Press

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Product Lifecycle Management (OEME7041T)		

Prerequisites:

1. Knowledge of basic concepts of Management.

Course Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Describe the phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Illustrate various approaches and techniques for designing and developing products.	L3	Apply
CO3	Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.	L3	Apply
CO4	Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.	L3	Apply

Product Lifecycle Management (OEME7041T)

Course Contents

Unit-I **10 Hrs.**

Introduction to PLM

Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications.
PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM.

Unit-II **08 Hrs.**

Product Design

Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process

Unit-III **08 Hrs.**

Product Data Management (PDM)

Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.
Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies

Unit-IV **08 Hrs.**

Integration of Environmental Aspects in Product Design

Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.

Unit-V **08 Hrs.**

Life Cycle Assessment and Life Cycle Cost Analysis

Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis

Books Recommended

Textbooks

1 Product Lifecycle Management: Paradigm for 21st Century Product Realization, John Stark, Springer-Verlag, 2004.

2 Product Design for the environment-A life cycle approach, Fabio Giudice, Guido La Rosa, Antonino Risitano, Taylor & Francis 2006.

Reference Books

1 Product Life Cycle Management, Saaksvuori Antti, Immonen Anselmie, Springer, Dreamtech.

2 Product Lifecycle Management: Driving the next generation of lean thinking, Michael Grieve, Tata McGraw Hill, 2006.

3 Product Life-Cycle Management: Geometric Variations, François Villeneuve, Luc Mathieu, Max Giordano, Wiley, 2010.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Management Information System (OEME7042T)		

Prerequisites:

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Course Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today‘s business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain how information systems Transform Business.	L2	Understand
CO2	Use information systems concepts to assess their effects on organizational operations.	L3	Apply
CO3	Describe IT infrastructure and its components and its current trends.	L2	Understand
CO4	Explain principal tools and technologies for accessing information from databases to improve business performance and decision making.	L2	Understand
CO5	Use enterprise-wide knowledge management systems to show their benefits for business operations.	L3	Apply

Management Information System (OEME7042T)

Course Contents

Unit-I **05 Hrs.**

Foundation Concepts

Information Systems in Business, Functional Area Information System, The Components of Information Systems, Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.

Unit-II **08 Hrs.**

Computer Systems

Information Technologies: Hardware and Software
Computer Systems: End User and Enterprise Computing
Computer Peripherals: Input, Output, and Storage Technologies
Application Software: End User Applications
System Software: Computer System Management
Data Resource Management: Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts, Knowledge Management
Networks: The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models

Unit-III **08 Hrs.**

MIS Tools and BI

MIS Tools and applications for Decision making: ERP and ERP support of Business Process Reengineering,
Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Visualization
Artificial Intelligence Technologies in Business

Unit-IV **06 Hrs.**

Security and Ethical Challenges

Security, Ethical, and Societal Challenges of IT Security Management of Information Technology

Unit-V **07 Hrs.**

Social Computing (SC)

Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM,E-business and E-commerce – B2B B2C, Mobile commerce.

Unit-VI **08 Hrs.**

Information System

Information System within Organization: Acquiring Information Systems and Applications:Various System development life cycle models.

Enterprise and Global Management of Information Technology: Managing Information Technology, Managing Global IT.

Books Recommended

Reference Books

1 Management Information Systems, 11th edition by James A O'Brien, George M., Ramesh Behl.

2 Kelly Rainer, Brad Prince, Management Information Systems, Wiley.

3 K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.

4 D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Operations Research (OEME7043T)		

Prerequisites:

1. Basic Knowledge of Algebra, Probability and Statistics.

Course Objectives:

1. To formulate a real-world decision problem as a mathematical programming model.
2. To learn the mathematical tools that are employed to solve mathematical programming models.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Analyze a real-world problem by formulating it as a Linear Programming Problem and interpreting the solution obtained using the Simplex method or other algorithms.	L4	Analyze
CO2	Determine real-world problems as Transportation Problem and Assignment Problem and solve the decision problem by choosing appropriate algorithm.	L3	Apply
CO3	Determine the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations.	L3	Apply
CO4	Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations.	L2	Understand
CO5	Explain the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.	L2	Understand
CO6	Explain the concept of simulation and replacement policy, apply Monte Carlo Simulation technique to systems such as inventory and queuing, and determine optimal replacement age.	L2	Understand

Operations Research (OEME7043T)

Course Contents

Unit-I **10 Hrs.**

Introduction to Operations Research

Introduction to Operations Research: Concept of decision making. Definition of OR. Formulation of decision problem as OR model, Concept of Optimization,
Linear Programming Problem: Mathematical Formulation. Finding optimal solution - Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.

Unit-II **08 Hrs.**

Assignment and Transportation Problems

Assignment Problems: Mathematical Formulation, Finding optimal solution - Hungarian Method.
Transportation problem: Mathematical Formulation, Finding initial basic feasible solution – North-west corner rule, row minima, column minima, least cost method and Vogel's approximation method.
Optimality test: the stepping stone method and MODI method.
Improving the solution.

Unit-III **06 Hrs.**

Dynamic Programming

Bellman's Principle of optimality - Applications of dynamic programming- Employment smoothening problem, capital budgeting problem, shortest path problem, cargo loading problem.

Unit-IV **10 Hrs.**

Queuing Models and Approximate Methods

Queuing Models: Characteristics of queuing models.
Single Channel – Single and multi phase servers, Poisson arrivals, exponential service time - with infinite population and finite population models – with infinite and finite capacity.
Multichannel – Single phase server - Poisson arrivals, exponential service time with infinite population.
Game Theory: Introduction. Minimax & Maximin Criterion and optimal strategy. Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle.
Approximate methods - Iterative method, m x 2 & 2 x n games -Graphical method and method of sub-games.
Expressing game as LPP.

Unit-V **08 Hrs.**

Simulation and Replacement Models

Simulation: Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages.
Replacement Models: Replacement of items that deteriorate with time - when money value is not counted and counted, Replacement of items that fail suddenly – individual and group replacement

policy.

Books Recommended

Textbooks

1 Operations Research, Sharma J. K., Trinity Press

2 Operations Research, Gupta P. K., Hira D. S., S. Chand Limited

Reference Books

1 Operations Research - An Introduction; Taha, H.A.; Prentice Hall

2 Operations Research: Principles and Practice; Ravindran, A, Phillips, D. T and Solberg, J. J.; John Willey and Sons

3 Introduction to Operations Research; Hiller, F. S. and Liebermann, G. J.; Tata McGraw Hill

4 Operations Research Principles and Practice; Pradeep Prabhakar Pai; Oxford University Press

5 Operations Research, R. Panneerselvam, PHI Publications.

6 Operations Research, A. M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education.

7 Operations Research; Kanti Swarup, P. K. Gupta and Man Mohan; Sultan Chand & Sons.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Cyber Security and Laws (OEME7044T)		

Prerequisites:

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Course Objectives:

1. To understand and identify different types cybercrime and cyber offenses.
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliance

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the different types of cybercrime and security issues E Business.	L2	Understand
CO2	Analyze different types of cyber threats and techniques for security management.	L3	Apply
CO3	Analyze the legal requirements and standards for cyber security in various countries to regulate cyberspace.	L4	Analyze
CO4	Explain the Information Technology Act and the legal framework of right to privacy, data security, and data protection.	L2	Understand

Cyber Security and Laws (OEME7044T)

Course Contents

Unit-I **12 Hrs.**

Introduction to Cybercrime

Introduction to Cybercrime: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, Web Jacking, Illegal online Selling, Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing Identity Theft (ID Theft)
Cyber offenses: How criminal plan the attacks, Social Engineering, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector

Unit-II **08 Hrs.**

Cyber Threats Analysis and Cyber Security Management

Cyber Threats Analysis

- Knowledge of Dynamic and Deliberate Targeting Knowledge of Indications and Warning
- Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities and Actions
- Knowledge of Key Cyber Threat Actors and their Equities
- Knowledge of Specific Target Identifiers and Their Usage

Cyber Security Management

- Knowledge of Emerging Security Issues, Risks, and Vulnerabilities

Unit-III **06 Hrs.**

Electronic Business and legal issues

Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic Business, paper vs paper less contracts, E-Commerce models- B2B, B2C, E security. E- Payment Mechanism; Payment through card system, E-Cheque, E-Cash, E-Payment Threats & Protections, Security for E-Commerce.

Unit-IV **08 Hrs.**

Indian IT Act and Security aspect in cyber Law

Indian IT Act : Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments.
Security aspect in cyber Law : The Contract Aspects in Cyber Law , The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law ,The Evidence Aspect in Cyber Law ,The Criminal Aspect in Cyber Law

Unit-V **08 Hrs.**

Security Industries Standard Compliances

IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber security, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI-DSS.
OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Center for Internet Security Controls)

Books Recommended

Reference Books and Material

1 Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi

2 The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi

3 The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.

4 E-Commerce Security and Privacy", Anup K. Ghosh, Springer Science and Business Media, 2012

5 Izzat Alsmadi , The NICE Cyber Security Framework Cyber Security Intelligence and Analytics, Springer

6 Cyber Law & Cyber Crimes, Advocate Prashant Mali; Snow White Publications, Mumbai

7 Nina Godbole, Information Systems Security, Wiley India, New Delhi

8 Kennetch J. Knapp, Cyber Security & Global Information Assurance Information Science Publishing.

9 William Stallings, Cryptography and Network Security, Pearson Publication

10 Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in

11 Website for more information, A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer- professionals-33538

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Personal Finance Management (OEME7045T)		

Prerequisites:

1. Basic Knowledge of Algebra, Probability and Statistics.

Course Objectives:

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familiarize the students with microfinance for accelerating the expansion of local micro-businesses.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Use a framework for financial planning to understand the overall role finances play in his/her personal life.	L3	Apply
CO2	Calculate income from salaries, house property, business/profession, capital gains and income from other sources.	L3	Apply
CO3	Calculate the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.	L3	Apply
CO4	Describe how Microfinance can help in financial inclusion.	L2	Understand

Personal Finance Management (OEME7045T)

Course Contents

Unit-I **07 Hrs.**

Introduction to Personal Finance

Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion.
Introduction to Personal Finance Person Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services. Consumer Credit: Advantages, Disadvantages, Sources and Costs.

Unit-II **07 Hrs.**

Personal Financial Management

Loans: Home, Car, Education, Personal, Loan against property and Jewel loan.
Insurance: Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance.
Investment: Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning for the Future.

Unit-III **08 Hrs.**

Income Tax

Income Tax Act Basics- Introduction to Income Tax Act, 1961.
Heads of Income and Computation of Total Income and Tax Liability- Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and Carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons.
Tax Management, Administrative Procedures and ICDS - TDS, TCS and Advance Tax Administrative Procedures, ICDS.

Unit-IV **10 Hrs.**

Goods and Services Tax

Goods and Services Tax: GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union & State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council, GST Network, State Compensation Mechanism, Registration.
Levy and Collection of GST: Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme; Classification of Goods and Services

Unit-V **10 Hrs.**

Microfinance

Introduction to Microfinance: Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinance, Customers of Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation

& Operation of Self Help Groups (SHGs).
Models in Microfinance: Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements & Challenges
Institutional Mechanism: Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints & Governance Issues, Institutional Structure of Microfinance in India :NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand & Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs,

Books Recommended

Reference Books

1 Banking and Financial Sector Reforms in India , by Asha Singh, M.S. Gupta, Serials Publication.

2 Indian Banking Sector: Essays and Issues (1st) , by M.S. Gupta & J.B. Singh, Serials Publication.

3 Basics Of Banking & Finance , by K.M. Bhattacharya O.P. Agarwal , Himalaya Publishing House

4 Agricultural Finance And Management, by S. Subba Reddy , P. Raghu Ram .

5 The Indian Financial System And Development , by Dr.Vasant Desai, Himalaya Publishing House; Fourth Edition

6 Income Tax Management , Simple Way of Tax Management, Tax Planning and Tax Saving, By Sanjay Kumar Satapathy

7 Direct Tax System Income Tax by Dr. R. K. Jain, SBPD Publications.

8 Simplified Approach to GST Goods and Services Tax, By S K Mishra , Educreation Publishing.

9 Introduction To Microfinance , By Todd A Watkins , World Scientific Publishing Company

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Energy Audit and Management (OEME7046T)		

Prerequisites:

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Course Objectives:

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility
3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
4. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Identify and describe the present state of energy security and its importance.	L2	Understand
CO2	Identify and describe the basic principles and methodologies adopted in the energy audit of a utility	L2	Understand
CO3	Describe the energy performance evaluation of some common electrical installations and identify energy-saving opportunities.	L2	Understand
CO4	Describe the energy performance evaluation of some common thermal installations and identify energy-saving opportunities.	L2	Understand
CO5	Analyze the data collected during performance evaluation and recommend energy-saving measures.	L4	Analyze

Energy Audit and Management (OEME7046T)

Course Contents

Unit-I **05 Hrs.**

Energy Scenario

Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance.

Unit-II **10 Hrs.**

Energy Audit and Financial Analysis Techniques

Energy Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring targeting, Energy audit instruments. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit.
Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI) Internal rate of return (IRR).

Unit-III **10 Hrs.**

Energy Management and Energy Conservation in Electrical System

Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressor, fan and blower. industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.

Unit-IV **10 Hrs.**

Energy Management and Energy Conservation in Thermal Systems

Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation- types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.

Unit-V **07 Hrs.**

Energy conservation in Buildings

Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating,
Application of Non-Conventional and Renewable Energy Sources, Energy sources and energy management in electric vehicles.

Books Recommended

Reference Books

1 Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science.

2 Designing with light: Lighting Handbook, By Anil Valia, Lighting System.

3 Energy Management Handbook, By W.C. Turner, John Wiley and Sons.

4 Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).

5 Energy Management Principles, C.B. Smith, Pergamon Press.

6 Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press.

7 Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press.

8 www.energymanagertraining.com

9 www.bee-india.nic.in

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Disaster Management and Mitigation Measures (OEME7047T)		

Prerequisites:

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Course Objectives:

1. To provide basic understanding hazards, disaster and various types and categories of disaster occurring around the world.
2. To identify extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand roles and responsibilities of individual and various organization during and after disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Describe natural as well as man-made disasters, their extent, and possible effects on the economy.	L2	Understand
CO2	Describe the institutional framework and organizational structure in India for disaster management and explain government policies, acts, and various emergency laws.	L2	Understand
CO3	Describe the simple do's and don'ts during extreme events and explain the skills required to respond accordingly	L2	Understand
CO4	Explain the importance of disaster prevention and various mitigation measures with exposure to disaster hotspots across the globe.	L2	Understand

Disaster Management and Mitigation Measures (OEME7047T)

Course Contents

Unit-I **10 Hrs.**

General Information about Disaster

Brief concept of Hazards, definition and types of Disasters : Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters, Impact of disaster on National development.
Study of Natural disasters: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc.
Study of Human/Technology Induced Disasters: Chemical, Industrial and Nuclear disasters, Internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit-II **08 Hrs.**

Disaster Management

Brief Introduction, Disaster management cycle, Evolution of Disaster and Disaster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc.
Prior, During and Post disaster management activities: (Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public awareness, Research, Reconstruction of essential services and livelihood restoration.

Unit-III **08 Hrs.**

Institutional framework and Mechanism for disaster management in India

Institutions in India for dealing with various disasters, Organizational structure, functions and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central and state government during and after disaster, NGO's involved in disasters and their task, Jobs carried out by armed forces.
Financial Relief During disaster (State, National and International Disaster Assistance)

Unit-IV **08 Hrs.**

Disaster risk reduction and Mitigation Measures

Need of disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction.
Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality, climate change, land use, winter storms and aquatic biology etc.
Use of information management, GIS, GPS and remote sensing Mitigation measure.
Do's and don'ts in case of disasters and effective implementation of relief aids.

Unit-V **08 Hrs.**

Case studies on disaster (National /International)

Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004) , Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on.
(Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken).

Books Recommended

Reference Books

1 Disaster Management, by Harsh K.Gupta, Universities Press Publications (2003).

2 Disaster Management: An Appraisal of Institutional Mechanisms in India, by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.

3 Introduction to International Disaster Management, by Damon Copolla, Butterworth Heinemann Elsevier Publications (2015).

4 Disaster Management Handbook, by Jack Pinkowski, CRC Press, Taylor and Francis group (2008).

5 Disaster management & rehabilitation, by Rajdeep Dasgupta, Mittal Publications, New Delhi (2007).

6 Natural Hazards and Disaster Management, Vulnerability and Mitigation, by R B Singh, Rawat Publications (2006).

7 Concepts and Techniques of GIS, by C.P.Lo Albert, K.W. Yonng, Prentice Hall (India) Publications (2006).

8 Risk management of natural disasters, by Claudia G. Flores Gonzales, KIT Scientific Publishing (2010).

9 Disaster Management – a disaster manger's handbook, by W. Nick Carter, Asian Development Bank (2008).

10 Disaster Management in India, by R. K. Srivastava, Ministry of Home Affairs, GoI, New Delhi (2011)

11 The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy, by Wil Mara, Marshall Cavendish Corporation, New York, 2011.

12 The Fukushima 2011 Disaster, by Ronald Eisler, Taylor & Francis, Florida, 2013.
(Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Science of Well-being (OEME7048T)		

Prerequisites:

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Course Objectives:

1. To create consciousness about importance of holistic health and physical as well as mental well-being.
2. To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.
3. To introduce the learners to the means of mental and physical well-being, ill effects of malpractices like alcoholism, smoking etc.
4. To equip the learners to manage and cope up with stress in their daily living.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Describe concepts of holistic health and well-being, differentiate between its true meaning and misconceptions, and explain the benefits of well-being.	L2	Understand
CO2	Describe the meaning of happiness, practice gratitude and self-compassion, and analyze incidents from one's own life	L4	Analyze
CO3	Explain the causes and effects of stress, identify reasons for stress in one's own surroundings and self.	L2	Understand
CO4	Describe the importance of physical health and fitness, assess one's lifestyle, and justify its limitations or effectiveness.	L5	Evaluate
CO5	Analyze one's own coping mechanisms, assess their effectiveness, develop and strategize for betterment, and execute them.	L4	Analyze

Science of Well-being (OEME7048T)

Course Contents

Unit-I **06 Hrs.**

Health and well-being

The concept of health, dimensions of health, the notion of well- being, various facets of well-being, relation between health and well-being. Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.

Unit-II **08 Hrs.**

Concepts of happiness

Happiness: what is it and how do we measure it? Philosophical perspectives on happiness, Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Narrow vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.

Unit-III **10 Hrs.**

Stress and mental health/well-being

Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms of stress, effects of stress, different models of stress.
Sources of stress and how does stress cause illness, various sources of stress, delineate between external and internal sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.

Unit-IV **10 Hrs.**

Physical Well-being / Health management

Concept of health behaviours, dimensions of health behaviours. Health enhancing behaviors: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviors and illness management: concept of illness management, effectiveness of illness management. Concept of Nutrition, Role of Nutrition, Components of Nutrition, concept of Malnutrition, Health compromising behaviours: Alcoholism, Smoking and its effects on health.

Unit-V **08 Hrs.**

Dealing with Difficult Times / Coping mechanisms

The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Chronic stress, theories of the stress-illness link, role of stress in mental disorders.
Concept of coping, Ways of coping and stress management, basic knowledge about stress management, various techniques of stress management, stress management programs. Mental strengths and virtues, Hope, Optimism, Resilience – concept, pathways and models, Meditation and Self-introspection.

Books Recommended

Textbooks

1 The Science of well-being by Felicia Huppert, Nick Baylis, Barry Keverne; Oxford University Press

2 Health and Well-Being: Emerging Trends by S. Ojha, U. Rani Srivastava, Shobhna Joshi, Global Vision Publishing House

3 Positive psychology: The scientific and practical explorations of human strengths by Shane

4 J. Lopez, Jennifer Teramoto Pedrotti, Charles Richard Snyder; Sage Publications.

Reference Books

1 The pursuit of happiness and the realization of sympathy: Cultural patterns of self, social relations, and well-being by Kitayama, S., & Markus, H. R, Culture and subjective well-being, The MIT Press.

2 Man Adapting by Dubos, R; New Haven: Yale University Press.

3 Happiness a history by McMahon D. M., Atlantic Monthly Press.

4 Well-being: The foundations of hedonic psychology by D. Kahneman & E. Diener & N. Schwarz, New York: Russell Sage

5 Selye H. The Stress of Life. New York; McGraw-Hill; 1984.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Research Methodology (OEME7049T)		

Prerequisites:

1. Basic Knowledge of Probability and Statistics.

Course Objectives:

1. To understand Research and Research Process.
2. To acquaint learners with identifying problems for research and develop research strategies.
3. To familiarize learners with the techniques of data collection, analysis of data and interpretation.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Apply preliminary research design concepts for projects in their subject matter areas.	L3	Apply
CO2	Analyze and report research data using appropriate statistical and analytical techniques.	L2	Understand
CO3	Explain complex data or situations clearly.	L2	Understand
CO4	Analyze the research findings.	L4	Analyze
CO5	Summarize a structured research report based on research findings.	L2	Understand

Research Methodology (OEME7049T)

Course Contents

Unit-I **07 Hrs.**

Basic Research Concepts

Meaning of research, Objectives of research, Types of research, Significance of research Research process.

Unit-II **10 Hrs.**

Research Methodology

Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.

Unit-III **10 Hrs.**

Research and Sample Design

Meaning of research and sample design, Need of research design, Features of good research design, Important concepts, Different research designs, Types of sampling designs

Unit-IV **10 Hrs.**

Data Collection and Data Analysis

Types of data, Methods for collecting data: Experiments and surveys, Collection of primary and secondary data, Hypothesis testing and interpretation of Data.

Unit-V **Hrs.**

Interpretation and Report Writing

Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues.

Books Recommended

Reference Books

1 Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.

2 Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.

3 Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd Edition), Singapore, Pearson Education.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Public Systems and Policies (OEME70410T)		

Prerequisites:

1. Basic Knowledge of Social science and Current affairs

Course Objectives:

1. To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
2. To understand public systems in a fast-changing environment in the global context.
3. To provide an in-depth understanding of the ills prevailing in the society and aids to identify the solutions for them.
4. To explain public policy and its operations with special focus on policy relating to Government finance.
5. To analyze and evaluate the impact of the public policy on firms and economy at large.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the importance of public systems in a fast-changing environment in the global context.	L2	Understand
CO2	Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.	L4	Analyze
CO3	Explain public policy and its operations with special focus on policy relating to Government finance.	L2	Understand
CO4	Analyze the impact of public policy on firms and the economy at large and work under various fields as policymakers.	L4	Analyze
CO5	Apply analytical skills through Expenditure Policy in public services case studies.	L3	Apply

Public Systems and Policies (OEME70410T)

Course Contents

Unit-I **10 Hrs.**

Introduction and Overview of Public Systems

Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size of Government.

Unit-II **06 Hrs.**

Public Sector in the Economics Accounts

Public Sector in the circular flow; Public Sector in the National Income Accounts.

Unit-III **08 Hrs.**

Public Choice and Fiscal Politics

Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.

Unit-IV **12 Hrs.**

Introduction and Overview of Public Policy

Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.

Unit-V **06 Hrs.**

Case Studies in Expenditure Policy: Public Services

- National Defense
- Highways
- Outdoor Recreation
- Education

Books Recommended

Reference Books

1 Introduction to Public Policy by Charles Wheelan, W.W. Norton & Company.

2 Understanding Public Policy by Thomas R. Dye, Prentice Hall.

3 Public Policy-Making: An Introduction by Anderson J.E., Boston, Houghton.

4 Public Administration by Avasthi & Maheshwari, Lakshminarayan Agarwal, Agra.

5 New Horizons of Public Administration by Bhattacharya, Mohit, Jawahar Publishers, New Delhi.

6 Public Administration and Public Affairs by Henry, Nicholas, Prentice Hall of India, New Delhi.

7 Public Finance 10th Edition by Harvey S Rosen and Ted Gayer, McGraw-Hill Education, 2013.

8 Public Finance in Theory and Practice by Musgrave and Musgrave.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VII
Project Stage II (PJME7050L)		

Prerequisites:

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Course Objectives:

1. To implement the solution as per the problem statement
2. To develop the team building, writing, logical reasoning and management skills.
3. To provide the connections between the designs and concepts across different disciplinary boundaries.
4. To encourage students to become independent personnel, critical thinkers and Lifelong learners.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Analyze the problem statement and produce solution of the problem considering cultural, social, environmental and economic factors using appropriate tool and method.	L4	Analyze
CO2	Interpret project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Apply the ability to work in teams and manage to conduct the project development activity.	L3	Apply
CO4	Use different perspectives from relevant disciplines which help them to get internships, jobs, and admission for higher studies.	L3	Apply
CO5	Explain the project development in the form of technical writing, and interpret what constitutes plagiarism and the use of proper referencing styles.	L2	Understand

Project Stage II (PJME7050L)

Project-I work done in VI semester shall be continued as Project-II in semester VII. Students should complete remaining implementation of ideas given in synopsis/Abstract of semester VII
Students / group must plan their execution of project, so that project work should be completed before end of semester.
Project-II involves fabrication, design, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing, possible results and report writing.
Each project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VII in the form of Hard bound.
Domain knowledge (any beyond) needed from the various areas in the field of mechanical engineering for the effective implementation of the project.
The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines

The main purpose of this activity is to improve the students technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

- Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.
- In the first review of this semester, each group is expected to complete 30% of project.
- In the second review of this semester, each group is expected to complete 50% of project.
- Interaction with alumni mentor will also be appreciated for the improvement of project.

Student is expected to :

- Select an appropriate project title based on acquired knowledge from subjects.
- Maintain a Log Book of weekly work done (Log Book Format will be as per Table 1).
- Report weekly to the project guide along with the log book.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				

Assessment Criteria

- At the end of the semester, after confirmation by the project guide, each project group will submit a project completion report in the prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the Project Stage-II (at the end of the semester) will be done by the departmental committee (including project guide).
- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project.

Prescribed project report guidelines

Every group should prepare hard bound report (preferable LaTeX) of about minimum 40 pages on the work carried out by a batch of students in respect of the project work done during semester-VII. Project Report should include appropriate content for:

- Title
- Abstract
- Introduction
- Literature Survey
- Problem identification and project objectives
- Related Theory
- Project design and Implementation details
- Case study/Analysis/Design Methodology
- Project Outcomes
- Result and Conclusion
- Future scope
- References

Assessment criteria for departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress, and marks allocation will be as per Table 2.

Table 2: Continuous Assessment table

Sr	PRN	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress
- Documentation/Technical paper writing
- Key findings
- Validation of results
- Product Development

Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TA ensures the satisfactory performance on the above aspects.

Assessment criteria for departmental committee (including project guide) for End Semester Exam:

Evaluate the project as per Table 3.

Table 3: Evalution Table

Sr	PRN	Name of Student	Project Selection	Design/ Simulation	model/ programming	Result Verification	Presentation	Total
			5	5	5	5	5	25

Each group shall present/publish a paper based on the project in reputed/peer-reviewed Conference/Journal/TechFest/Magazine before the end of the semester.

Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Syllabus Details of Semester-VIII

Final Year B.Tech in Mechanical Engineering

(Auto Scheme) with effect from Year 2023-24
(TA modified in 2024-25)

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405 Ph: 02563 259 802,
Web: www.rcpit.ac.in/mechanical-engineering-syllabus

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Design of Mechanical Systems (PEME8011T)		

Prerequisites:

1. Knowledge of Material Technology, Power Engineering, Machine Design I and Machine Design II.

Course Objectives:

1. To study design of snatch block, belt conveyors, engine system, pumps and machine tool gearbox.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Design gear boxes for a given machine tool application.	L6	Create
CO2	Design hoisting mechanism of an Electric overhead traveling crane.	L6	Create
CO3	Design belt conveyor systems.	L6	Create
CO4	Design engine components such as cylinder, piston, connecting rod and crankshaft.	L6	Create
CO5	Design pumps for a given application.	L6	Create

Design of Mechanical Systems (PEME8011T)

Course Contents

Unit-I **10 Hrs.**

Design of Gear Box

Requirements of a gear box, Determination of variable speed range, Graphical representation of speeds, Structure diagram, Ray diagram, Selection of optimum ray diagram, Estimation of numbers of teeth on gears, Deviation diagram, Layout of gear box.

Unit-II **08 Hrs.**

Design of Hoisting mechanism

Selection of wire rope, Design and selection of sheave pulley, axle and bearings, Selection of hook, Design of nut, Selection of thrust bearing, Design of cross-piece with trunion, Design of shackle plate, Design of rope drum, drum shaft and bearing, Selection of motor.

Unit-III **08 Hrs.**

Design of belt conveyors

Selection of belt, Selection of motor, Design of drive pulley assembly, Design of driven pulley assembly, Design of over running idler assembly, Design of under running idler assembly.

Unit-IV **08 Hrs.**

Engine Design (Petrol and Diesel)

Design of cylinder, Design of piston with pin and rings, Design of connecting rod, Design of crank shaft with bearings.

Unit-V **08 Hrs.**

Design of gear pump and centrifugal pump

Design of gear pump: Selection of motor, Design of gear, Selection of bearing, Design of bolts, Design of suction and delivery pipe.
Design of centrifugal pump: Selection of motor, Design of impeller and impeller shaft, Design of volute casing, Design of suction and delivery pipe.

Books Recommended

Textbooks

1 Mechanical Engineering Design - J. E. Shigley and C. R. Mischke - McGraw-Hill Education

2 Design of Machine Elements – V. B. Bhandari - McGraw-Hill Education

3 Mechanical System Design - S. P. Patil - JAICO Publishing House

Reference Books

1 Material Handling Equipment – N. Rudenko - M.I.R. publishers.

2 Design of machine tools - S. K. Basu and D. K. Pal - Oxford and IBH Pub. Co.

3 Machine tool design - N. K. Mehta - McGraw-Hill Education

4 Gear Design Handbook - Gitin Maitra - McGraw-Hill Education.

5 Design Data book by P.S.G. College of Technology, Coimbatore.

6 Design Data Book- Design of engine parts by Khandare S. S. & Kale A. V.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Industrial Engineering (PEME8012T)		

Prerequisites:

1. Basic knowledge of Manufacturing processes and various manufacturing systems.

Course Objectives:

1. To familiarise with concept of integration of various resources and the significance of optimizing them in manufacturing and allied Industries.
2. To acquaint with various productivity enhancement techniques.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Illustrate the need for optimization of resources and its significance.	L4	Analyze
CO2	Develop ability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.	L6	Create
CO3	Demonstrate the concept of value analysis and its relevance.	L3	Apply
CO4	Evaluate and implement different concepts involved in method study and understanding of work content in different situations.	L5	Evaluate
CO5	Describe different aspects of work system design and facilities design pertinent to manufacturing industries.	L2	Understand
CO6	Illustrate concepts of Agile manufacturing, Lean manufacturing and Flexible manufacturing.	L4	Analyze

Industrial Engineering (PEME8012T)

Course Contents

Unit-I **08 Hrs.**

Introduction to Industrial Engineering

History and contribution, Industrial engineering approach, Definition and concept of Productivity, productivity measurements, factors influencing productivity and productivity improvement techniques.
Value Engineering and Value Analysis: Distinction between value engineering & value analysis and their significance. Steps in value engineering & analysis and check lists.

Unit-II **08 Hrs.**

Work study

Method study: micro-motion study and principles of motion economy, Therbligs, Work measurement: Time Study, Work Sampling, Standard Data, Predetermined Motion Time System (PMTS); Maynard Operation Sequence Technique (MOST).

Unit-III **10 Hrs.**

Work system design

Introduction to ergonomics and its scope in relation to work. Outline of discipline of anatomy, physiology and psychology, with respect to ergonomics building blocks such as anthropometry and biomechanics; Industrial Psychology concept, aim & objectives and scope of industrial psychology; Job evaluation, merit rating, incentive schemes, wage administration and business process reengineering.

Unit-IV **08 Hrs.**

Facility Design

Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; Line Balancing: objectives, constraints, terminology in assembly line, heuristic methods like Kilbridge-Wester, Largest Candidate rule, Rank positional weight; Materials handling systems, AGV. Concepts of Group Technology and cellular manufacturing.

Unit-V **08 Hrs.**

Agile manufacturing

Introduction, developing agile manufacturing, Integration of Product/Process Development, Application of IT/IS concepts, Agile supply chain management, Design of skill and knowledge and Computer control of Agile manufacturing. Flexible manufacturing, Lean Manufacturing, Value Stream Mapping.

Books Recommended

Textbooks

1 Industrial Engineering and Management, Ravi Shankar, Galgotia Publications Pvt Ltd.

2 Industrial Engineering and Management, O.P. Khanna, Dhanpat Rai Publications.

Reference Books

1 Introduction to Work study, ILO, Geneva, and Oxford & IBH Pub Co. Pvt. Ltd.

2 Ergonomics at Work, Murrell

3 Plant Layout and Material Handling, James M. Apple, John Wiley & Sons

4 Facility Layout and Location – An Analytical Approach, Richard L. Francis & John A. White, Prentice Hall

5 Production Planning and Control, Samuel Elion

6 Production and Operations Management, Joseph G. Monks

7 Quality planning and analysis, J M Juran, FM Gryana, TMH

8 Total Quality Management, D. H. Bester Field et al. prentice hall

9 TQM in new product manufacturing, HG Menon; TMH

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
CAD/CAM/CIM (PEME8013T)		

Prerequisites:

1. Knowledge of CAMD and Finite Element Analysis.

Course Objectives:

1. To introduce CAD/CAM/CIM with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design and manufacturing by using CAM software.
3. To develop New API for CAD
4. To introduce capabilities of additive manufacturing to replace conventional machining.
5. To make students aware about computer Integrated manufacturing (CIM).

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain basics of computer graphics and computer modelling technique.	L2	Understand
CO2	Measure Transform, manipulate objects and computer assisted generation of tool path.	L5	Evaluate
CO3	Apply Artificial Intelligence concept to Design and manufacturing.	L3	Apply
CO4	Apply and replace conventional manufacturing process by additive manufacturing process.	L3	Apply
CO5	Apply and replace conventional manufacturing process by additive manufacturing process.	L3	Apply

CAD/CAM/CIM (PEME8013T)

Course Contents

Unit-I **08 Hrs.**

Computer Graphics and Techniques for Geometric Modeling

Basics of computer graphics, Introduction to computer graphics algorithms, Raster Graphics, Vector Graphics, DDA Line generation Algorithm, Bresenham's Line Generation Algorithm, Introduction to Painters Algorithm, Introduction to Area Subdivision Algorithm, The parametric representation of geometry,Bezier curves. Constructive solid geometry (CSG), Boundary Representation (B-Rep), Wire Frame Modelling, Solid Modeling, SurfaceModelling, Parametric Modelling.

Unit-II **10 Hrs.**

Introduction to Computer Aided Manufacturing (CAM) and CAM software

G Code, M Code, CNC Programming, writing a code for Turning Operation, Writing a code for Milling Operation. Machine Setup, Tool Selection, Tool simulation and stock material removal, Automatic Tool Path generation, Generation of CNC code for machining, Produce setup sheets.
2D & 3D Transformations (Translation, Rotation, Scaling & Magnification). Programming for Transformations.

Unit-III **08 Hrs.**

AI in Design and API

Artificial Intelligence in Design & Manufacturing: The integration of predictive machine learning, Optimizing several variables, Unprecedented customization, Automated experimentation, Smart manufacturing, Predictive Maintenance, Smart Maintenance, 24x7 Production, Safer Operational Environment, Microscopic Defect Identification, Shop floor performance improvement, Generative design, Novel Opportunities for Humans.
Application Programming Interface (API) : Concept of customizing applications by writing programs, Creating Scripts and Add-Ins, Creating Programs for Assemblies, Joint, B- Rep & Geometry.

Unit-IV **06 Hrs.**

Introduction to Additive Manufacturing

Classification of additive manufacturing processes, Seven Classes of Additive Manufacturing, Binder jetting, Directed Energy Deposition, Powder Bed Fusion, Sheet Lamination, Material Extrusion, Material Jetting, Vat Photo Polymerization.
Discussion on latest technique available on each type of additive manufacturing processes. Specification, working principal, material compatibility and Post processing.

Unit-V **10 Hrs.**

CIM,DM and CAPD

Computer Integrated Manufacturing, Digital manufacturing : Introduction, Evolution, Objectives, CIM Hardware and Software, CIM Benefits, Nature androle of the elements of CIM, Identifying CIM needs, Data base requirements of CIM, Role of CAD/CAM in CIM, Obstacles to Computer Integrated Manufacturing, Concept of the future CIM systems, Socio -techno- economic aspects of CIM.
Computer Aided Product Design and Manufacturing: Overview of toy design for entertainment and

play, creative product design, Ideas for new toys that serve clients in the community, Fundamental aspects of the product development process, Determining customer needs, brainstorming, estimation, sketching, sketch modeling, concept development, design aesthetics, detailed design, and prototyping.

Books Recommended

Textbooks

1 CAD/CAM: Computer Aided and Manufacturing – Mikell P. Groover and Emory W. Zimmers, Jr. – Pearson Education

2 CAD/ CAM: Theory & Practice – Ibrahim Zeid, R. Sivasubramanian – Tata McGraw Hill Publications

3 CAD/CAM Principles and Applications – P.N. Rao – Tata McGraw Hill Publications

Reference Books

1 Computer Graphics – Donald Hearn and M. Pauline Baker – Eastern Economy Edition

2 Principle of Computer Graphics – William.M. Neumann and Robert.F. Sproul – McGraw Hill publishers.

3 Fundamental of CIM technology – David L. Goetsch – Delmar publication

4 Computer Integrated Design and Manufacturing – David Bedworth – McGraw Hill publishers.

5 CNC Machines – B.S. Pabla and M. Adithan – New Age International Publishers.

6 Numerical Control and Computer Aided Manufacturing – T.K. Kundra, P.N. Rao and N.K. Tiwari – Tata McGraw Hill publishers

7 CNC Technology and Programming – Krar S. and Gill A. – McGraw Hill publishers

8 Computer Integrated Manufacturing - An Introduction with Case Studies – Paul G. Ranky – Prentice Hall International

9 Additive Manufacturing Technologies – Ian Gibson, David W Rosen, Brent Stucker., Mahyar Khorasani – Springer.

10 Additive Manufacturing – Juan Pou, Antonio Riveiro and J. Paulo Davim – Elsevier

11 Additive Manufacturing (A Tool for Industrial Revolution 4.0) – M. Manjaiah, K. Raghavendra, N. Balashanmugam, J. Paulo Davim – Woodhead Publishing

12 Additive Manufacturing – An Elsevier Journal

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Smart Industries (PEME8014T)		

Prerequisites:

1. Knowledge of Basic courses in Mechanical Engineering.

Course Objectives:

1. To provide students with a comprehensive understanding of the process of Industrial transformation and concepts of smart industry, Industry 4.0.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the basic principles behind smart industry.	L2	Understand
CO2	Explain smart industry key levers and drivers.	L2	Understand
CO3	Explain the supporting technologies for Smart factories.	L2	Understand
CO4	Discuss from leading industries and develop smart factory roadmaps.	L2	Understand

Smart Industries (PEME8014T)

Course Contents

Unit-I **07 Hrs.**

Introduction to Smart Industry

Traditional Manufacturing Practices and Limitations, Industry Revolution, Introduction to Fourth Industrial Revolution and Concept of Smart Industry, Journey of Smart Industry, Key Drivers of smart industry/Industry 4.0, Changing society, product and processes, Need for renovating and standardizing production and manufacturing Industries to compete with global challenges, Smart Industry Roadmap, Opportunities and Challenges.

Unit-II **10 Hrs.**

Supporting Tools and Technologies for Smart Industries – Part I

Introduction to and Use of following Technologies in Smart Industries:
IOT, Industrial IOT, Autonomous Robots, Additive Manufacturing, Horizontal and Vertical System Integration.

Unit-III **10 Hrs.**

Supporting Tools and Technologies for Smart Industries – Part II

Introduction to and Use of following Technologies in Smart Industries:
AI, Cloud Computing, Big Data and ICT, Block chain, Simulation, Cyber Physical Systems, Augmented Reality and Virtual Reality in Smart Factories.

Unit-IV **10 Hrs.**

Dimensions of Smart Manufacturing

Smart and connected products, Smart Machinery, Smart materials and manufacturing processes, and Smart material handling.
Smart Logistics, Marketing and sales, post sales service and customer relationship management. Smart Money: Digital payment strategy in India.

Unit-V **08 Hrs.**

Smart Industry applications with case studies

Discussion on case studies and success stories across industries who had developed and implemented several smart factory solutions.

Books Recommended

Textbooks

1 Handbook of Industry 4.0 and SMART Systems - Diego Galar Pascual, Pasquale Daponte and Uday Kumar – CRC Press.

Reference Books

1 Implementing Industry 4.0: The Model Factory as the Key Enabler for the Future of Manufacturing - Carlos Toro, Wei Wang, and Humza Akhtar - Springer Publications.

2 Smart Digital Manufacturing: A guide of digital transformation with real case studies across industries - Rene Wolf and Raffaello Lepratti - Wiley-VCH publications.

3 Intelligent Transportation Systems: Smart and Green Infrastructure Design - Frank Kreith - Mechanical Engineering Series - Taylor and Francis Group.

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

5 Internet of Things - Jeeva Jose - Khanna Publishing House, Delhi.

6 Block Chain Basics - Daniel Drescher - Apress.

7 Sensors and Actuators - C.W. de Silava - CRC Press.

8 Introduction to sensors - J. Vetelino and A. Reghu - CRC Press.

9 Smart Plant Factory: The Next Generation Indoor Vertical Farms - Toyoki Kozai - Springer Nature Publications.

10 Introduction to Industry 4.0 and Industrial Internet of Things - Prof. Sudip Misra - NPTEL Course - IIT Kharagpur.

11 Smart Industry & Smart Education - Michael E. Auer and Reinhard Langmann – Springer Publications.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Sustainable Energy Management (PEME8015T)		

Prerequisites:

1. Knowledge of fundamentals of Thermodynamics, Heat Transfer, Energy conversion systems.

Course Objectives:

1. To gain knowledge of present energy scenario in global and national level.
2. To understand the fundamental of energy economics and methods energy auditing.
3. To understand and analyze the energy efficiency in thermal and electrical utilities.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Illustrate the present energy scenario, global environmental concern, and importance of sustainable energy management.	L3	Apply
CO2	Analyze energy trends in energy intensive sectors and carry out energy action plan.	L4	Analyze
CO3	Describe the energy economy of the energy intensive sectors.	L2	Understand
CO4	Analyze the energy utilization in thermal and electrical utilities.	L4	Analyze
CO5	Analyze the efficiency of boilers, steam systems, furnace, HVAC and refrigeration systems.	L4	Analyze

Sustainable Energy Management (PEME8015T)

Course Contents

Unit-I **08 Hrs.**

Energy Scenario

Introduction: Energy Scenario, various forms of energy, energy management and its importance, recent trends in energy conservation.
Global environmental concerns: United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon fund (PCF).

Unit-II **08 Hrs.**

Energy Action Planning

Key elements, force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Organizing - location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability. Motivating-motivation of employees: Information system-designing barriers, strategies; Marketing and communicating-training and planning.

Unit-III **08 Hrs.**

Energy Economics

Simple payback period, time value of money, IRR NPV, life cycle costing, cost of saved energy, cost of energy generated. Monitoring and Targeting: Defining monitoring and targeting, elements of monitoring, targeting and reporting, Energy accounting, energy monitoring, energy audit process.

Unit-IV **12 Hrs.**

Energy Efficiency in Thermal and Electrical

Energy Efficiency in Thermal Utilities: Boilers, steam systems, furnaces insulation and refractories, FBC boilers, cogeneration, waste heat recovery.
Energy Efficiency in Electrical Utilities: Electrical systems, electric motors, compressed air system, HVAC and refrigeration systems, fans and blowers, pumps and pumping systems, cooling towers, lighting system, diesel generating system.

Unit-V **06 Hrs.**

Environmental Management

Review National And International Protocols, Environmental Quality Criteria And Standards, Significant Sources of Water & Air Pollution, Indices of Environmental Quality.

Books Recommended

Textbooks

1 Energy Management and Conservation – K. V. Sharma and P. Venkataseshaiah, I.K. – International Publication House.

2 Industrial Energy Conservation – D. A Reay – Pergamon Press.

3 Energy Management – W. R. Murphy – Springer.

Reference Books

1 Energy Management and Conservation Handbook – Frank Kreith – CRC Press.

2 Energy Efficiency – Ming Yang and Xin Yu – Springer

3 Economics of Solar Energy & Conservation Systems – Krieth & RE West – CRC Press

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Industrial Waste Management (PEME8016T)		

Prerequisites:

1. Knowledge of fundamental of Thermodynamics and Energy conversion systems.

Course Objectives:

1. To impart knowledge on source and characteristics of various industrial wastes.
2. To impart the strategies for prevention and control of industrial pollution.
3. To understand the methods and techniques of treatments for wastes.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Describe the sources of pollution from industries.	L2	Understand
CO2	Explain the characteristics of pollution.	L2	Understand
CO3	Analyze the effects and hazardless of the industrial pollution.	L4	Analyze
CO4	Select plan to minimize of industrial wastes.	L4	Analyze
CO5	Design facilities for the processing and reclamation of industrial waste water.	L6	Create

Industrial Waste Management (PEME8016T)

Course Contents

Unit-I **08 Hrs.**

Introduction

Types of industries and industrial pollution, Characteristics of industrial wastes – Population equivalent – Bio-assay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health – Environmental legislation related to prevention and control of industrial effluents and hazardous wastes.

Unit-II **08 Hrs.**

Waste management

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.

Unit-III **08 Hrs.**

Industrial pollution

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation Concepts.

Unit-IV **10 Hrs.**

Treatment Technologies

Wastewater treatment, Equalization – Neutralization – Removal of suspended and dissolved organic solids - Chemical oxidation – Adsorption - Removal of dissolved inorganic – Combined treatment of industrial and municipal wastes – Residue management – De-watering – Disposal.

Unit-V **08 Hrs.**

Hazardous and Radioactive Waste Management

Hazardous Waste Management: Hazardous wastes - Physico chemical treatment – solidification – incineration – Secure land fills.
Radioactive Waste Management: Sources, Measures on health effects, nuclear power plants and fuel production, Waste generation from nuclear power plants, disposal options.

Books Recommended

Textbooks

1 Industrial Pollution Prevention – T. T. Shen – Springer.

2 Environmental Pollution and Management – Avnish Chauhan – Wiley Publication.

Reference Books

1 Environmental Management Systems and Cleaner Production Ruth Hillary – Wiley Publication.

2 Industrial Water Pollution Control – W. W. Eckenfelder Jr – McGraw-Hill Publication Company.

3 Wastewater Treatment – M. N. Rao and A. K. Dutta – Oxford Publication.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Business Analytics (PEME8021T)		

Prerequisites:

1. Knowledge of basic statistics and Database.

Course Objectives:

1. To Familiarize with Business Analytics refers to skills, practices and techniques used in converting data into information and knowledge that aid business decision making.
2. To acquaint with Statistical learning including quantitative, qualitative analysis techniques.
3. To acquaint with the use of the above analysis and visualization to aid decision making.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Apply Base SAS programming.	L3	Apply
CO2	Explain and demonstrate visual analytics.	L2	Understand
CO3	Design the report using reporter.	L6	Create
CO4	Select various reports using different media devices.	L4	Analyze

Business Analytics (PEME8021T)

Course Contents

Unit-I **09 Hrs.**

Introduction to Base SAS

SAS Program: Introduction to SAS program, Submitting a SAS program – SAS Studio, SAS Enterprise Guide, SAS Windowing environment, SAS program syntax.
Accessing Data: Examining SAS Data sets, Accessing SAS Libraries.
Producing Detail Reports: Subsetting Report data, Sorting and Grouping Report data, Enhancing Reports.
Formatting Data Values: Using SAS Formats, User defined Formats.

Unit-II **06 Hrs.**

Reading SAS Dataset, Spreadsheet and Database data

Reading SAS Dataset, Customize SAS Dataset, Router Reading Spreadsheet data, Reading database data.

Unit-III **12 Hrs.**

Visual Analytics

Visual Analytics : Getting Stated with SAS Visual Analytics: Exploring SAS VA concepts, Using Home page Administrating the Environment and Managing Data: Exploring Data Builder, Exploring Administrator, Demonstrations and Exercises.
Using the Explorer: Selecting Data and defining Data Item properties, Creating Visualizations, Enhancing Visualizations with Analytics, Interacting with Visualizations and Explorations

Unit-IV **09 Hrs.**

Designing Reports with Reporter

Creating a Simple Report, Creating Data Items and Working with Graphs Working with Filters and Report sections Working with other objects, Demonstrations and Exercises.

Unit-V **06 Hrs.**

Viewing SAS VA Reports and Case Study

Creating Analyses and Reports. Viewing Reports on the Web, Viewing Reports on the Mobile Device/ Office Analytics, Case Study – Creating Analyses and Reports.

Books Recommended

Reference Books

1 SAS programming 1 – Essentials.

2 SAS Visual Analytics – Fast Track.

3 SAS Support

4 Business Analytics, Data Analysis and Decision Making - S. Christian Albright, Wayne L. Winston - CENGAGE Learning

5 Business Analytics, A Data-Driven Decision Making Approach for Business, Volume I - Amar Sahay - Business Expert Press

6 Data Science for Business and Decision Making - Luiz Paulo Favero and Patricia Belfiore - Elsevier Science.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
IoT and Applications (PEME8022T)		

Prerequisites:

1. Knowledge of fundamentals of Electrical and Electronics Engineering and Internet Technology.

Course Objectives:

1. Understand general concepts of Internet of Things (IoT).
2. Recognize various devices, sensors and applications.
3. Apply design concept to IoT solutions.
4. Evaluate design issues in IoT applications.
5. Create IoT solutions using sensors, actuators and Devices.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Discuss IoT value chain structure (device, data cloud), application areas and technologies involved.	L2	Understand
CO2	Explain IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.	L2	Understand
CO3	Evaluate market forecast for IoT devices with a focus on sensors.	L5	Evaluate
CO4	Design and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi.	L6	Create

IoT and Applications (PEME8022T)

Course Contents

Unit-I **10 Hrs.**

Introduction to Internet of Things

IoT concepts, Definition and Characteristics of IoT, IoT standards, components of IOT System (Sensors, Actuators), relevance of IOT for the future, Physical Design of IoT – IoT Protocols, IoT communication models, IoT communication APIs, IOT enabled technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems.

Unit-II **08 Hrs.**

IoT Physical Devices and Endpoints

Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

Unit-III **10 Hrs.**

Controlling Hardware and Sensors

Controlling Hardware: Connecting LED, Buzzer, switching high power devices with transistors, Controlling AC power devices with relays, Controlling servo motor, speed control of DC Motor,unipolar and bipolar Stepper motors.
Sensors: Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, temperature and humidity sensor DHT11, Motion detection Sensors, Wireless Bluetooth sensors, Level sensors, USB sensors, Embedded sensors, distance measurement with ultrasound sensor.

Unit-IV **06 Hrs.**

High-end vehicles

Introduction of automated high-end vehicles, Drone technology, Automated guided vehicles in material handling.

Unit-V **08 Hrs.**

IoT Applications

Smart factories, Home automation, Smart city, environment, energy, agriculture and relevant case studies based on real world applications.

Books Recommended

Textbooks

1 Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press.

2 Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD).

3 Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles, Florian, Springer.

4 Internet of Things (A Hands-On-Approach), Vijay Madisetti and Arshdeep Bahga, VPT.

Reference Books

1 Peter Waher, 'Learning Internet of Things', Packt Publishing, Editors Ovidiu Vermesan

2 Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers.

3 N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Process Equipment Design (PEME8023T)		

Prerequisites:

1. Knowledge of Engineering Thermodynamics, Fluid mechanics, Materials Technology, Heat Transfer, Machine Design I, and Machine Design II.

Course Objectives:

1. To understand the design process of various process equipment used in industries.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain the basics of process equipment design.	L2	Understand
CO2	Design a reaction vessel to meet the given requirements.	L6	Create
CO3	Design a storage tank as per industrial standards.	L6	Create
CO4	Design a shell and tube heat exchanger for single phase heat transfer.	L6	Create
CO5	Design vertical towers like distillation columns.	L6	Create

Process Equipment Design (PEME8023T)

Course Contents

Unit-I **08 Hrs.**

Process design parameters

Basic concepts in process design, Block diagrams for flow of processes, Material flow balance, Design pressures & temperatures, Design stresses, Factory of safety, Minimum shell thickness and corrosion allowance, Weld joints efficiency, Design loading, Stress concentration and thermal stresses, Failure criteria, Optimization technique such as Lagrange's multiplier and golden section method, Cost and profitability estimation. Introduction to design codes like IS-2825, ASME-SECT, EIGHT-DIV-II TEMA.API-650, BS-1500 & 1515.

Unit-II **09 Hrs.**

Mechanical design of Reaction Vessel

Mechanical design of shell, head, Jacket, coil, agitator, nozzle, body flange, etc., Different types of agitators & their selection criteria, Different types of agitator shaft sealing system & their selection criteria, Different types of power transmission system, Determination of power required for agitation, shaft diameter, blade thickness, etc., Different types of jackets & their selection criteria.

Unit-III **08 Hrs.**

Mechanical design of Storage Tank

Classification of storage tank as per IS-803, Determination of storage tank capacity, diameter & height, Design of shell and bottom plate for storage tank, Design of conical roof, Selection of column, girders and rafters, roof curb angle and floating roof.

Unit-IV **08 Hrs.**

Mechanical design of Shell & Tube Heat Exchangers

Mechanical design of shell, tube, tube sheet, head, channel shell, etc. of shell & tube heat exchanger.

Unit-V **09 Hrs.**

Mechanical design of Vertical Tall Tower (Distillation Column)

Mechanical design of shell, head, tray support, nozzle, body flange for vertical tall tower, Determination of shell thicknesses at various heights for tray tower & packed tower in case of internal & external pressure, Different types of tray supports & their selection criteria, Design of horizontal structural member with periphery ring type packing support.

Books Recommended

Textbooks

1 Process Equipment Design - M. V. Joshi and V. V. Mahajani- Mc-Millan publication

2 Introduction to Chemical Equipment Design (Mechanical Aspects) - B. C. Bhattacharya - CBS publication.

Reference Books

1 I.S.: 2825-1969 - Code for Unfired Pressure Vessels.

2 ASME Boiler & Pressure Vessel Code (BPVC) – Section VIII

3 Pressure Vessel Design Manual - D. R. Moss - Gulf Professional Publishing.

4 Pressure Vessel Handbook – E. F. Megyesy - Pressure Vessel Publishing.

5 Process Equipment Design - Lloyd E. Brownell and Edwin H. Young - Wiley publication.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Motor Sports Engineering (PEME8024T)		

Prerequisites:

1. Knowledge of fundamental concepts of materials technology, Finite Element analysis, Computational fluid dynamics (CFD) concept, electronics and electrical engineering.

Course Objectives:

1. To gain knowledge of different types of advanced materials and their manufacturing techniques for motorsports vehicle.
2. To Understand the fundamental scientific, and engineering principles involved in motorsport responsible for high performance.
3. Design, analysis and performance-based techniques of competition vehicles, and related aspects of materials science, aerodynamics, structural analysis, vehicle systems related to motorsport.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain selection criteria and specifications of metallic and non-metallic materials.	L2	Understand
CO2	Analyze modelling and simulation results with respect to structural responses behavior.	L4	Analyze
CO3	Categorize the complex relationships between competition vehicle design aspects and competition vehicle performance.	L4	Analyze
CO4	Calculate the matching of engine, transmission, and vehicle chassis for motorsport applications.	L4	Analyze
CO5	Explain application of aerodynamics in motorsports.	L2	Understand
CO6	Design, evaluate and optimize data systems based on fundamental principles of electrical and digital information transfer.	L6	Create

Motor Sports Engineering (PEME8024T)

Course Contents

Unit-I **08 Hrs.**

Introduction: to motorsport

Introduction: History of motorsport and competition vehicle development, Competition vehicle categories, Sporting, and technical regulations.
Introduction to advance materials, application, and manufacturing: The physical and metallurgical properties of high strength steels, stainless steels, metal matrix composites and aluminium, and titanium alloys, rubbers, elastomers, plastics, and honeycomb.
Advance materials application in Motorsport industry through case studies include Materials forms, performance, and selection, advance manufacturing technology and joining techniques in context with motorsports.

Unit-II **08 Hrs.**

Design, analyses, and optimization techniques

Design of competition vehicles with structural design context, analyses, finite element modelling and simulations, shape optimization, Identification of failure modes and non-destructive test methods

Unit-III **08 Hrs.**

Vehicle dynamics

Tyre shear force development, measurement and characterization, Suspension geometry description and analysis, Steady turning equilibrium states, suspension/chassis interactions, stability and controllability ,Limit behavior and design aspects, differentials and brake balancing Simulation tools and model building, Vibration behavior of car and wheels, springs, dampers, track roughness, Minimum time optimization.

Unit-IV **12 Hrs.**

Powertrain

The design of high-performance vehicle transmission systems, ,Mechanical design of high performance two and four stroke petrol and diesel motorsport engines, the matching of engine, transmission and vehicle, Hybrid and electric powertrains as used in motorsport Aerodynamics: The application of aerodynamic design principles to motorsport components, Mechanisms for controlling aerodynamic lift and drag generation, application of CFD

Unit-V **06 Hrs.**

Data Acquisition

Electrical circuit design and its issues, sensors, signal conditioning, Sampling issues in amplitude and frequency domain, Data communications on vehicle and test cell, Data processing and analysis techniques, Introduction to real time software, Practical system packaging

Books Recommended

Reference Books

1 Advanced Motorsport Engineering - Andrew Livesey

2 Competition Car Composites: A Practical Handbook - Simon Mc Beath

3 Suspension Geometry and Computation - john C.Dixon.

4 Race Car Vehicle Dynamics - William F. Milliken and Douglas L. Milliken

5 Chassis Engineering - Herb Adams

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Advanced Quantitative Techniques (PEME8025T)		

Prerequisites:

1. Knowledge of Basic courses in Mechanical Engineering.

Course Objectives:

1. To equip the students with the expert knowledge and skills needed to apply the various quantitative techniques for decision making.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Analyze significance of sensitivity analysis of LPP and perform sensitivity analysis on various parameters involved in LP model.	L4	Analyze
CO2	Apply suitable algorithms to overcome the limitations of the simplex method and obtain integer solutions to Linear Programming Problems.	L3	Apply
CO3	Analyze real-world problems as special cases of Linear Programming Problems and solve decision problems by choosing appropriate algorithms.	L4	Analyze
CO4	Analyze various decision-making situations, outline decision alternatives, and determine the best alternative.	L4	Analyze
CO5	Analyze a real-world problem as a Non-Linear Programming Problem and distinguish local and global extreme points and points of inflection.	L4	Analyze

Advanced Quantitative Techniques (PEME8025T)

Course Contents

Unit-I **10 Hrs.**

Introduction to Decision model and Quantitative techniques

Concept of decision making and decision problem, Mathematical Model of decision problem, Concept of Optimization, Quantitative techniques for finding optimal solutions to decision problems.
Linear Programming Problem: Mathematical Formulation. Overview of Simplex Method. Sensitivity Analysis.
Linear Goal programming: Formulation as Goal programming model, Optimal solution by graphical method and simplex method.

Unit-II **07 Hrs.**

Integer Programming Problem

Types of Integer Programming Problems. Gomory's cutting plane Algorithm, Branch and Bound Technique.
Introduction to Decomposition algorithms.

Unit-III **07 Hrs.**

Traveling, Transhipment Problem

Traveling Salesman Problem: Branch and Bound method.
Transhipment Problem: Formulation and finding optimal solution.
Network Optimization Models: Shortest Path, Minimum Spanning Tree, and Maximum Flow Problems

Unit-IV **09 Hrs.**

Decision Theory

Decision Making under risk, under uncertainty, Decision Trees & Utility Theory, Bayesian approach in decision making
Decision Making under certainty, Introduction to concepts of AHP (Analytic Hierarchy Process) & ANP (Analytic Network Process).

Unit-V **09 Hrs.**

Nonlinear programming problems (NLPP)

Convex programming Unconstrained NLPP –Search Algorithm and Gradient method. Constrained NLPP – Kuhn-Tucker Conditions, Geometric Programming Quadratic programming.

Books Recommended

Textbooks

1 Operations Research, Sharma J. K., Trinity Press

2 Operations Research, Gupta P. K., Hira D. S., S. Chand Limited.

Reference Books

1 Operations Research - An Introduction; Taha, H.A.; Prentice Hall

2 Operations Research: Principles and Practice; Ravindran, A, Phillips, D. T and Solberg, J. J.; John Willey and Sons

3 Introduction to Operations Research; Hiller, F. S. and Liebermann, G. J.; Tata McGraw Hill

4 Operations Research Principles and Practice; Pradeep Prabhakar Pai; Oxford University Press

5 Operations Research, R. Panneerselvam, PHI Publications.

6 Operations Research, A. M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education.

7 Operations Research; Kanti Swarup, P. K. Gupta and Man Mohan; Sultan Chand & Sons.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Internship (INTME8030L)		

Prerequisites:

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Course Objectives:

1. To expose technical students for the industrial environment, allowing them to gain real-world experience and develop into competent professionals.
2. To provide opportunities to learn and enhance the practical technical skills required for professional roles.
3. To familiarize students with current technological developments relevant to their field of study.
4. To develop technical writing skills for reports and projects.
5. To introduce students to the responsibilities and ethics of the engineering profession.
6. To develop an understanding of employee psychology, habits, attitudes, and problem-solving approaches.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Apply theoretical knowledge to real-world engineering problems through hands-on experience in industry or field settings.	L3	Apply
CO2	Apply technical knowledge and problem-solving approaches to address complex engineering problems in an industrial environment.	L3	Apply
CO3	Analyze organizational structures, workflows, and technologies to understand industry practices and operational challenges.	L4	Analyze
CO4	Develop technical documentation, reports, and presentations reflecting experiential learning and problem-solving approaches.	L6	Create
CO5	Discuss career goals and identify areas for personal and professional development based on internship exposure.	L2	Understand

Internship (INTME8030L)

Internships offer valuable educational and career development opportunities by providing students with practical experience in their field of study. In Semester–VIII, students have two options for their internship: Industry Internship and In-house Internship.

A. Industry Internship

1. Industry Internship Guidelines

- The Training and Placement (T&P) cell of the institute will arrange internships for students in industries/organizations after the semester VII.
- Students are expected to accept internship offers regardless of the company, job profile, location, or stipend offered.
- Alternatively, students can individually apply for industry internships, adhering to the prescribed guidelines as follows:
    1. Only T&P department granted internship will be considered.
    2. The internship duration should be of minimum 12 Weeks.
    3. Each student needs to take prior permission from T&P department before proceeding for any internship opportunity on his/her own.
    4. Each student will be monitored twice (virtually/through online meetings) during the internship period in the presence of an industry mentor and the departmental faculty mentor and the concerned TPC.
    5. If any student wants to withdraw from the Internship, he/she can only be allowed within two weeks of joining the same. Such students will have to continue the semester VIII academic activities regularly along with In-house internship.

2. Expected Activity in Industry Internship:

- Students may choose to work on innovation or entrepreneurial activities resulting in start-ups or undergo internships with Industry/NGO/ Government organizations/Micro/ Small/ Medium enterprises to prepare for the industry.
- Every student is required to prepare a file containing documentary proofs of the activities done by him/her. The evaluation of these activities will be done twice (virtually/through online meetings) during the internship period by the committee constituted by the Head of the Department which shall include Industry mentor, faculty mentor and Department T&P Co-ordinator (TPC). The assessment criteria for continuous assessment is as per Table 1.

Table 1: Continuous Assessment for Industry Internship

Internship Objectives and Goals (30 Marks)	**Internship Experience Skills Gained/Enhanced (30 Marks)**	**Professional Development and Growth (30 Marks)**	**Internship Report (30 Marks)**	**Presentation (30 Marks)**

- The ESE will be jointly evaluated by an industry mentor, faculty member and department T&P coordinator (TPC). The evaluation criteria is as per Table 2.

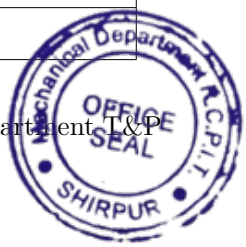

Table 2: Evaluation Criteria of Industry Internship

Internship Objectives and Goals (30 Marks)	**Internship Experience Skills Gained/Enhanced (30 Marks)**	**Professional Development and Growth (30 Marks)**	**Internship Report (30 Marks)**	**Presentation (30 Marks)**

3.Industry Internship Report:

- Upon completion of the internship, students should prepare a comprehensive report that reflects their observations and learnings during the internship period. Students can consult their Industrial Supervisor, Faculty Mentor, or T&P Co-ordinator/Officer for guidance on selecting special topics and problems for the report.
- The internship report will be evaluated based on the following criteria:
  - Adequacy and purposeful write-up.
  - Variety and relevance of learning experience.
  - Practical applications and connections with the fundamental theories and concepts covered in the course (Semester I to VII).

B. In-house Internship

1. In-house Industry Internship Guidelines

- The in-house internship provides students with research-oriented opportunities to cultivate a research mindset. It serves as an extension of the project completed in VI and VII semesters (Project Stage-I & II) or offers new objectives provided by the department or research guide.
- The in-house internship can be pursued individually or as a group activity.
- If extending a project from Stage II, at least one student in the group must have participated in Stage I & II.
- If working on the topic offered by the department or in-house mentor, a group of fresh students can form a team.
- The maximum group size is limited to four students.
- In case of extension of project stage II, the outcomes should be in the form of product development/technology transfer along with patent and copyright / one research publication (UGC care listed journal/conference). Students can work jointly with any government funding agency or industry. In such cases, a detailed project report shall be submitted after verification by the in-house mentor and industry/funding agency mentor/authority. In case of standalone/non-sponsored activity, i.e. without any funding agency/industry collaboration, the detailed project report shall be submitted after verification by the in-house mentor.
- If pursuing a Topic offered by the department or in-house mentor, the outcome of the in-house internship should include the publication of a research paper, preferably in an SCI/Scopus/UGC care listed/indexed Journal/Conference. The detailed project report must be submitted and verified by the in-house mentor.
- All the designated work shall be submitted to the department in the form of a report in hard-bound as well as soft copy.

2.Evaluation Scheme

I. **Continuous Assessment:**

- A logbook (as per Table 3) of the work done must be maintained by each group.
- Each in-house internship activity will be reviewed twice in the semester. In the first review (as per Table 4), at least 40% work shall be completed including the topic identification / introduction/ scope of the work, literature survey, problem definition and objectives. The remaining 60% of work shall be completed in the second review (as per Table 5) including implementations, key findings, publications/ patenting / copyright / product development etc.

II. **End Semester Examination:**

- End semester examination (as per Table 6) will be jointly evaluated by the faculty mentor and an external examiner appointed by the HOD in consultation with the COE.

Assessment Formats:

Table 3: Log Book Format

Sr	**Week (Start Date: End Date)**	**Work Done**	**Sign of In-house mentor**	**Sign of Coordinator**
1				

Table 4: First Review

Topic Identification & Validation (20 Marks)	**Literature Survey (20 Marks)**	**Problem Definition (20 Marks)**	**Objectives (15 Marks)**

Table 5: Second Review

Implementation (20 Marks)	**Publications (20 Marks)**	**Report (20 Marks)**	**Presentation (15 Marks)**

Table 6: End Semester Examination

Topic Identification & Validation	**Literature Survey & Problem Definition**	**Objectives & Implementation or Product Development**	**Presentation**	**Report, Publications/Patent/IPR Documents**
(30 Marks)	(30 Marks)	(30 Marks)	(30 Marks)	(30 Marks)