Shirpur Education Society's

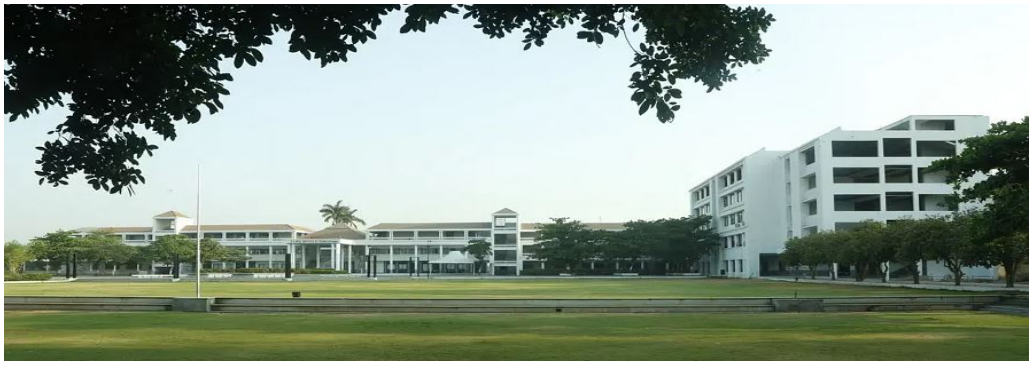
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Syllabus Structure

Final Year B.Tech in Mechanical Engineering

(RCP22 Scheme) with effect from Year 2025-26



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 - RCP22)

Semester – VII (w.e.f.2025-26)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme (hrs.)			Evaluation Scheme (CA) (marks)				ESE (marks)	Total	Credit	
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average (TT1 & TT2)				
							[A]			[B]	[C]	[A+B+C]		
1	PE	22PCME7010T	Design of Mechanical Systems	3	-	-	25	10	10	10	65	100	3	4
		22PCME7010L	Design of Mechanical Systems Laboratory	-	-	2	25	-	-	-	25	50	1	
2	PE	22PCME7020T	Production Planning and Control	3	-	-	25	10	10	10	65	100	3	4
		22PCME7020L	Production Planning and Control Laboratory	-	-	2	25	-	-	-	25	50	1	
3 $	PE	22PEME7031T	Flexible Manufacturing Systems	3	-	-	25	10	10	10	65	100	3	4
		22PEME7031L	Flexible Manufacturing Systems Laboratory	-	-	2	25	-	-	-	-	25	1	
		22PEME7032T	Design of Automotive Systems	3	-	-	25	10	10	10	65	100	3	
		22PEME7032L	Design of Automotive Systems Laboratory	-	-	2	25	-	-	-	-	25	1	
		22PEME7033T	Piping Engineering	3	-	-	25	10	10	10	65	100	3	
		22PEME7033L	Piping Engineering Laboratory	-	-	2	25	-	-	-	-	25	1	
		22PEME7034T	Bionics Engineering	3	-	-	25	10	10	10	65	100	3	
		22PEME7034L	Bionics Engineering Laboratory	-	-	2	25	-	-	-	-	25	1	
		22PEME7035T	Computational Fluid Dynamics	3	-	-	25	10	10	10	65	100	3	
		22PEME7035L	Computational Fluid Dynamics Laboratory	-	-	2	25	-	-	-	-	25	1	
		22PEME7036T	Business Model Design	3	-	-	25	10	10	10	65	100	3	
		22PEME7036L	Business Model Design Laboratory	-	-	2	25	-	-	-	-	25	1	
		22PEME7037T	Soft Computing	3	-	-	25	10	10	10	65	100	3	
		22PEME7037L	Soft Computing Laboratory	-	-	2	25	-	-	-	-	25	1	
4 ~	PE	22PEME7041T	Digital Manufacturing	3	-	-	25	10	10	10	65	100	3	3
		22PEME7042T	Automotive Materials and Manufacturing	3	-	-	25	10	10	10	65	100	3	
		22PEME7043T	Design for X	3	-	-	25	10	10	10	65	100	3	
		22PEME7044T	Renewable Energy Systems	3	-	-	25	10	10	10	65	100	3	
		22PEME7045T	Startup Registration and Development	3	-	-	25	10	10	10	65	100	3	
		22PEME7046T	Big Data Analytics	3	-	-	25	10	10	10	65	100	3	
5 ₹	OE	22OEME7051T	Product Life Cycle Management	3	-	-	25	10	10	10	65	100	3	3
		22OEME7052T	Management Information System	3	-	-	25	10	10	10	65	100	3	
		22OEME7053T	Operations Research	3	-	-	25	10	10	10	65	100	3	
		22OEME7054T	Cyber Security and Laws	3	-	-	25	10	10	10	65	100	3	
		22OEME7055T	Personal Finance Management	3	-	-	25	10	10	10	65	100	3	
		22OEME7056T	Energy Audit and Management	3	-	-	25	10	10	10	65	100	3	
		22OEME7057T	Public Systems and Policies	3	-	-	25	10	10	10	65	100	3	
		22OEME7058T	Science of Well-being	3	-	-	25	10	10	10	65	100	3	
		22OEME7059T	Research Methodology	3	-	-	25	10	10	10	65	100	3	
6	PJ	22PJME7060L	Project Stage-II	-	-	4	25	-	-	-	25	50	2	2
7	ES	22ESME7070L	Full Stack Development Laboratory	-	-	2	25	-	-	-	25	50	1	1
			Total	**15**	**0**	**12**	**250**	**50**	**50**	**50**	**425**	**725**	**21**	**21**

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

$, ~ Any 1 Professional Elective III and IV from given list. ₹ Any 1 Open Elective I from given list.

Mechanical Department R.C.P.I.T. 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

Department of Mechanical Engineering
(Autonomous - RCP22)

Semester – VIII (w.e.f.2025-26)

Sr. No	Course Category	Course Code	Course Title	Teaching Scheme (hrs.)			Evaluation Scheme (CA) (marks)				ESE (marks)	Total	Credit	
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average (TT1 & TT2)				
							[A]			[B]	[C]	[A+B+C]		
1 @	PE	22PEME8011T	Industrial Engineering and Management *	3	-	-	25	10	10	10	65	100	3	3
		22PEME8012T	Automation and IoT *	3	-	-	25	10	10	10	65	100	3	
		22PEME8013T	Sustainable Manufacturing *	3	-	-	25	10	10	10	65	100	3	
		22PEME8014T	Motorsports Engineering *	3	-	-	25	10	10	10	65	100	3	
		22PEME8015T	Project Management *	3	-	-	25	10	10	10	65	100	3	
		22PEME8016T	Entrepreneurship Development and Management *	3	-	-	25	10	10	10	65	100	3	
			NPTEL/SWAYAM Course #	3	-	-	25	10	10	10	65	100	3	
2 &	PE	22PEME8021T	Business Analytics *	3	-	-	25	10	10	10	65	100	3	3
		22PEME8022T	Energy Audit and Management *	3	-	-	25	10	10	10	65	100	3	
		22PEME8023T	Human Resource Management *	3	-	-	25	10	10	10	65	100	3	
		22PEME8024T	Logistic and Supply Chain Management *	3	-	-	25	10	10	10	65	100	3	
		22PEME8025T	IPR and Patenting *	3	-	-	25	10	10	10	65	100	3	
		22PEME8026T	Environmental Management *	3	-	-	25	10	10	10	65	100	3	
			NPTEL/SWAYAM Course #	3	-	-	25	10	10	10	65	100	3	
3	INT	22INTME8030L	Internship	-	-	20	150	-	-	-	150	300	10	10
4	MC	22MCME8040T	Disaster Management and Preparedness	2	-	-	-	-	-	-	-	A	A	A
			Total	**8**	**0**	**20**	**200**	**20**	**20**	**20**	**280**	**500**	**16**	**16**

PE-Professional Elective, INT- Internship, MC-Mandatory Course.

@, & 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 certificates 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 Exanination (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.I.T. 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

Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

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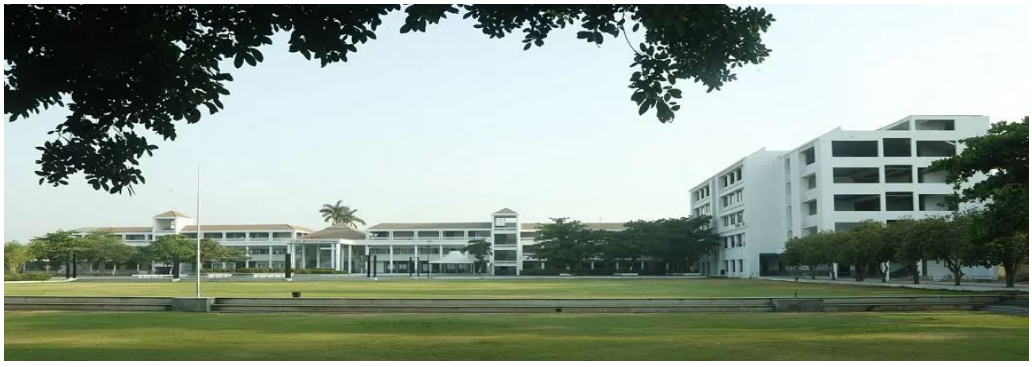
Syllabus Details of Semester-VII

Final Year B.Tech in Mechanical Engineering

(RCP22 Scheme) with effect from Year 2025-26



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Web: www.rcpit.ac.in/mechanical-engineering-syllabus

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VII
Design of Mechanical Systems (22PCME7010T)		
Design of Mechanical Systems Laboratory (22PCME7010L)		

Prerequisites:

1. Knowledge of Material Technology,
2. Mechanics of Materials,and
3. Design of Machine Elements.

Course Objectives:

1. To acquaint with functional and strength design principles of important machine elements used in mechanical systems.
2. To study the detailed design procedure of the different types of machine elements used in mechanical systems.
3. To familiarize selection of standard elements such as rolling contact bearings.
4. To study system design of various systems such as Gearbox, snatch block, belt conveyors and pumps.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Design gears based on the given conditions and develop multispeed gearboxes for a specified machine tool application.	L6	Create
CO2	Select bearings for a given application.	L4	Analyze
CO3	Design hoisting mechanism of an Electric overhead traveling crane.	L6	Create
CO4	Design belt conveyor systems.	L6	Create
CO5	Design pumps for a given application.	L6	Create

Design of Mechanical Systems (22PCME7010T)

Course Contents

Unit-I **10 Hrs.**

Design of Gears

Design of spur, helical, bevel and worm gears with strength, wear and thermal considerations.

Unit-II **09 Hrs.**

Design of Bearings

Rolling Contact Bearings : Types of bearing, designation, selection of rolling contact bearings based on constant / variable load (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing).
Sliding Contact Bearings: Design of hydro dynamically lubricated bearings (self-contained), Introduction to hydrostatic bearings, Types and selection of Mechanical seals.

Unit-III **04 Hrs.**

Introduction to Mechanical System Design

Design of Gear Box: Design of gear box (multi speed) for machine tool applications (Maximum two stages and nine speeds) 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 (Excluding Deviation diagram, Layout of gear box).

Unit-IV **07 Hrs.**

Design of Hoisting mechanism

Introduction to material handling system, Design of EOT crane system: Snatch Block assembly, Selection of wire rope, Design and selection of sheave pulley, axle and bearings, Design of nut, Selection of thrust bearing, Design of cross-piece with trunnion, Design of shackle plate, Design of rope drum, drum shaft and bearing, Selection of motor. (Excluding Selection of hook).

Unit-V **05 Hrs.**

Design of Belt Conveyors

Design of belt conveyor system for specified material and capacity: 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-VI **04 Hrs.**

Design of Gear Pump

Introduction of Gear pump, Design of gear pump for specified discharge and speed etc., Selection of motor, Design of gear, Selection of bearing, Design of bolts, Design of suction and delivery pipe.

Design of Mechanical Systems Laboratory (22PCME7010L)

Suggested Experiments

A Design and detailed assembly drawing (computer aided drawing on A3 size sheets) of minimum two design problems, from the following:

1 Design of hoisting mechanisms
2 Design of belt conveyors
3 Design of pumps

B Exercises on following topics in the form of design calculations with sketches and / or drawings:

1 Design of Gears
2 Rolling contact bearings/ Sliding contact bearing
3 Design of gearbox

C Course Project:

Students in a group (2 to 4 students) should be able to apply and integrate the knowledge gained during the course. Design and preparation of working drawings of any system having minimum 5 to 6 components is expected.

Books Recommended

Textbooks

1 Richard G. Budynas and J. Keith Nisbett, Shigley's Mechanical Engineering Design, McGraw-Hill Education, New York, 2024.

2 V. B. Bhandari, Design of Machine Elements, McGraw-Hill Education, New Delhi, 2021.

3 S. P. Patil, Mechanical System Design, Jaico Publishing House, Mumbai, 2004.

4 B. Sharma and H. Purohit, Design of Machine Elements, Prentice Hall India, New Delhi, 2008.

5 Robert L. Norton, Machine Design - An Integrated Approach, Pearson Education, Upper Saddle River, NJ, 2006.

6 J.E. Shigley, Mechanical Engineering Design, McGraw Hill, New York, 2009.

Reference Books

1 S. K. Basu and D. K. Pal, Design of Machine Tools, CBS Publishers Distributors, New Delhi, 2018.

2 N. K. Mehta, Machine Tool Design, McGraw-Hill Education, New Delhi, 2012.

3 PSG College of Technology, Design Data: Data Book of Engineers, Kalaikathir Achchagam, Coimbatore, 2023.

4 S. S. Khandare and A. V. Kale, Design of Engine Parts, Charotar Publishing House, Anand, 2008.

5 Pandya Shah, Machine Design, Charotar Publishing, Anand, 2020.

6 Reshetov, Machine Design, Mir Publication, Moscow, 2019.

7 Black Adams, Machine Design, McGraw Hill, New York, 2021.

8 Mahadevan, Design Data Book,CBS Publishers Distributors Pvt Ltd,2013.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Production Planning and Control (22PCME7020T)		
Production Planning and Control Laboratory (22PCME7020L)		

Prerequisites:

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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 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	Illustrate production-planning functions and manage manufacturing functions in a better way.	L3	Apply
CO2	Determine the demand of the product and prepare an aggregate plan.	L3	Apply
CO3	Develop the skills of Material Planning, Inventory Management Model and Control.	L6	Create
CO4	Develop the competency in scheduling and sequencing of manufacturing operations.	L6	Create
CO5	Explain the significance of implementation of ERP.	L2	Understand

Production Planning and Control (22PCME7020T)

Course Contents

Unit-I **08 Hrs.**

Manufacturing systems

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 **06 Hrs.**

Forecasting, Aggregate planning, 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 **05 Hrs.**

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.

Unit-IV **08 Hrs.**

Independent & dependent Demand Inventory Models

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-V **07 Hrs.**

Job Shop Scheduling and Project 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. 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 and CPM, cost analysis and crashing, resource leveling.

Unit-VI **05 Hrs.**

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.

Production Planning and Control Laboratory (22PCME7020L)

Suggested Experiments

A Group: Lab Work

1 Case-study presentation on Manufacturing System and Importance of PPC department.
2 Case-study presentation on Forecasting Techniques and Capacity Management.
3 Case-study presentation on Material Management and Scientific Inventory Control.
4 Case-study presentation on Job Shop and Project scheduling.
5 Case-study presentation on structure, modules and implementation of an ERP.

B Group B : List of Assignments

1 Assignment on Manufacturing System and Importance of PPC department.
2 Assignment on Forecasting Techniques and Capacity Management.
3 Assignment on Material Management and Scientific Inventory Control.
4 Assignment on Job Shop and Project scheduling.
5 Assignment on structure, modules and implementation of an ERP.

Books Recommended

Textbooks

1 L. C. Jhamb, Production Planning and Control, Everest Publishing House, 2016.

2 L. C. Jhamb, Inventory Management, Everest Publishing House, 2013.

3 D. S. Hira and P. K. Gupta, Problems in Operations Research (Principles and Solutions), S Chand Publications, 2010.

4 Rahul V. Altekar, Enterprise-wide Resource Planning: Theory and Practice, PHI Publication, 2004.

Reference Books

1 Samuel Eilon, Elements of Production Planning and Control, Universal Publishing Corporation, 2015.

2 W. Bolton, Production Planning and Control, Pearson Education Limited, 1994.

3 James L. Riggs, Production Systems - Planning, Analysis Control, John Wiley Sons, 2018.

4 Thomas E. Vollman, William L. Berry Others, Manufacturing Planning and Control Systems, Galgotia Publishers, 1984.

5 Anand Bewoor, Manufacturing Process Planning and Systems Engineering, Dreamtech Press, 2019.

6 S. N. Chary, Production and Operations Management, TMH Publishing Company, 2019.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Flexible Manufacturing Systems (22PEME7031T)		
Flexible Manufacturing Systems Laboratory (22PEME7031L)		

Prerequisites:

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Course Objectives:

1. To introduce the basic concepts of flexible manufacturing system (FMS) like material handling, loading, scheduling, storage etc.
2. Developing skills to design and optimize manufacturing cells.
3. Incorporate advanced tools like Petri nets enabling students for modeling manufacturing processes, enhancing system analysis and decision-making.

Course Outcomes:

On completion of the course:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Develop an understanding of the evolution, principles, and economic justification of FMS, along with the role of CIM (Computer Integrated Manufacturing) in enhancing flexibility, and distinguish between job shop, batch production, and mass production systems.	L2	Understand
CO2	Apply efficient workstations, integrate automated systems like AGVS and ASRS, and manage storage and work-in-progress inventories in FMS.	L3	Apply
CO3	Analyze part families, apply part classification systems, design machine cells, and use clustering algorithms to enhance manufacturing efficiency.	L4	Analyze
CO4	Evaluate algorithms to assess FMS flexibility and determine the necessary resources to support manufacturing cells.	L5	Evaluate
CO5	Create the use of Petri nets to model and analyze complex manufacturing systems, improving production planning, system coordination, and resource utilization.	L6	Create

Flexible Manufacturing Systems (22PEME7031T)

Course Contents

Unit-I **09 Hrs.**

Introduction

Introduction – FMS evolution, need for flexibility, economic justification of FMS, role of CIM in FMS, case studies.
Production systems in FMS - Types of Production-Job Shop, Batch and Mass production; Organization and information processing in manufacturing - Plant layout - Batch production – Work in progress inventory.

Unit-II **09 Hrs.**

FMS components

Workstations, Computer control system (data file, reports, hardware and software development), types of automated guided vehicle system (AGVS)and automated storage retrieval system (ASRS), carousel storage system,
WIP storage, analysis of AGV and AS/RS systems.

Unit-III **09 Hrs.**

Cellular manufacturing

Formation of part families, Part classification, Coding system optiz, Machine cells design, clustering methods, modern algorithms, benefits of GT, system planning, cell characteristic - system definition and sizing, human resources and its objective, staffing, supervisor role.

Unit-IV **04 Hrs.**

Evaluation of FMS

Algorithms for cell evaluations, measure of flexibility.

Unit-V **08 Hrs.**

Production control in FMS

scheduling in FMS, line balancing in FMS and inventory control in FMS. Applications of Petri net methodology to manufacturing systems.

Flexible Manufacturing Systems Laboratory (22PEME7031L)

Suggested Experiments

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1 Determine the components and configuration of the FMS to simulate machines, robots, conveyors, automated Guided Vehicles (AGVs), and storage.

2 Define various inputs to be given to FMS system - product types, production rates, machine setup times, processing times.

3 Simulation on software (Arena, Simul8, FlexSim) , create a digital model of the flexible manufacturing system and set up various operational parameters.

4 Analyze system performance measures with given production schedules.

5 Optimize the material handling system by testing different transport methods (e.g., conveyor vs. AGVs), using simulation software

6 Implement scheduling algorithms such as First-Come-First-Served (FCFS), Shortest Job First (SJF), or Priority Scheduling in a simulated FMS setup.

7 Use Value Stream Mapping (VSM) to identify and eliminate waste in the FMS setup.

All seven experiments from the above list or any other experiment based on the syllabus will be included, which would help the learner apply the concept.

Books Recommended

Reference Books

1 B. S. Nagendra Parashar, Cellular Manufacturing System –An integrated approach, PHI learning private ltd, 2009.

2 Mikell Groover., Automation Production Systems Computer Integrated manufacturing, PHI, 4th edition, 2016.

3 H. K. Shivananda, “Flexible manufacturing Systems”, Dhanpat Rai publications, New Delhi, 2006.

4 N. K. Jha, Handbook of Flexible manufacturing system, Academic press Inc., 1991.

5 William W. Luggen., Flexible Manufacturing Cells and Systems, Prentice Hall, NJ, 1991

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Design of Automotive Systems (22PEME7032T)		
Design of Automotive Systems Laboratory (22PEME7032L)		

Prerequisites:

1. Engineering mechanics; Machine design; Material science; Thermodynamics
2. Fundamentals of electronics, and electrical engineering.

Course Objectives:

1. To impart fundamental knowledge of automotive system design, including material selection and optimization techniques.
2. To develop competency in designing critical engine components such as cylinders, pistons, crankshafts, and valve mechanisms.
3. To enable students to design and analyze power transmission components, including clutches, gearboxes, and driveline systems.
4. To familiarize students with braking and suspension system design, including performance considerations and material selection.
5. To introduce modern automotive technologies such as ABS, ESC, CVTs, and advanced driveline configurations for improved vehicle performance.

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 fundamental principles of automotive system design and component optimization.	L2	Understand
CO2	Apply engineering principles to design and analyze key engine and power transmission components.	L3	Apply
CO3	Develop clutch and transmission system designs based on torque transmission requirements and material properties.	L6	Create
CO4	Design braking and suspension systems, considering safety, performance, and material constraints.	L6	Create
CO5	Evaluate driveline components, including propeller shafts, differentials, and axle designs, for various vehicle configurations.	L5	Evaluate
CO6	Analyze improvements for vehicle systems using modern automotive technologies, enhancing efficiency and performance.	L4	Analyze

Design of Automotive Systems (22PEME7032T)

Course Contents

Unit-I **07 Hrs.**

Design of Engine Components

- 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
- Valve mechanism design: push-rods, valves, valve springs, tappets, and rocker arms (theory only).

Unit-II **06 Hrs.**

Design of Clutches

- Selection criteria, torque transmission capacity, and lining materials.
- Design requirements of friction clutches.
- Design of single plate, and multi-plate clutches.

Unit-III **06 Hrs.**

Design of Transmissions System

- Design considerations and material selection.
- Types of gearboxes: sliding mesh, constant mesh, synchromesh, and epicyclic gearboxes.
- Design of synchromesh gearbox.

Unit-IV **06 Hrs.**

Design of Powertrain

- Powertrain types, Design approaches for IC engine based vehicles and EVs. Layouts of electric and hybrid electric powertrains and their design approaches and considerations.
- Design of Propeller shaft design for bending, torsion, and rigidity.
- Universal joints, slip joints, and differential design.

Unit-V **07 Hrs.**

Braking Systems

- Design of internal expanding shoe brakes and disc brakes.
- Braking force calculation and thermal considerations.
- Materials for Brake Lining.

Unit-VI **07 Hrs.**

Suspension Systems

- General design considerations of suspension systems.
- Design of MacPherson strut suspension system.
- Air (pneumatic) and hydro-elastic suspension systems (theory).

Design of Automotive Systems Laboratory (22PEME7032L)

Suggested Experiments

A Study-Type/ Case-Study-based Experiments (Theoretical and Conceptual Learning) (any 2):

1. Study the design and materials of various engine components (cylinder, piston, crankshaft) from different vehicle models.
2. Compare the working principles, advantages, and disadvantages of different transmission systems (manual, automatic, CVT).
3. Research and present a report on the evolution of braking systems, including ABS and ESC technologies.
4. Study the design and characteristics of different suspension systems (leaf spring, coil spring, air suspension) in various vehicles.

B Numerical Analysis/ Simulation-based Experiments (Python/ MATLAB/ Simulink, etc.) (any 2):

1. Simulate the performance of an IC engine under varying loads and speeds using software.
2. Simulate the effect of different gear ratios on vehicle acceleration and fuel economy.
3. Simulate the torque distribution in an AWD system under different road conditions.
4. Simulate the dynamic behavior of a suspension system over rough terrain using MATLAB or ADAMS.

C Design-Based Experiments (any 2):

1. Design a braking system for a passenger car
2. Design transmission system for a two-wheeler
3. Design a suspension system for a bus.
4. Design a clutch system for a heavy duty trucks.

D Performance-Based Experiments (Hands-on and Simulation Tools) (any 2):

1. Performance evaluation of a single-plate clutch system.
2. Braking performance and thermal response analysis.
3. Propeller shaft torsional and bending rigidity test.
4. Suspension system response and ride comfort testing (MacPherson Strut).

A minimum of eight experiments from the above-suggested list (02 from each group) or any other experiment based on the syllabus will be included, which would help the learner to apply the concept.

Books Recommended

Textbooks

1 Kirpal Singh, Automobile Engineering Volume 1, Standard, 2000.

2 R. K. Rajput, A Text Book of Automobile Engineering, Laxmi Publication, 2008.

3 V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill, 2010.

4 Tom Denton, Automobile Mechanical and Electrical Systems, CRC Press, 2017.

5 G. K. Awari, V. S. Kumbhar, R. B. Tirpude, Automotive Systems: Principles and Practices, CRC Press, 2021.

6 Günther Prokop, Hermann Winner, and Markus Maurer, Automotive Systems Engineering II, Springer International Publishing, 2017.

7 Kirpal Singh, Automobile Engineering Volume 2, Standard, 1993.

Reference Books

1 Design Data Book by P.S.G. College of Technology, Coimbatore, 2022.

2 S. S. Khandare and A. V. Kale, Design Data Book – Design of Engine Parts, 2018.

3 Tom Denton, Advanced Automotive Fault Diagnosis, Taylor Francis, 2006.

4 Tom Denton, Automobile Electrical and Electronic Systems, CRC Press, 2017.

5 Hermann Winner, and Markus Maurer, Automotive Systems Engineering, Springer Berlin Heidelberg, 2013.

6 Mark van den Brand, Yanja Dajsuren, Automotive Systems and Software Engineering: State of the Art and Future Trends, Springer International Publishing, 2019.

7 Harald Naunheimer, Bernd Bertsche, Joachim Ryborz, Peter Fietkau and Wolfgang Novak, Automotive Transmissions Fundamentals, Selection, Design and Application, Springer Berlin Heidelberg, 2010.

8 John C. Dixon, Suspension Geometry and Computation, Wiley, 2009.

9 Julian Happian-Smith, An Introduction to Modern Vehicle Design, Elsevier Science Technology Books, 2001.

Web References

1 Fundamentals of Automotive Systems
`https://nptel.ac.in/courses/107106088`

2 Ergonomics In Automotive Design
`https://nptel.ac.in/courses/107103084`

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Piping Engineering (22PEME7033T)		
Piping Engineering Laboratory (22PEME7033L)		

Prerequisites:

1. Fundamentals of mechanical elements

Course Objectives:

1. To study components, materials and standards of piping systems
2. To study piping layout and drawings
3. To study basic loading conditions and failure nodes.
4. To study compliance and regulatory requirements for piping systems.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Describe needs and requirements of a piping system.	L2	Understand
CO2	Design piping parts and its layout.	L6	Create
CO3	Analyze the piping materials, codes, stress- strain and their flexibility.	L4	Analyze
CO4	Analyze a pipe network for specified application.	L4	Analyze
CO5	Evaluate pressure drop in piping system using fluid mechanics fundamentals.	L5	Evaluate

Piping Engineering (22PEME7033T)

Course Contents

Unit-I **010 Hrs.**

Introduction of Piping systems and Components

Importance of piping engineering in Industrial application. Types of pipes and their systems, fittings, flanges, valves, their types and their selection with sizes. Expansion of joints and flexible connectors. Pipe supports, types, selection and design.

Unit-II **06 Hrs.**

Piping materials

Material selection, including metals, plastics and composites. Material properties and characteristics. Material specifications and material data sheets. Material testing and quality assurance. Materials of piping required for transportation of gas like H2.

Unit-III **13 Hrs.**

Piping design

Piping codes and standards. Piping layout and routing principles, Isometric drawings, piping drawings graphics and Piping design for different plants. Software used for Piping and Instrumentation diagram (PIDs). Maintain PID symbols and legends. Geotagging and aligning diagrams. Design of basic piping parts. Basic formulae. Pipe sizing methods. Pressure drop based pipe sizing. Piping design for transportation of gas like H2. Use of Generative technology in Piping design.

Unit-IV **07 Hrs.**

Piping stress analysis

Basic stress and strain in piping systems. Piping Flexibility Analysis. Concepts of flexibility analysis with software usage. Introduction on CAESAR II and Autopipe software.

Unit-V **03 Hrs.**

Piping Code compliance and regulatory requirements

Compliance with piping codes and standards. Regulatory requirements. Inspection and testing procedures.

Piping Engineering Laboratory (22PEME7033L)

Suggested Experiments

A Study-Type/ Case-Study-based Experiments (Theoretical and Conceptual Learning):

1 Analysis of stress induced in piping systems using software like CAESAR II.
2 Analyze vibrations in piping systems to identify potential problems and ensure safe operation.
3 Simulation of the thermal expansion and contraction of pipes to assess their behavior under temperature variations.
4 Simulation of pressure test and leak test of piping systems.
5 Case study on safety training required in piping systems.
6 Simulation of different flow conditions in piping systems.
7 Calculation head loss due to friction, velocity or pressure drop using the Darcy-Weisbach equation.
8 Calculation of the required pipe size and flow velocity based on flow rate and fluid properties in piping system.
9 Designing piping layouts using software like AutoCAD.

All experiments from the group A list or any other experiment based on the syllabus will be included, which would help the learner apply the concept.

Books Recommended

1 M.W. Kellogg Co. Design of Piping Systems. Wiley, 1961.
2 Silowash, Brian. Piping Systems Manual. McGraw Hill Professional, 2009.
3 Peng, Liang-Chuan and Tsen-Loong Peng. Pipe Stress Engineering. ASME press, 2009.
4 Menon, Shashi. Piping calculations manual. McGraw Hill Professional, 2004.
5 Wilson, B. Detail Engineering and Layout of piping systems, 2011.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Bionics Engineering (22PEME7034T)		
Bionics Engineering Laboratory (22PEME7034L)		

Prerequisites:

1. Fundamentals of Mechanical Engineering.
2. Fundamentals of Design, Manufacturing, Assembly.

Course Objectives:

1. To introduce the fundamentals of bionics and biomimetics in engineering applications.
2. To develop an understanding of bio-inspired design methodologies and their practical applications.
3. To explore the mechanical properties of biological materials and their relevance to engineering.
4. To examine biomimetic manufacturing techniques for sustainable and efficient production.
5. To investigate bio-inspired locomotion and robotic systems for engineering applications.
6. To analyze real-world applications of bionics in aerospace, automotive, biomedical, and renewable energy sectors.

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 core principles of biomimetics and how biological systems inspire engineering solutions	L2	Understand
CO2	Apply biomimetic design methodologies to develop innovative mechanical systems.	L3	Apply
CO3	Analyze the mechanical properties of biological materials and their applications in engineering.	L4	Analyze
CO4	Evaluate biomimetic manufacturing techniques, including 3D printing and self-assembly methods.	L5	Evaluate
CO5	Develop bio-inspired robotic mechanisms by applying principles of natural locomotion and Assess the impact of bionic innovations in aerospace, automotive, biomedical, and renewable energy fields.	L6	Create

Bionics Engineering (22PEME7034T)

Course Contents

Unit-I **06 Hrs.**

Introduction to Bionics & Biomimetic

- Definition, scope, and importance of bionics in engineering
- Historical background and key advancements
- Nature-inspired design principles
- Biological systems as models for engineering solutions.

Unit-II **10 Hrs.**

Fundamentals of Bio-Inspired Design

- Fundamentals of Bio-Inspired Design
- Biomimetic design methodology
- Case studies in bio-inspired mechanical systems
- Structural and functional adaptations in nature
- Computational approaches in bio-inspired design.

Unit-III **06 Hrs.**

Materials & Mechanics in Bionics

- Biological materials and their mechanical properties
- Smart materials inspired by nature (e.g., self-healing, shape memory)
- Nanomaterials and their bio-inspired applications
- Soft robotics and bio-inspired actuation.

Unit-IV **07 Hrs.**

Biomimetic Manufacturing & Fabrication Techniques

- Bio-inspired 3D printing and additive manufacturing
- Nano- and micro-fabrication techniques
- Self-assembly and biofabrication
- Sustainable and green manufacturing approaches inspired by nature.

Unit-V **10 Hrs.**

Bio-Inspired Motion & Robotics and Applications

- Bio-Inspired Motion & Robotics
  - Locomotion principles in biological systems
  - Bio-inspired robotic mechanisms (e.g., insect-inspired robots, snake robots)
  - Fluid dynamics in natural locomotion (e.g., fish, birds)
  - Energy-efficient motion strategies from nature
- Applications of Bionics in Engineering
  - Aerospace: Bio-inspired wings, drag reduction techniques
  - Automotive: Nature-inspired aerodynamics and materials
  - Biomedical: Prosthetics, exoskeletons, and tissue engineering
  - Renewable Energy: Bio-inspired energy harvesting (solar panels, wind turbines)

Bionics Engineering Laboratory(22PEME7034L)

Suggested Experiments

A Study-Type/ Case-Study-based Experiments (Theoretical and Conceptual Learning):

1 Biomimetic Surface Experiment (Lotus Effect Shark Skin)
2 Bio-Inspired Structural Strength (Honeycomb vs. Conventional Structures)
3 Bio-Inspired Aerodynamics (Kingfisher Beak Bullet Train Nose)
4 Soft Robotics Bio-Inspired Actuation (Octopus-Inspired Grippers)
5 Biomimetic Energy Harvesting (Butterfly Wing-Inspired Solar Panels)
6 Locomotion Analysis in Bio-Inspired Robotics (Snake vs. Quadruped Robots)
7 Biomimetic Cooling System (Termite Mound-Inspired Ventilation)
8 Bio-Adhesion Study (Gecko Feet-Inspired Dry Adhesives)
9 Case Study Presentation on Biomimetic Innovations

A minimum of eight experiments from the above-suggested list or any other experiment based on the syllabus will be included, which would help the learner to apply the concept.

Books Recommended

Textbooks

1 Yoseph Bar-Cohen, Biomimetics: Nature-Based Innovation, CRC Press, 2011.
2 Wole Soboyejo and Leo Daniel, Bioinspired Structures and Design: Butterfly Wings, Lotus Leaves, and Other Natural Wonders, Cambridge University Press, 2018.
3 Janine M. Benyus, Biomimicry: Innovation Inspired by Nature, Harper Perennial, 2002.
4 Junzhi Yu, Bioinspired Robotics: Mechanisms and Control, Elsevier, 2022.
5 Nathan F. Lepora, Anna Mura, and Tony J. Prescott (Eds.), Biomimetic and Biohybrid Systems, Springer, 2013.

Reference Books

1 Alicia Kim, Bioinspired Engineering, Wiley, 2021.

2 Chad S. Korach, Mechanics of Biological Systems and Materials, Springer, 2015.

3 Lígia Rodrigues and Manuela E. Gomes (Eds.), Bioinspired Materials for Medical Applications, Woodhead Publishing, 2017.

4 Xin-She Yang, Nature-Inspired Optimization Algorithms, Elsevier, 2014.

Web References

1 Introduction to Biomimicry
`https://onlinecourses.nptel.ac.in/noc22_ge24/preview`

2 Wyss Institute for Biologically Inspired Engineering –Harvard University
`https://wyss.harvard.edu`

3 Journal of Bionic Engineering – Springer
`https://www.springer.com/journal/42235`

4 Biomimicry Institute
`https://biomimicry.org`

5 Biological Inspired Design – Georgia Tech
`https://bid.isye.gatech.edu`

6 MIT Biomimetics Robotics Lab
`http://biomimetics.mit.edu`

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Computational Fluid Dynamics (22PEME7035T)		
Computational Fluid Dynamics Laboratory (22PEME7035L)		

Prerequisites:

1. Fundamentals of Engineering Mechanics and Applied Mathematics
2. Fundamentals of Fluid Mechanics and Heat Transfer.

Course Objectives:

1. To understand the basics of CFD and its working methodology.
2. To gain knowledge about the governing equations applicable for CFD problems.
3. To study various concepts related to Turbulence.
4. To understand the working of Finite Difference method and its application to CFD problems.
5. To evaluate and solve problems of conduction, convection and diffusion in 1-D using Finite Volume Method.
6. To explore the various boundary conditions and solution algorithms.

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 concept and Methodology working of CFD.	L2	Understand
CO2	Explain the governing equations applicable in CFD problems.	L2	Understand
CO3	Apply the turbulence model for various CFD Problems.	L3	Apply
CO4	Analyze 1D problems of Conduction, Convection and diffusion using Finite Volume Method.	L4	Analyze
CO5	Explain the various boundary conditions.	L2	Understand
CO6	Explain the various solution algorithms.	L2	Understand

Computational Fluid Dynamics (22PEME7035T)

Course Contents

Unit-I **04 Hrs.**

Introduction to CFD

What is CFD, Scope and Application of CFD, Methods of Predictions like Experimental and theoretical, Working of Commercial CFD Software's, Solution methodology: Pre-processing, Solver, Post processing, Types of Grids and their application.

Unit-II **06 Hrs.**

Mathematical description of Physical Phenomenon

Governing Differential Equations, Meaning of Differential equation, The Continuity Equation, Momentum equation, Energy Equation, General Differential Equation.

Unit-III **06 Hrs.**

Turbulence Modelling and Finite Difference Method

Introduction to Turbulence Modelling, Turbulence Models, The Time-Averaged Equation for Turbulent Flow.

Unit-IV **13 Hrs.**

Finite Volume Method applied to Heat Conduction, Convection and Diffusion

Steady One-dimensional Conduction, Convection, Diffusion, Unsteady One- dimensional Conduction, Introduction to two and three-dimensional Situations.

Unit-V **04 Hrs.**

Boundary Conditions

Types of Boundary Conditions and their applications, Initial and Boundary Conditions, Initial and Boundary Value problems.

Unit-VI **06 Hrs.**

Solution Algorithms for Pressure Velocity Coupling

Staggered Grid, SIMPLE Algorithm, SIMPLEC Algorithm.

Computational Fluid Dynamics Laboratory (22PEME7035L)

Suggested Experiments

A Simulations using ANSYS Workbench:

1 Introduction to Ansys Spaceclaim, Meshing and Fluent
2 Mixing elbow for fluid under steady incompressible conditions
3 Double Pipe Counterflow Heat Exchanger
4 Wind Pipe

B Python Programming:

1 Introduction to Grid Generation. Solving algebraic equations.
2 Solution to 1 D Steady Conduction.

C A mini project

A Mini Project would help the learner to apply the concept

A minimum of five experiments from the above-suggested list and a Mini Project.

Books Recommended

Textbooks

1 H. K. Versteeg, W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson, England, 2007.

Reference Books

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

2 P. Niyogi, M. K. Laha, S. K. Chakrabarty, Introduction to Computational Fluid Dynamics, Pearson Education, India, 2006.

3 K. Muralidhar, and T. Sundararajan, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 2003.

4 P. S. Ghoshdasdidar, Computer Simulation of Flow and Heat Transfer, Tata McGraw-Hill Publishing Company Ltd, 2017.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Business Model Design (22PEME7036T)		
Business Model Design Laboratory (22PEME7036L)		

Prerequisites:

Nil

Course Objectives:

1. Understanding business model frameworks.
2. Analyze value creation strategies.
3. Assess revenue and cost structures.
4. Evaluate customer segmentation and market fit.
5. Integrate innovation into business models

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 components of a business model.	L2	Understand
CO2	Analyze market needs and develop value propositions.	L4	Analyze
CO3	Evaluate cost and revenue structures for financial sustainability.	L5	Evaluate
CO4	Evalute customer segmentation strategies for market alignment.	L5	Evaluate
CO5	Apply innovation-driven strategies to enhance business models.	L3	Apply

Business Model Design (22PEME7036T)

Course Contents

Unit-I **08 Hrs.**

Introduction to Business Models

- Definition and Importance
- Components of a Business Model
- Case Studies on Successful Business Models

Unit-II **08 Hrs.**

Value Creation and Market Positioning

- Identifying Customer Needs
- Competitive Advantage and Differentiation
- Market Research and Business Fit.

Unit-III **06 Hrs.**

Revenue and Cost Considerations

- Revenue Models and Pricing Strategies
- Cost Structure and Financial Sustainability
- Key Financial Metrics

Unit-IV **06 Hrs.**

Customer Segmentation and Market Alignment

- Identifying Target Segments
- Business Model Adaptation for Different Markets
- Consumer Behavior and Decision Making
- Collaborative Business Models

Unit-V **06 Hrs.**

Business Model Development

- Developing and Structuring Business Models
- Leveraging Technology in Business Models
- Business Model Evolution in Emerging Industries
- Digital Transformation Strategies

Unit-VI **05 Hrs.**

Business Model Validation

- Business Model Testing and Refinement
- Risk Assessment and Contingency Planning
- Final Business Model Development and Evaluation

Business Model Design Laboratory (22PEME7036L)

Suggested Experiments

A Exercises:

1 Business Model Analysis
- Detailed Description : Study and evaluate business models of successful companies using real- world case studies. Identify key components such as value proposition, revenue streams, and customer segments.

2 Customer Value Proposition Mapping
- Detailed Description : Develop customer value propositions for a selected business idea. Define key benefits offered to customers and create differentiation strategies.

3 Business Model Canvas Development
- Detailed Description : Construct a Business Model Canvas for a proposed startup, detailing key partners, activities, customer relationships, cost structure, and revenue models.

4 Revenue and Cost Structure Analysis
- Detailed Description : Identify and analyze various revenue streams and cost drivers for a given business idea. Assess financial sustainability and explore monetization strategies.

5 Market Opportunity Identification
- Detailed Description : Conduct primary and secondary market research to validate business ideas. Identify customer needs, potential market size, and growth opportunities

6 Competitive Analysis and Positioning
- Detailed Description : Assess competition in a given industry. Identify direct and indirect competitors, analyze market positioning, and develop differentiation strategies.

7 Business Model Testing and Validation
- Detailed Description : Apply structured testing frameworks (e.g., Lean Startup methodology) to refine business assumptions. Conduct customer interviews and prototype testing.

8 Scalability and Sustainability Assessment
- Detailed Description : Evaluate the long-term scalability and sustainability of a business model. Assess factors such as resource allocation, market expansion potential, and financial growth.

9 Innovative Business Model Design

- Detailed Description : Design a business model for an emerging industry or disruptive technology. Develop creative approaches to solving market problems.

10 Final Business Model Presentation

- Detailed Description : Prepare and present a refined business model to a panel. Justify business assumptions, financial projections, and growth strategies. Receive feedback for improvement.

B Continuous Assessment:

Assignment on Each Module (total 6 Assignment)

A minimum of ten experiments (all six from the group A list and any four from the group B list) or any other experiment based on the syllabus will be included, which would help the learner apply the concept.

Books Recommended

1 Baisya, Rajat K. Indian Entrepreneurship: Analysis of Business Practices. SAGE Publications, New Delhi, 2021.

2 Blank, Steve, and Bob Dorf. The Startup Owner's Manual. K&S Ranch Publishing, Pescadero, 2012.

3 Desai, Vasant. Entrepreneurship Development in India. Himalaya Publishing House, Mumbai, 2019.

4 Joshi, M.V. Entrepreneurship Development and Startup India. Himalaya Publishing House, Mumbai, 2020.

5 Kumar, S. Ramesh. Business Development: A Comprehensive Approach. McGraw Hill, New Delhi, 2018.

6 Osterwalder, Alexander. Value Proposition Design. Wiley, New Jersey, 2014.

7 Osterwalder, Alexander, and Yves Pigneur. Business Model Generation. Wiley, New Jersey, 2010.

8 Prasad, Rohit. Start-up Sutra: What the Angels Won't Tell You About Business and Life. Hachette India, New Delhi, 2013.

9 Purohit, Prachi. Startup India: The Complete Guide to Launching and Managing a Business. Notion Press, Chennai, 2021.

10 Ries, Eric. The Lean Startup. Crown Business, New York, 2011.

11 Thiel, Peter. Zero to One. Crown Business, New York, 2014.

12 Van der Pijl, Patrick. Business Model Shifts. Wiley, New Jersey, 2020.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Soft Computing (22PEME7037T)		
Soft Computing Laboratory (22PEME7037L)		

Prerequisites:

1. Mathematics and Statistics.
2. Programming and Computational Tools.
3. Mechanical Engineering Fundamentals.
4. Control Systems and Automation (Desirable but not mandatory).

Course Objectives:

1. To introduce the fundamental concepts of soft computing and its applications in engineering and optimization problems.
2. To provide a deep understanding of fuzzy logic systems, including fuzzy sets, membership functions, fuzzy inference, and defuzzification techniques.
3. To explore the principles of evolutionary computing, including genetic algorithms (GA), evolutionary strategies, and their applications in problem-solving.
4. To understand artificial neural networks (ANNs), their architectures, training techniques, and applications in predictive modeling and classification.
5. To introduce swarm intelligence algorithms such as Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) and their applications in engineering.
6. To develop problem-solving skills using hybrid soft computing techniques, integrating fuzzy logic, neural networks, and evolutionary algorithms for real-world applications.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Differentiate between soft computing and conventional computing techniques to determine their suitability for complex problem-solving.	L4	Analyze
CO2	Apply fuzzy logic concepts, including fuzzy inference and defuzzification techniques, to solve decision-making problems in engineering.	L3	Apply
CO3	Apply evolutionary computing techniques, including genetic algorithms, to optimize complex engineering problems.	L3	Apply
CO4	Design and train artificial neural networks for pattern recognition, classification, and predictive analytics.	L6	Create
CO5	Apply swarm intelligence and probabilistic models to solve multi-objective optimization problems.	L3	Apply
CO6	Design hybrid intelligent systems by integrating multiple soft computing techniques for solving complex problems in mechanical and manufacturing engineering.	L6	Create

Soft Computing (22PEME7037T)

Course Contents

Unit-I **07 Hrs.**

Introduction to Soft Computing and Optimization

- Concept of Soft Computing: Definition, characteristics, and advantages over hard computing.
- Applications of Soft Computing: Engineering applications
- Optimization Fundamentals: Global and local optima, Problem formulation; Review of basic calculus concepts (Convex functions, Eigenvalue Decomposition, Singular Value Decomposition); Classification of optimization problems in machine learning.
- Optimization Methods: Linear Programming: Graphical method, Simplex method, Duality; Unconstrained Optimization: Gradient-based methods, Cauchy's steepest descent, Newton's method, Conjugate gradient method; Constrained Optimization: Direct methods, Penalty function methods, Steepest descent method.

Unit-II **06 Hrs.**

Fuzzy Logic and Applications

- Fuzzy Set Theory: Fuzzy sets, Operations, Membership functions; Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inference; Defuzzification Techniques: Methods and applications.
- Fuzzy Logic Controller (FLC): Design, Rule base, Inference mechanism;
- Applications in control systems and decision-making.

Unit-III **06 Hrs.**

Artificial Neural Networks (ANNs)

- Introduction to ANN: Biological vs. Artificial neurons, ANN architecture; Types of ANN: Feedforward, Recurrent; Activation functions: Linear, Sigmoid, Tanh.
- Training Techniques: Supervised and unsupervised learning; Backpropagation algorithm.
- Applications of ANN: Pattern recognition, Control systems, Fault detection

Unit-IV **07 Hrs.**

Evolutionary Computing and Genetic Algorithms (GA)

- Evolutionary Computation Concepts: Evolutionary processes, Evolutionary algorithms, Evolutionary programming.
- Genetic Algorithm (GA) Framework: Working principle, Encoding, Fitness function; Selection techniques (Roulette wheel, Tournament selection); Crossover techniques, Mutation techniques.
- Multi-objective Genetic Algorithms (MOEA): Pareto optimization, Crowding distance, Ranking methods.
- Applications of GA: Engineering optimization problems.

Unit-V **07 Hrs.**

Swarm Intelligence and Reinforcement Learning

- Swarm Intelligence Concepts: Features and principles; Algorithms: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC); Applications in engineering optimization.
- Reinforcement Learning (RL): Basic concepts, Policy, Reward function,
- Value function; RL approaches: Value-based, Policy-based, Model-based; Q- learning algorithm; Comparison between RL and supervised learning.

Unit-VI **06 Hrs.**

Probabilistic Models and Applications in Engineering

- Markov Models: Markov decision process, State transitions; Hidden Markov Models (HMM); Applications in mechanical engineering.
- Probabilistic Design in Mechanical Systems: Stress-strength models, Reliability estimation; Probability distributions in failure modeling
- Applications of Soft Computing in Engineering: Predictive maintenance, Fault detection; Image-based part classification, Process optimization; Tuning of control algorithms.

Soft Computing Laboratory (22PEME7037L)

Suggested Experiments

A Group A : Any five assignments (one from each group) for a data set using a suitable software package/ programming language.

1 Group 1 : Fuzzy Logic Systems

1 Implementation of Fuzzy Membership Functions (Triangular, Trapezoidal, Gaussian)
2 Fuzzy Set Operations (Union, Intersection, Complement)
3 Fuzzy Relation and Composition (Max-Min and Max-Product Composition)
4 Defuzzification Techniques (Centroid, Bisector, Mean of Maximum)
5 Design and Simulation of a Fuzzy Logic Controller (FLC) for Temperature Control

2 Group 2 : Genetic Algorithms (GA) and Evolutionary Computing

1 Implementation of Genetic Algorithm (GA) for Function Optimization
2 Solving the Traveling Salesman Problem (TSP) using Genetic Algorithm
3 Multi-Objective Genetic Algorithm (MOGA) for Pareto Optimization
4 Implementing Crossover and Mutation Techniques in GA
5 Design and Optimization of a Mechanical Component using Genetic Algorithm

3 Group 3 : Artificial Neural Networks (ANN)

1 Implementation of Single-Layer Perceptron for Binary Classification
2 Backpropagation Algorithm for Training a Multi-Layer Perceptron (MLP)
3 Handwritten Digit Recognition using ANN (MNIST Dataset) in Python
4 Design and Training of an ANN-based Predictive Maintenance Model
5 Comparison of Supervised vs. Unsupervised Learning in Neural Networks

4 Group 4 : Swarm Intelligence Techniques

1 Implementation of Particle Swarm Optimization (PSO) for Function Minimization
2 Solving Optimization Problems using Ant Colony Optimization (ACO)
3 Implementation of Artificial Bee Colony (ABC) Algorithm for Optimization
4 Comparison of PSO, ACO, and GA for Engineering Design Problems
5 Hybrid Soft Computing Approach: Integrating Fuzzy Logic and Neural Networks for Control Applications

5 Group 5 : Probabilistic Models & Applications in Engineering

1 Implementation of Markov Decision Process (MDP) for System State Prediction
2 Hidden Markov Model (HMM) for Predictive Maintenance in Mechanical Systems
3 Reliability Estimation of Mechanical Components using Stress-Strength Models
4 Failure Probability Modeling using Monte Carlo Simulation
5 Image-Based Part Classification using Machine Learning

B Group B : A mini project (Mandatory):

One mini project (in a group of 2 students) based on the above contents and using the mechanical engineering application dataset.

Books Recommended

Textbooks

1 Mangey Ram, and Suraj B. Singh, Soft Computing: Techniques om Engineering Sciences, De Gruyter, 2020.

2 S. Chakraverty, Deepti M. Sahoo, and Nisha R. Mahato, Concept of Soft Computing: Fuzzy and ANN Programming, Springer Nature Singapore, 2019.

3 Ashish M. Gujarathi, B. V. Babu," Evolutionary Computation: Techniques and Applications", CRC Press 2016.

4 Tettamanzi Andrea, Tomassini and Marco, Soft Computing Integrating Evolutionary, Neural and Fuzzy Systems, Springer, 2001.

5 Singiresu S Rao, Engineering Optimization Theory and Practice, John Wiley Sons, Inc, 2019

6 Parag Kulkarni and Prachi Joshi, "Artificial Intelligence – Building Intelligent Systems", PHI learning Pvt. Ltd., 2015.

Reference Books

1 Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.

2 X. Yao," Evolutionary Computation: Theory & Applications", World Scientific Publ. Co., 1999.

3 Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.

4 Solanki, Nayyar, Emerging Trends & Applications of Machine Learning, IGI Global, 2018.

5 Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.

6 Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.

Web References

1 Introduction to Soft Computing `https://nptel.ac.in/courses/106105173`

2 Soft Computing Techniques `hptts://nptel.ac.in/courses/111105614`

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Digital Manufacturing (22PEME7041T)		

Prerequisites:

1. Fundamentals of CAD/CAM.

Course Objectives:

1. To focus on equipping the students with the knowledge and skills to leverage digital technologies in the manufacturing process.
2. To gain knowledge about digital procurement, predictive maintenance and predictive quality in digital manufacturing process.
3. To study various cyber threats in digital manufacturing.
4. To gain knowledge about various methods to mitigate the cyber security threats in digital manufacturing.
5. To study usage AI and ML Technology in manufacturing to enhance its performance.

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 various steps involved in digital manufacturing and smart factory concepts.	L2	Understand
CO2	Apply the predictive quality and predictive maintenance concepts in manufacturing process.	L3	Apply
CO3	Analyse the benefits of digital procurement in manufacturing process.	L4	Analyze
CO4	Evaluate cyber security issues in digital manufacturing environment.	L5	Evaluate

Digital Manufacturing (22PEME7041T)

Course Contents

Unit-I **10 Hrs.**

Introduction to Digital Manufacturing and Production in Digital Era

- Evolution of conventional to digital Manufacturing (DM), introduction to digital transformation and drivers for digital transformation in manufacturing.
- Planning: Optimization, Rough cut Capacity Planning (RCCP) and Labour planning.
- Execution: Process parameters, Enterprise Data Management (EDM), Run time errors and documentation.
- Technology: Robotic Process automation (RPA) and 3 DP (three dimensional printing).
- Smart factory concepts .
- Digital Twins: Learning about creating digital replicas of physical assets and processes to simulate and optimize performance.

Unit-II **10 Hrs.**

Predictive Quality

- Classification of predictive analysis. Steps involved in implementing of predictive analytics in the organization. Data collection and integration of the data. Real time data monitoring, Analysis and modelling of the data using Emerging tools (Industrial IoT, ML, statistical modelling, neural networks and AI). Use of models to predict quality issues and setting up the alert.
- Benefits of predictive quality analysis in manufacturing.
- Case study discussion on implementation of Predictive Quality in an industry.

Unit-III **07 Hrs.**

Predictive Maintenance (PdM)

- Definition of PdM. Types of PdM. Difference between predictive and preventive maintenance. Steps used in PdM.
- Collection of the data on parameters like vibration, temperature, humidity, pressure and noise using and transmission of the real time data for analysis using IOT.
- Analysis of the data using AI and ML tools and creation of models to predict the life span of the machines. Setting up the alert for maintenance issues.
- Benefits of PdM in manufacturing.
- Discussion on case study.

Unit-IV **06 Hrs.**

Digital Procurement

- Definition of digital procurement. Types of procurement. 5 R's in procurement. Digital procurement strategy and steps. Procurement to pay cycle (P2P).
- Use of online platforms for supplier selection, bidding and contract management.

- Analysis of procurement data to identify trends, optimize spending and improve decision-making using ML.
- Use of AI for price prediction, supplier selection and risk assessment.
- Use of digital tools for managing contracts, tracking compliance and mitigating risks.
- Benefits of digital procurement.

Unit-V **06 Hrs.**

Cybersecurity/ Big Data Security in Digital Manufacturing

- Introduction, basic cybersecurity concepts, threats, vulnerabilities and attacks relevant to digital manufacturing.
- Network and System Security: Security of networks i.e. wireless security, firewalls, intrusion detection systems (IDS) and intrusion prevention systems (IPS) in relevance to the digital factory environment.
- Industrial Control Systems (ICS) Security: SCADA (Supervisory Control and Data Acquisition) systems, PLC (Programmable Logic Controller) networks and other critical ICS components.
- Data Security: Protection of sensitive data i.e. intellectual property, customer data and operational data, through data encryption, access control, and data loss prevention (DLP) techniques in digital manufacturing.
- Mitigation of cyber security risks.

Books Recommended

Textbooks

1 Sunil Mudumala, Leading Digital Transformation in Manufacturing Industry 4.0.

2 J. Paulo Davim , Kaushik Kumar, Divya Zindani , J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0, Taylor and Francis, 2021.

3 Dipti Bandi, Digital Procurement unlocked, Notion press, 2023.

4 Mark J. Barrenechea, Tom Jenkins, Digital Manufacturing, Waterloo, 2018

5 Florian Schupp, Heiko Wöhner, Digitalization in Procurement, Springer, 2024.

6 Chandrakant D. Patel, Chun-Hsien Chen, Digital Manufacturing, Elsevier, 2024.

Reference Books

1 Andries Feikema, Digital Transformation in Procurement, Koganpage, 2025.

2 Lane Thames, Dirk Schaefer, Cybersecurity for Industry 4.0, Springer, 2017.

3 R Sujatha, G Prakash, Noor Zaman Jhanjhi, Cyber Security Applications for Industry 4.0, Chapman & Hall, 2024

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Automotive Materials and Manufacturing (22PEME7042T)		

Prerequisites:

Nil

Course Objectives:

1. To provide an understanding of advanced materials, including composites and specialty materials in automotive applications.
2. To introduce the mechanical behavior, constitutive models, and applications of polymers and composite materials in automotive design.
3. To explore smart materials, sensors, and actuators, and their integration into automotive structures.
4. To study the criteria for material selection in automotive design based on strength, cost, formability, and machinability.
5. To understand the impact of globalization on automotive manufacturing and supply chain management.

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 significance of advanced materials in vehicle design and performance.	L2	Understand
CO2	Understand the viscoelastic behavior of polymers under different loading conditions.	L2	Understand
CO3	Evaluate design and manufacturing challenges in integrating smart materials.	L5	Evaluate
CO4	Identify suitable materials for automotive components based on mechanical and economic factors.	L3	Apply
CO5	Analyze strategies for product-process-business integration in a globalized economy.	L4	Analyze

Automotive Materials and Manufacturing (22PEME7042T))

Course Contents

Unit-I **06 Hrs.**

Overview of materials used in automotive systems

Traditional vs. advanced materials, Metallic and non-metallic composites: Properties, applications in structural and non-structural components, Specialty materials: High-strength steels, lightweight alloys (Al, Mg, Ti), shape memory alloys, and ceramics, Nanotechnology in automotive systems: Nano-coatings, nanocomposites, nano- lubricants, energy storage and thermal management, Environmental and sustainability considerations in advanced material selection

Unit-II **06 Hrs.**

Composite Materials

Composite materials, including naturally occurring substances such as wood and bone, and engineered materials from concrete to carbon fiber reinforced epoxies. Design and analysis of composite components in automotive applications. Natural composites (e.g., wood, bamboo) and bio-based composites in green automotive design.

Unit-III **07 Hrs.**

Smart Materials and Structures

Theoretical aspects of smart materials, sensors and actuator technologies. It will also cover design, modeling and manufacturing issues involved in integrating smart materials and components with control capabilities to engineering smart structures.

Unit-IV **06 Hrs.**

Materials in Manufacturing and Design

Material selection based on cost, strength, formability and machinability. Advanced strength analysis of heat-treated and cold-formed parts including axial, bending, shear and cyclic deformation. Correlations of functional specifications and process capabilities

Unit-V **08 Hrs.**

Laser Materials Processing

Application of lasers in materials processing and manufacturing. Laser principles and optics. Fundamental concepts of laser/material interaction. Laser welding, cutting, surface modification, forming, and rapid prototyping.

Unit-VI **06 Hrs.**

Assembly Modeling for Design and Manufacturing

Assembly on product and process, Assembly representation, Assembly sequence, Datum flow chain, Geometric Dimensioning and Tolerance, Tolerance analysis, Tolerance synthesis, Robust design, Joint design and joining methods, Stream of variation, Auto body assembly case studies.

Books Recommended

Textbooks

1 S. Kalpakjian and S. R. Schmid, Manufacturing Engineering and Technology, Pearson Education South Asia Pte Limited, 2013.Education.

2 William D. Callister, William D. Callister, Jr., and David G. Rethwisch, Materials Science and Engineering: An Introduction, Wiley, 2008.

3 M. P. Groover, Fundamentals of Modern Manufacturing: Processes, and Systems, Wiley, 1996.

4 W. F. Smith, J. Hashemi, and F. Presuel-Moreno, Foundations of Materials Science and Engineering, McGraw-Hill, 2018.

Reference Books

1 David R. H. Author Jones and M. A. Asbhy, Engineering Materials, Butterworth-Heinemann, 1996.

2 C. K. Chawla Composite Materials: Science and Engineering, Springer, 2012.

3 R. F. Gibson, Principles of Composite Material Mechanics, CRC Press, 2016.

4 F. C. Campbell (Jr.), and F. C. Campbell, Manufacturing Processes for Advanced Composites," Elsevier, 2003.

5 A. B. Strong, Plastics: Materials and Processing, Pearson Prentice Hall, 2006.

6 W. M. Steen, Laser Material Processing, Springer, 2013.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Design for X (22PEME7043T)		

Prerequisites:

1. Fundamentals of Mechanical Engineering.
2. Fundamentals of Design, Manufacturing, Assembly.

Course Objectives:

1. To Understand the fundamental principles of Design for X (DfX) and its role in product development.
2. To gain knowledge about DfX methodologies to optimize designs for manufacturability, cost, reliability, sustainability, safety, and maintainability.
3. To Develop analytical skills to assess trade-offs between different DfX factors and make informed design decisions.
4. To Gain knowledge of industry best practices, tools, and techniques used in DfX.
5. To Explore emerging trends and future advancements in DfX, including additive manufacturing, IoT integration, and sustainability-driven designs.

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 fundamental principles of DfX and its role in optimizing product design for various factors such as manufacturability, reliability, cost, and sustainability.	L2	Understand
CO2	Apply Design for Manufacturability (DfM) principles to optimize material selection, process constraints, and design simplification for efficient manufacturing.	L3	Apply
CO3	Analyze product designs to minimize assembly complexity, reduce part count, and optimize cost through effective DfA and DfC strategies.	L4	Analyze
CO4	Evaluate reliability and sustainability factors in product design using techniques such as Failure Modes and Effects Analysis (FMEA) and Life Cycle Assessment (LCA).	L5	Evaluate
CO5	Synthesize safety, maintainability, and serviceability requirements into product designs to ensure industry compliance and enhanced product longevity.	L6	Create
CO6	Develop an optimized product design by integrating multiple DfX principles and using digital tools such as CAD, simulation, and AI-driven optimization.	L6	Create

Design for X (22PEME7043T)

Course Contents

Unit-I **08 Hrs.**

Introduction to Design for X

Definition and Philosophy of DfX: Understanding "X" as a variable representing key design considerations, Holistic and proactive approach to engineering design, Emphasis on life-cycle thinking.
Importance of DfX in Product Development: Enhancing product quality, usability, and competitiveness, Reducing time-to-market and development cost, Supporting innovation while mitigating risks.
Role of DfX in the Product Development Cycle: Integrating DfX early in the concept and design stages. Cross-functional collaboration (design, manufacturing, supply chain, sustainability, etc.). Aligning with customer requirements and business goals.
Overview of Key DfX Disciplines: Design for Manufacturability (DfM), Design for Assembly (DfA), Design for Cost (DfC), Design for Reliability (DfR), Design for Sustainability (DfS) , Design for Safety (DfSa), Design for Maintainability & Serviceability (DfMS).
Case studies on successful DfX applications: Real-world examples of successful DfX applications from industries like automotive, aerospace, electronics, and consumer goods. Analysis of the impact of DfX on cost, quality, time, and environmental performance.

Unit-II **07 Hrs.**

Design for Manufacturability (DfM)

Principles of Manufacturability: Designing products for ease, efficiency, and cost-effectiveness in manufacturing, Avoiding overly complex geometry and unnecessary features,
Material Selection and Process Constraints: Matching materials to manufacturing processes and product requirements, Consideration of formability, machinability, weldability, etc.
Tolerance Analysis and Design Simplification: Importance of tolerancing in manufacturability and quality, GDT basics and statistical tolerance stacking, Simplifying part geometry to reduce processing steps.
Design Guidelines for Key Manufacturing Processes: Casting: Uniform wall thickness, draft angles, and riser design. Machining: Tool access, fixturing, and reducing setup changes. Injection Molding: Parting lines, flow paths, undercuts, and sink marks. Sheet Metal: Bend radii, material usage, and nesting. Additive Manufacturing: Layer orientation, support structures, and topology optimization.
Tools and Techniques: DFM/DFA software tools (DFMPro, DesignSpark, etc.), Case examples of design changes that improved manufacturability.

Unit-III **08 Hrs.**

DfA and DfC

Design for Assembly (DfA)
Principles of Assembly Efficiency: Minimizing assembly time, tools, and labor, Reducing orientation sensitivity.
Minimizing Part Count and Fasteners: Use of multifunctional and self-locating parts, Snap-fits, interlocking components, and integrated designs.
Modular Design and Standardization: Plug-and-play components, Reusability across product lines and platforms.
Automated Assembly Considerations: Robotics and automation-friendly design, Avoiding small, fragile, or asymmetrical parts.
Design for Cost (DfC):

Cost Modelling Techniques: Parametric costing, activity-based costing. Material and Process Cost Trade-offs: Evaluating performance vs. cost.
Design Simplifications for Cost Reduction: Standard components, simplified assemblies.
Life Cycle Cost Analysis: CAPEX, OPEX, maintenance, and end-of-life.

Unit-IV **08 Hrs.**

DfR and DfS

Design for Reliability (DfR)
Failure Modes and Effects Analysis (FMEA): Systematic identification and ranking of potential failure modes, Risk Priority Number (RPN) and mitigation strategies.
Reliability Prediction and Testing Methods: MTBF (Mean Time Between Failures), Weibull analysis, Accelerated life testing, environmental testing.
Fatigue, Wear, and Durability: Stress-life and strain-life approaches, Material selection and design against degradation.
Redundancy and Fault-Tolerant Design: Backup systems, graceful degradation, Criticality analysis and design for safe failure.
Design for Sustainability (DfS):
Environmental Impact: Energy consumption, emissions, waste, Life Cycle Assessment (LCA): Cradle-to- grave and cradle-to-cradle models, Sustainable Materials and Processes: Bio-based materials, green manufacturing,
Circular Economy: Reuse, remanufacturing, recycling, and take-back systems.

Unit-V **08 Hrs.**

DfM&S and Integrated DfX Approach

Design for Safety (DfS) Compliance with Safety Standards (ISO, OSHA, CE marking, etc.), Human Factors Ergonomics (User interaction, comfort, and errors), Hazard Analysis Techniques (HAZOP, FTA (Fault Tree Analysis), ETA (Event Tree)), Fail-Safe and Foolproof Design (Interlocks, alarms, and error-proofing (Poka-yoke)).
Design for Maintainability Serviceability (DfMS): Ease of Inspection and Diagnostics (Access to critical components, onboard diagnostics), Modularity and Repairability (Plug-and-play modules, standardized connectors), Spare Parts and Accessibility Considerations (Common fasteners, openable enclosures), Predictive Maintenance and IoT Integration (Real-time monitoring, analytics-driven alerts).
Integrated DfX Approach: Cross-functional Optimization (Balancing manufacturability, cost, reliability, and sustainability), Trade-off and Decision-Making Techniques (Pareto analysis, QFD, TRIZ, multicriteria decision analysis).
Digital Tools and Software: CAD/CAM/CAE integration for DfX analysis, PLM (Product Lifecycle Management) platforms, AI and machine learning in design optimization.
Industry Trends and Future Directions: Smart manufacturing, Industry 4.0, digital twins, DfX in circular economy and net- zero goals, Role of generative design and design automation.

Books Recommended

Reference Books

1 George Q. Huang, Design for X: Concurrent Engineering Imperatives, Springer London, 1996.
2 Geoffrey Boothroyd, Peter Dewhurst, and Winston Knight, Product Design for Manufacture and Assembly, CRC Press, 2010.
3 Gerhard Pahl and Wolfgang Beitz, Engineering Design: A Systematic Approach, Springer London, 2007.

4 David M. Anderson, Design for Manufacturability: How to Use Concurrent Engineering to Rapidly Develop Low-Cost, High-Quality Products for Lean Production, CRC Press, 2014.

5 Bryan R. Fischer, Mechanical Tolerance Stackup and Analysis, CRC Press, 2011.

6 Peter Sandborn, Cost Analysis of Electronic Systems, World Scientific Publishing, 2013.

7 E. E. Lewis, Reliability Engineering, Dover Publications, 1996.

8 Patrick D. T. O'Connor and Andre Kleyner, Practical Reliability Engineering, Wiley, 2012.

9 David T. Allen and David R. Shonnard, Sustainable Engineering: Principles and Practice, Pearson Education, 2011.

10 Louis J. Gullo and Jack Dixon, Design for Safety, Wiley, 2018.

11 Mark S. Sanders and Ernest J. McCormick, Human Factors in Engineering and Design, McGraw-Hill, 1993.

12 B. S. Dhillon, Maintainability, Maintenance, and Reliability for Engineers, CRC Press, 2006.

13 Kusiak, Concurrent Engineering: Contemporary Issues and Modern Design Tools, Wiley, 1993.

Web References

1 Dassault Systèmes
`https://www.3ds.com/store/cad/design-for-x`

2 ANSYS
`https://www.ansys.com/en-in/blog/what-is-dfx`

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Renewable Energy Systems (22PEME7044T)		

Prerequisites:

1. Knowledge of Energy science, Energy sources.
2. Fundamentals of Thermodynamics, Heat Transfer and Fluid mechanics.

Course Objectives:

1. To study working principles of various renewable energy sources and their utilities.
2. To study economics of harnessing energy from renewable energy sources.
3. To gain the knowledge of renewable energy conversion systems design.
4. To develop skills to analyse industry and domestic applications of RES.

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 need of different renewable energy sources.	L2	Understand
CO2	Discuss importance of renewable energy sources.	L2	Understand
CO3	Discuss various renewable energy sources in Indian context.	L2	Understand
CO4	Analyze the utilization of solar and wind energy.	L4	Analyze
CO5	Illustrate the design of biogas plant.	L3	Apply
CO6	Explain basics of hydrogen energy.	L2	Understand

Renewable Energy Systems (22PEME7044T)

Course Contents

Unit-I **04 Hrs.**

Introduction to Energy Sources

Renewable and non-renewable energy sources, Energy policy and sustainability, Energy Consumption as a measure of Nation's development; Strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources, Present status and current installations, Emerging and future energy technologies, various MNRE programmes.

Unit-II **09 Hrs.**

Solar Energy

Merits and demerits, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar Angles, sunrise, sunset and day length, Principle of solar energy conversion. Types of Solar Energy Technologies. Components of a Solar Power System. Solar Energy collection devices and Classification: Flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond, solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, Solar Photovoltaic systems & applications. Solar Energy in the Global Context. Future of Solar Energy.

Unit-III **08 Hrs.**

Wind Energy

Principle of wind energy conversion; Basic components of wind energy conversion systems; Wind turbine technologies, wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of Aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection Considerations. Global Wind Energy Development. Future Trends in Wind Energy.

Unit-IV **07 Hrs.**

Energy from Biomass & Hydrogen Energy

Energy from Biomass: Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of biogas, utilization of biogas. Hydrogen Energy: Methods of Hydrogen production, Hydrogen Storage, Fuel Cells and Types of Fuel Cells.

Unit-V **06 Hrs.**

Energy from the Ocean

Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.

Unit-VI **05 Hrs.**

Geothermal Energy

Estimation and nature of geothermal energy, geothermal sources and Resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and Application of geothermal energy, prospects of geothermal energy in India.

Books Recommended

Textbooks

1 G. D. Rai, Non-conventional energy sources, 6th edition, Khanna Publishers, 1988.

2 S. P. Sukhatme, and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, 4th edition, TMH, 2017.

3 H. P. Garg, and Jai Prakash, Solar Energy: Fundamentals and Applications, 1st revised edition, TMH, 1997.

4 Joshua Earnest, Wind Power Technology, PHI Learning, 2014.

5 J. W. Twidell, and Anthony D. Weir, Renewable Energy Sources, ELBS Publication, 1986.

6 D. Begamudre, Energy Conversion Systems, R. New Age International (P) Ltd., Publishers, 1998.

7 C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, 3rd Edition, PHI Learning, 2013.

Reference Books

1 D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.

2 Mukund R. Patel, Wind and Solar Power Systems, 2nd edition, CRC Press, 2005.

3 J. F. Manwell, J. G. McGowan, and A. L. Rogers, Wind Energy Explained: Theory, Design and Application, John Wiley and Sons, 2009.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Startup Registration and Development (22PEME7045T)		

Prerequisites:

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Course Objectives:

1. To Understand the startup registration process, legal structures, and compliance requirements.
2. To analyze government incentives, policies, and funding opportunities for startups.
3. To develop key business registration documents and compliance reports.
4. To assess intellectual property protection and its impact on startups.
5. To evaluate financial planning, fundraising, and investment strategies.
6. To ensure taxation, auditing, and regulatory compliance for startups.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Differentiate between various startup legal structures and their compliance requirements.	L4	Analyze
CO2	Evaluate government schemes, startup incentives, and funding policies.	L5	Evaluate
CO3	Assess essential business registration documents.	L5	Evaluate
CO4	Apply intellectual property protection strategies for business innovation.	L3	Apply
CO5	Develop financial models and fundraising strategies for startup sustainability.	L6	Create
CO6	Evaluate organizational practices against taxation, auditing, and corporate legal frameworks to maintain institutional compliance.	L5	Evaluate

Startup Registration and Development (22PEME7045T))

Course Contents

Unit-I **08 Hrs.**

Introduction to Startup Registration

Definition, Types, and Importance of Startups
Legal Structures: Proprietorship, LLP, Pvt. Ltd., Public Ltd.
Steps for Business Registration
Case Studies on Startup Registrations.

Unit-II **08 Hrs.**

Government Policies and Incentives for Startups

Overview of Startup India, MSME, and Other Government Schemes
Tax Benefits, Grants, and Financial Incentives
Public and Private Funding Support
Case Studies on Startups Using Government Incentives.

Unit-III **06 Hrs.**

Business Compliance and Documentation

Important Documents: MoA, AoA, GST Registration, UDYAM Certification
Business Licenses, Permits, and Compliance Reports
Understanding Business Ethics and Legal Challenges.

Unit-IV **06 Hrs.**

Intellectual Property Rights (IPR) for Startups

Types of Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets
Legal Framework and Filing Procedures (Startup India/IP India Portals)
Strategic Use of IP in Startup Growth and Fundraising
Licensing, Commercialization, and IP Monetization Techniques
Legal Aspects and Compliance for Engineering Startups
Case Studies on Startup IP Protection.

Unit-V **06 Hrs.**

Fundraising and Investment Strategies

Seed Funding, Angel Investors, Venture Capital, Crowdfunding
Investor Relations and Pitching Techniques
Understanding Term Sheets and Equity Dilution
Case Studies on Startup Fundraising.

Unit-VI **05 Hrs.**

Taxation, Compliance, and Business Growth

GST, Corporate Tax, and Financial Reporting
Auditing and Legal Risk Management
Business Growth and Exit Strategies (Mergers, Acquisitions, IPOs)
Final Startup Business Plan Development

Books Recommended

1 Purohit, Prachi. Startup India: The Complete Guide to Launching and Managing a Business. Notion Press, Chennai, 2021.

2 Joshi, M.V. Entrepreneurship Development and Startup India. Himalaya Publishing House, Mumbai, 2020.

3 Pathak, Akhileshwar. Legal Aspects of Business. McGraw Hill, New Delhi, 2018.

4 Hegde, Dinesh S. Indian Startups and their Funding Journey. Springer, New Delhi, 2021.

5 Sharma, Rajat. Business Laws for Entrepreneurs. Pearson, New Delhi, 2019.

6 Blank, Steve, and Bob Dorf. The Startup Owner's Manual. K&S Ranch Publishing, Pescadero, 2012.

7 Feld, Brad, and Jason Mendelson. Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist. Wiley, New Jersey, 2019.

8 Desai, Vasant. Entrepreneurship Development in India. Himalaya Publishing House, Mumbai, 2019.

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Big Data Analytics (22PEME7046T)		

Prerequisites:

1. Mathematics and Statistics.
2. Programming Fundamentals.
3. Fundamentals of Data Science and Machine Learning.
4. Mechanical Engineering Knowledge.

Course Objectives:

1. To study the fundamentals of big data analytics and its significance in mechanical engineering applications.
2. To explain various data acquisition, storage, and pre-processing techniques used in mechanical systems.
3. To explore statistical and machine learning techniques to analyze mechanical engineering data.
4. To impart the fundamentals of large datasets from mechanical systems using big data tools and frameworks such as Hadoop and Spark.
5. To evaluate the effectiveness of predictive maintenance and fault diagnosis models in mechanical engineering.
6. To be able to develop data-driven solutions for mechanical engineering problems using big data analytics techniques.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain big data concepts and their applications in mechanical engineering.	L2	Understand
CO2	Execute data collection, storage, and pre-processing protocols to manage high-fidelity datasets in mechanical engineering applications.	L3	Apply
CO3	Apply machine learning models to predict failures and optimize mechanical system performance.	L3	Apply
CO4	Analyze large-scale mechanical engineering datasets using big data tools like Apache Spark and Hadoop.	L4	Analyze
CO5	Evaluate different predictive analytics techniques for reliability assessment and fault detection in mechanical systems.	L5	Evaluate
CO6	Design a data-driven project related to mechanical engineering problems using big data analytics techniques.	L6	Create

Big Data Analytics (22PEME7046T)

Course Contents

Unit-I **06 Hrs.**

Introduction to Big Data and Analytics

- Definition and Characteristics of Big Data (Volume, Velocity, Variety, Veracity, and Value)
- Importance of Big Data in Mechanical Engineering
- Data Sources in Mechanical Engineering: IoT sensors, CAD/CAE simulations, Manufacturing, Maintenance logs
- Big Data vs. Traditional Data Processing
- Data security, risk mitigation, and life cycle assessment
- Case Studies: Predictive Maintenance in Industrial Machines.

Unit-II **06 Hrs.**

Data Acquisition, Storage, and Preprocessing

- Data Collection Methods: Sensors, IoT, SCADA, PLM Systems
- Data Storage Technologies: SQL vs NoSQL, Hadoop, HDFS, Apache Spark
- Data Preprocessing: Cleaning, Transformation, Feature Engineering
- Handling Missing Data and Outliers
- Introduction to Time-Series Data Processing in Mechanical Systems.

Unit-III **09 Hrs.**

Statistical Analysis and Machine Learning

- Descriptive Statistics: Mean, Median, Standard Deviation, Correlation
- Regression Models: Linear, and Multiple, Regression for Mechanical Data
- Classification Algorithms: Decision Trees, Support Vector Machines (SVM), k-NN
- Clustering Techniques: k-Means, DBSCAN, Hierarchical Clustering.

Unit-IV **06 Hrs.**

Big Data Tools and Frameworks

- Introduction to Hadoop and MapReduce
- Apache Spark for Real-time Data Processing
- Python Libraries for Big Data: Pandas, NumPy, SciPy, Scikit-learn
- Cloud Computing and Big Data: AWS, Google Cloud, Microsoft Azure
- Hands-on Session: Processing Mechanical Sensor Data using Spark.

Unit-V **06 Hrs.**

Applications in Mechanical Engineering

- Big Data in Manufacturing: Smart Factories, Industry 4.0, Digital Twins
- Condition Monitoring and Predictive Maintenance using IoT Data
- Fault Detection and Diagnosis in Mechanical Systems
- Big Data in CFD and FEA Simulations: Data-driven Optimization
- Hands-on Project: Analyzing Vibration Data for Predictive Maintenance.

Unit-VI **06 Hrs.**

Case Studies and Emerging Trends

- AI-Driven Predictive Analytics in Mechanical Engineering
- Applications in Autonomous Vehicles and Robotics
- Supply Chain Optimization in Manufacturing
- Ethical and Security Concerns in Big Data Applications
- Future Trends: Quantum Computing, Edge Computing, and Big Data

Books Recommended

Textbooks

1 M.Thangaraj, S. Suguna, G. Sudha, Big Data Analytics: Concepts, Techniques, Tools and Technologies, PHI Learning Pvt. Ltd., 2022.

2 B. L. S. Prakasa Rao, S. B. Rao, and Saumyadipta Pyne, Big Data Analytics: Methods and Applications, Springer India, 2016.

3 EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley, 2014.

4 David Loshin, Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, Morgan Kaufmann, 2013.

Reference Books

1 Edward L. Robinson, Data Analysis for Scientists and Engineers, Princeton University Press, 2016.

2 Parikshit N. Mahalle, Pravin P. Hujare, and Gitanjali Rahul Shinde, Predictive Analytics for Mechanical Engineering: A Beginners Guide, Springer Nature Singapore, 2023.

3 Venkat Ankam, Big Data Analytics, Packt Publishing, 2016.

4 Dina Darwish, Big Data Analytics Techniques for Market Intelligence, IGI Global, 2023.

5 Francesco Corea, Big Data Analytics: A Management Perspective, Springer International Publishing, 2016.

6 Mohammed Guller, Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis, Apress, 2015.

Web References

1 Algorithms for Big Data
`https://nptel.ac.in/courses/106106142`

2 Big Data Computing
`https://nptel.ac.in/courses/106104189`

Program: Mechanical Engineering	Final Y. B.Tech	Semester: VII
Product Life Cycle Management (22OEME7051T)		

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.	L2	Understand
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 Life Cycle Management (22OEME7051T)

Course Contents

Unit-I **09 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: 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.**

PDM & Virtual Product Development

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 **07 Hrs.**

Integration of Environmental Aspects in Product Design

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 **07 Hrs.**

Life Cycle Assessment and Life Cycle Cost Analysis

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 (22OEME7052T)		

Prerequisites:

Nil

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 needsof 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 the 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 (22OEME7052T)

Course Contents

Unit-I **03 Hrs.**

Foundation Concepts

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 **07 Hrs.**

Information Technologies

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 applications

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

Unit-V **07 Hrs.**

Social Computing (SC)

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.**

IT in Organizaion, Enterprise and Global Management

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 (22OEME7053T)		

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 real-world problems by converting them into Linear Programming Problems and analyzing the solutions obtained using the Simplex method or other algorithms.	L4	Analyze
CO2	Apply appropriate algorithms to identify real-world problems as Transportation Problems and Assignment Problems and address decision problems.	L3	Apply
CO3	Analyze time-varying decision situations and analyze them using the principles of dynamic programming in real-life situations.	L4	Analyze
CO4	Apply queuing theory concepts to identify the reasons for formation of queues, classify various queuing systems, and use defined system parameters for decision making in real-life situations.	L3	Apply
CO5	Apply decision-making concepts to competitive situations and determine appropriate strategies for two-person zero-sum games.	L3	Apply
CO6	Apply the concept of simulation and Monte Carlo simulation techniques to systems such as inventory and queuing, and determine solutions for them.	L3	Apply
CO7	Apply the concept of replacement policy to determine the optimal replacement age.	L3	Apply

Operations Research (22OEME7053T)

Course Contents

Unit-I **10 Hrs.**

Introduction & LPP

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 & 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 **05 Hrs.**

Dynamic Programming

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 & Game Theory

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 **06 Hrs.**

Simulation & 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 (22OEME7054T)		

Prerequisites:

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Course Objectives:

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

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain different types of cybercrime and security issues in E-Business.	L2	Understand
CO2	Analyzes different types of cyber threats and techniques for security management.	L4	Analyze
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 (22OEME7054T)

Course Contents

Unit-I **10 Hrs.**

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,, Phishing Identity Theft (ID Theft) ,How criminal plan the attacks, Social Engineering, Cyber stalking.

Unit-II **06 Hrs.**

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.

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

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 **09 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

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

Web References

1 The Information Technology ACT, 2008- TIFR
`https://www.tifrh.res.in`

2 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 (22OEME7055T)		

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 familarise the students with microfinance for accelerating the expansion of local microbusinesses.

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	Compute income from salaries, house property, business, capital gains, and other sources.	L3	Apply
CO3	Calculate the net CGST, SGST, and IGST payable after utilizing eligible input tax credit.	L3	Apply
CO4	Describe how Microfinance can help in financial inclusion.	L2	Understand

Personal Finance Management (22OEME7055T)

Course Contents

Unit-I **07 Hrs.**

Overview of Indian Financial System

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 **07 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 **09 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 **09 Hrs.**

Introduction to Micro – finance

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 (22OEME7056T)		

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 (22OEME7056T)

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 **09 Hrs.**

Energy Audit

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 & 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 **09 Hrs.**

Energy Management & 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 **06 Hrs.**

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.

Web References

1 `www.energymanagertraining.com`

2 `www.bee-india.nic.in`

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VII
Public Systems and Policies (22OEME7057T)		

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 (22OEME7057T)

Course Contents

Unit-I **09 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 **07 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 **11 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

A) National Defense, B) Highways, C) Outdoor Recreation, D) 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, 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
Science of Well-being (22OEME7058T)		

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 mal-practices 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.	L2	Understand
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.	L2	Understand
CO5	Analyze one's own coping mechanisms, assess their effectiveness, develop and strategize for betterment, and execute them.	L4	Analyze

Science of Well-being (22OEME7058T)

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 **09 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 **08 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. 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 (22OEME7059T)		

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.	L4	Analyze
CO3	Explain complex data or situations clearly.	L2	Understand
CO4	Analyze research findings.	L4	Analyze
CO5	Summarize a structured research report based on research findings.	L2	Understand

Research Methodology (22OEME7059T)

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 **09 Hrs.**

Research Methodology

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

Unit-III **09 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 **09 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 **05 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
Project Stage-II (22PJME7060L)		

Prerequisites:

–

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 (22PJME7060L)

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

The size of the report shall be a minimum of 25 pages. The Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details
- Project Stage-II Outcomes
- Conclusion
- 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

Each review consists of 50 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.

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VII
Full Stack Development Laboratory (22ESME7070L)		

Prerequisites:

1. Basic understanding of computers and web browsers
2. Familiarity with basic programming concepts (variables, loops, functions, etc.)

Course Objectives:

1. To introduce students to the fundamentals of web development using HTML, CSS, and JavaScript.
2. To provide in-depth knowledge of modern JavaScript (ES6+) features used in frontend development.
3. To enable students to build interactive user interfaces using React and its component-based architecture.
4. To develop skills in managing state, handling events, and using React Hooks for building dynamic applications.
5. To empower learners to build and deploy real-world React projects including a personal portfolio.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Design responsive web pages using HTML5, CSS, and modern layout techniques.	L6	Create
CO2	Apply core JavaScript and ES6+ features to build interactive web functionalities.	L3	Apply
CO3	Develop dynamic user interfaces using React components, props, state, and event handling.	L6	Create
CO4	Examine application state and side effects using React Hooks and advanced patterns.	L3	Apply
CO5	Build and deploy real-world React projects and a personal portfolio showcasing frontend skills.	L6	Create

Full Stack Development Laboratory (22ESME7070L)

Course Content

Unit-I **08 Hrs.**

Learn React JS for Front-end development

ES6+ Features: Let and Const (Replacing var), Arrow functions, Promises (async /await), Spread / Rest operators, Destructuring.
Javascript Functions: Array Map Method, JavaScript for Each Method, JavaScript Filter() Method, JavaScript Reduce Method.
React Fundamentals: About React, About JSX in React, Components in React, Iteration in React, Conditional Rendering, Range Utility & styling in React.
Working With State in React: Event Handlers, The use State Hook, Forms in React, Props Vs. State.
React Hooks: About Hooks, Immutability Revisited & Refs, Side Effects, Custom hooks & Data Fetching, Memoization.
Project - Interactive Forms with Dynamic Tabs
Project - The Job Application Form.
Component API Design : The Spectrum of Components, Polymorphism & Compound Components, React Context, Understanding Modals
Portfolio Project - Portfolio Website
Project - 2048 Game
Advanced Patterns and Smarter State in React : React State and Visual Updates, Smarter Component Design in React, Managing Complex State with use Reducer, Advanced UI and Safe State Updates in React.

Unit-II **06 Hrs.**

Learn HTML / CSS

Introduction to HTML : Introduction to HTML tags and structure, List / Images / Links / Table using HTML, Semantic HTML, Project: HTML.
Introduction to CSS : Ways to style using CSS, CSS selectors and properties, CSS layout and positioning - Box model,Project: CSS.

Unit-III **14 Hrs.**

Learn Javascript

Output / Print in JavaScript : Introducing output/printing, Printing on multiple lines, Print text and numbers using single print
Variables & datatypes : Introduction to variables & datatypes, Boolean data type & negative numbers.
Strings :Introduction to strings, Functions in JavaScript.
Functions, Use functions in problems
Conditional statements: Intro to if / else, Combining conditions - And / or
Debug your code : Learn to debug common errors, Practice debugging.
Arrays : Introduction to arrays, Loops : While loops, For loops, Break / continue.
ES6+ Features in JavaScript :Introduction to let and const, Arrow Functions, Spread and Rest Operators, Destructuring in JavaScript.
User Inputs : take user input
Algorithmic problems : test cases, custom inputs

Full Stack Development Laboratory (22ESME7070L)

Suggested Experiments

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1 Creation of HTML Skeleton

2 Creation of a Paragraph in HTML

3 Add the elements in HTML - images and videos. Links to external websites, Create lists, Add tables

4 Use semantic HTML

5 Do inline styling in CSS

6 Create a style sheet in CSS - internal and external

7 Use class / ID selector in CSS

8 Do font stying in CSS

9 Do layout and positioning in CSS

10 Printing a number/text in JS

11 Arithmetic Operations in JS

12 Inserting text Between Outputs in JS

13 Create and Declare Variables in JS

14 Use of String datatype/Float Datatype

15 Create a boolean variable

16 Use a function in JS

17 Call a function within a function

18 Render Dynamic Data in JSX

19 Do Inline Styles in JSX

20 Update the given React component to display dynamic values and additional information inside the in React

21 Create a basic react component in React

22 Create flexible and reusable components in React

23 Create a component with an input field and two buttons in React

24 Interact with DOM elements and handle side effects in React using useRef and useEffect

25 Handle Form Submissions with Fetch in React

Minimum 25 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended

Textbooks

1 A. Banks and E. Porcello, Learning React: Modern Patterns for Developing React Apps, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2020.

Reference Books

1 S. Stefanov, React – Up & Running: Building Web Applications, Sebastopol, CA, USA: O'Reilly Media, 2016.

2 A. Accomazzo, N. Murray, A. Lerner, C. Blank, and D. Gallo, Fullstack React: The Complete Guide to ReactJS and Friends, San Francisco, CA, USA: Fullstack.io, 2017.

3 D. Crockford, JavaScript: The Good Parts, Sebastopol, CA, USA: O'Reilly Media, 2008.

4 M. Haverbeke, Eloquent JavaScript: A Modern Introduction to Programming, 3rd ed. San Francisco, CA, USA: No Starch Press, 2018.

5 J. Duckett, HTML and CSS: Design and Build Websites, Indianapolis, IN, USA: Wiley, 2011.

Shirpur Education Society's

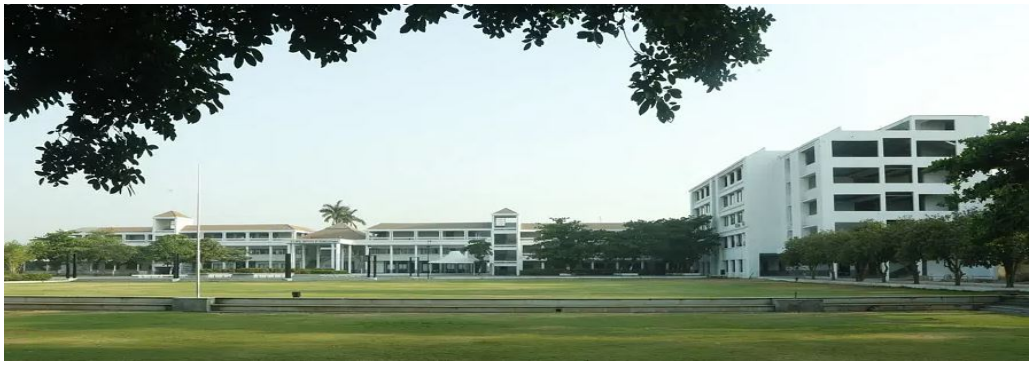
R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Syllabus Details of Semester-VIII

Final Year B.Tech in Mechanical Engineering

(RCP22 Scheme) with effect from Year 2025-26



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
Industrial Engineering and Management (22PEME8011T)		

Prerequisites:

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

Course Objectives:

1. To introduce Industrial Engineering foundations, productivity concepts, and value engineering for efficiency improvement.
2. To build skills in work study, ergonomics, and system design for optimizing human–machine interaction and workplace performance.
3. To provide knowledge of facility planning, layout design, line balancing, and agile/lean practices for sustainable resource utilization.
4. To understand the principles and practices of Quality Management, including Quality Circles, TQM and apply them in real-world scenarios.

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.	L2	Understand
CO2	Develop ability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.	L3	Apply
CO3	Implement different concepts involved in method study in different situations.	L3	Apply
CO4	Describe different aspects of work system design and facilities design pertinent to manufacturing industries.	L2	Understand
CO5	Describe concepts of Agile manufacturing, Lean manufacturing and Flexible manufacturing.	L2	Understand
CO6	Evaluate organizational case studies to recommend evidence-based continuous improvement strategies using TQM and Quality Circles.	L5	Evaluate

Industrial Engineering and Management (22PEME8011T)

Course Contents

Unit-I **07 Hrs.**

Introduction to Industrial Engineering

- History and contribution of Industrial Engineering, Industrial Engineering approach to problem solving and system improvement.
- Definition and concept of Productivity.
- Productivity measurements: partial, total, multifactor productivity.
- Factors influencing productivity: Organizational and managerial aspects, Environmental and social influences.
- Productivity improvement techniques.
- Value Engineering and Value Analysis: Distinction between value engineering and value analysis, Significance, and role in cost reduction and efficiency improvement.
- Steps in value engineering and analysis.
- Checklists for systematic implementation.

Unit-II **08 Hrs.**

Work Study

- Method study: Definition and objectives, Steps in method study
- Micro-motion study, Principles of motion economy
- Therbligs: elemental motions in work study
- Time study: objectives, equipment, procedure.
- Work sampling: applications, methodology.
- Standard data: development and application.
- Predetermined Motion Time Systems (PMTS): concept and use.
- Maynard Operation Sequence Technique (MOST): principles and applications.

Unit-III **07 Hrs.**

Work System Design

- Introduction to ergonomics and its scope in relation to work.
- Anatomy, physiology, and psychology: relevance to ergonomics.
- Ergonomics building blocks: Anthropometry- measurement and application in workplace design, Biomechanics: human body mechanics in work.
- Industrial Psychology: Concept, Aims and objectives, Scope in industrial settings.
- Job evaluation: purpose, methods.

- Merit rating: individual performance assessment.
- Incentive schemes: types and applications.
- Wage administration: principles and methods.
- Business process re-engineering (BPR): objectives and process.

Unit-IV **07 Hrs.**

Facility Design

- Factors affecting location decisions, Evaluation of alternative locations (qualitative and quantitative techniques).
- Plant layout: Types of layouts (product, process, fixed-position, cellular, hybrid), Evaluation of layouts, Computer-aided layout design techniques.
- Line Balancing: Objectives and constraints, Terminology in assembly line.
- Heuristic methods: Kilbridge-Wester method, Largest Candidate Rule, and Rank Positional Weight method.
- Materials handling systems: principles, equipment, and Automated Guided Vehicles (AGVs).
- Group Technology (GT) and Cellular Manufacturing concepts.

Unit-V **06 Hrs.**

Agile Manufacturing

- Introduction to Agile Manufacturing: need and concept.
- Developing agile manufacturing systems.
- Integration of Product and Process Development.
- Application of IT/IS concepts in agile systems.
- Agile supply chain management.
- Design of skills and knowledge in workforce development.
- Computer control of agile manufacturing.
- Flexible manufacturing systems (FMS): features and applications.
- Lean Manufacturing: principles and practices.
- Value Stream Mapping (VSM): process, tools, and applications.
- Industry 5.0 and Cyber physical systems

Unit-VI **07 Hrs.**

Quality Management

- History and fundamentals of Quality Management,
- Quality function deployment, Quality circle.
- Total Quality Management and TQM case studies.

Books Recommended

Textbooks

1 Ravi Shankar, Industrial Engineering and Management, Galgotia Publications Pvt Ltd ,June 2000

Reference Books

1 Apple, James M., Plant Layout and Material Handling, John Wiley & Sons, New York, 1977.

2 Besterfield, Dale H. et al., Total Quality Management, Prentice Hall, New Jersey, 2011.

3 Elion, Samuel, Production Planning and Control, Prentice Hall, New Jersey, 1987.

4 Francis, Richard L. & White, John A., Facility Layout and Location – An Analytical Approach, Prentice Hall, New Jersey, 1974.

5 International Labour Organization (ILO), Introduction to Work Study, Oxford & IBH Publishing Co. Pvt. Ltd., Geneva/New Delhi, 1978.

6 Juran, J. M. & Gryna, F. M., Quality Planning and Analysis, Tata McGraw-Hill, New Delhi, 1993.

7 Menon, H. G., TQM in New Product Manufacturing, Tata McGraw-Hill, New Delhi, 1992.

8 Monks, Joseph G., Production and Operations Management, McGraw-Hill, New York, 1982.

9 Murrell, K. F. H., Ergonomics at Work, Taylor & Francis, London, 1965.

Web References

1 www.nptel.ac.in

2 https://www.smartzworld.com/notes/management-and-enterpreneurship-notes-me-vtu/

3 https://www.maggubhai.com/management-process-organising-and-staffing/

4 https://tutorstips.com/difference-between-directing-and-controlling/

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Automation and IoT (22PEME8012T)		

Prerequisites:

1. Fundamentals of Mechanical, Electrical, and Electronics Engineering.
2. Basics of Control Systems and Mechatronics.
3. Programming skills in C/Python/Arduino.
4. Basic knowledge of Computer Networks and Sensors.

Course Objectives:

1. To introduce the fundamentals of automation and IoT technologies in mechanical engineering applications.
2. To develop an understanding of sensors, actuators, and communication protocols for IoT-based systems.
3. To study automation tools like PLC, SCADA, and their integration with IoT.
4. To apply data analytics, cloud computing, and cybersecurity principles to IoT systems.
5. To analyze real-world industrial case studies in smart manufacturing and predictive maintenance.

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 role of automation and IoT in Industry 4.0 and smart manufacturing.	L2	Understand
CO2	Apply the principles of sensors, actuators, and controllers for industrial automation.	L3	Apply
CO3	Design IoT-enabled systems using microcontrollers and communication protocols.	L6	Create
CO4	Analyze industrial processes using PLC, SCADA, and IoT integration.	L4	Analyze
CO5	Evaluate the benefits and challenges of cloud-based monitoring and predictive maintenance.	L5	Evaluate
CO6	Assess security, scalability, and sustainability challenges in IoT-enabled automation systems.	L5	Evaluate

Automation and IoT (22PEME8012T)

Course Contents

Unit-I **08 Hrs.**

Introduction to Automation and IoT

- Overview of Automation and IoT in Industry 4.0.
- Evolution of automation technologies.
- Role of IoT in mechanical engineering systems.
- Case studies: Smart manufacturing, automotive, healthcare.

Unit-II **08 Hrs.**

Sensors, Actuators, and Controllers

- Sensors: Temperature, vibration, pressure, proximity, flow.
- Actuators: Pneumatic, hydraulic, and electrical actuators.
- Controllers: Arduino, Raspberry Pi, ESP32.
- Interfacing basics with industrial systems.

Unit-III **08 Hrs.**

Communication Technologies for IoT

- IoT architecture and layers.
- Communication protocols: MQTT, OPC-UA, Modbus, Zigbee, 5G.
- Edge, Fog, and Cloud computing.
- IoT data pipelines.

Unit-IV **09 Hrs.**

Industrial Automation Systems

- Programmable Logic Controllers (PLC): Architecture, ladder logic.
- Supervisory Control and Data Acquisition (SCADA) systems.
- Integration of PLC/SCADA with IoT.
- Case studies: Automated production line, robotics in manufacturing.

Unit-V **09 Hrs.**

Data Analytics, Cybersecurity, and Emerging Trends

- IoT data analytics and predictive maintenance.
- Cloud platforms for IoT: AWS, Azure, ThingWorx.
- Cybersecurity issues in IoT-based automation.
- merging trends: Digital twins, AR/VR, blockchain in IoT.

Books Recommended

Textbooks

1 Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.

2 Ovidiu Vermesan & Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013.

3 Mukesh Kumar & Ravi Joshi, Industrial Automation and Robotics, PHI Learning, 2021.

Reference Books

1 Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Elsevier, 2014.

2 John Soldatos, Building Blocks for IoT Analytics, River Publishers, 2017.

3 Frank Lamb, PLC Control Systems for Industrial Automation, McGraw Hill, 2013.

Web References

1 IoT and Digital Twins: https://nptel.ac.in/courses/106105166

2 NPTEL Course on Industrial Automation and Control: https://nptel.ac.in/courses/108105062

3 NPTEL Course on IoT: https://nptel.ac.in/courses/106105166

4 Coursera – Industrial IoT Fundamentals: https://www.coursera.org/learn/industrial-internet-of-things

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Sustainable Manufacturing (22PEME8013T)		

Prerequisites:

1. Fundamentals of manufacturing processes, materials science, and energy systems.
2. Basics of sustainability principles, optimization techniques, and data analysis.

Course Objectives:

1. Introduce the fundamental concepts of sustainable manufacturing and its significance in modern industry.
2. Analyze the environmental, economic, and social impacts of manufacturing processes.
3. Equip students with tools and methodologies for assessing and improving the sustainability of products and processes.
4. Explore advanced topics such as life cycle analysis, green supply chain management, and sustainable product design.
5. Encourage critical thinking and problem-solving skills to develop innovative solutions for sustainable manufacturing challenges.

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 principles and importance of sustainable manufacturing.	L2	Understand
CO2	Analyze environmental impact assessments using LCA methodologies, carbon footprint analysis, and regulatory frameworks.	L4	Analyze
CO3	Apply sustainable design methodologies integrating material selection, product life cycle optimization, and end-of-life strategies.	L3	Apply
CO4	Evaluate energy optimization strategies and sustainable technologies to justify their impact on manufacturing efficiency and waste minimization.	L5	Evaluate
CO5	Develop resilient and circular supply chain models incorporating green logistics, ethical sourcing, and digital transparency.	L6	Create
CO6	Evaluate sustainability metrics, frameworks, and regulations while exploring emerging technologies and future trends in sustainable manufacturing.	L5	Evaluate

Sustainable Manufacturing (22PEME8013T)

Course Contents

Unit-I **06 Hrs.**

Introduction to Sustainable Manufacturing

Definition and significance, three pillars of sustainability: environmental, economic, and social. Comparison between traditional and sustainable manufacturing practices. global trends and drivers for adopting sustainable manufacturing, role of Industry 4.0 and digitalization in sustainability, sustainability challenges, and future scope.

Unit-II **06 Hrs.**

Environmental Impact Assessment and Life Cycle Analysis (LCA)

Introduction to environmental impact assessment methodologies. Life cycle analysis (LCA): principles, phases, types, and applications. Tools and software for conducting LCA, carbon footprint analysis, and case studies on LCA in manufacturing industries

Unit-III **08 Hrs.**

Sustainable Product Design and Development

Eco-design principles, integration of Circular Economy principles in product design, biomimicry, and material innovation. Design for Environment (DFE), design for disassembly (DFD), and remanufacturing strategies. Application of additive manufacturing in sustainable design, extended producer responsibility (EPR) and regulatory aspects, and case studies on sustainable product innovations.

Unit-IV **08 Hrs.**

Green Manufacturing Processes and Technologies

Energy-efficient and waste-minimization techniques, lean and six sigma for sustainability, renewable energy integration in manufacturing, advanced and hybrid manufacturing approaches, metrics and key performance indicators, case studies on sustainable manufacturing implementation.

Unit-V **08 Hrs.**

Sustainable Supply Chain and Operations Management

Green procurement, sourcing strategies, circular economy principles, recycling, and reuse of finished products. Reverse logistics and end-of-life product management. Sustainable logistics, digital transformation, and blockchain for supply chain transparency. Corporate social responsibility in manufacturing. Industry case studies on sustainable supply chain models.

Unit-VI **06 Hrs.**

Sustainable Manufacturing Metrics, Policies, and Future Trends

Key performance indicators, standards, and sustainability assessment methods, government policies, industry regulations, incentives, role of AI, IoT, and digital twins.

Books Recommended

Textbooks

1 Umeda, Y., Fukushige, S., & Kondoh, S., Sustainable Manufacturing: An Introduction, Springer, 2022.

2 Jawahir, I. S., & Dillon, O. W. (Eds.), Sustainable Manufacturing: The Path to a Circular Economy, Springer, 2019.

3 Jayal, A. D., Badurdeen, F., Dillon, O. W., & Jawahir, I. S., Sustainable Manufacturing: Modeling and Optimization Challenges at the Product, Process and System Levels, Springer, 2013.

4 Sutherland, J. W., Jawahir, I. S., & Brocchi, E. (Eds.), Progress in Sustainable Manufacturing, Springer, 2018.

5 Low, J. S. C., & Ong, S. K. (Eds.), Sustainable Manufacturing and Remanufacturing Management: Enhancing Knowledge through Lifecycle Thinking, Springer, 2014.

6 Dornfeld, D. A. (Ed.), Green Manufacturing: Fundamentals and Applications, Springer Science & Business Media, 2012.

7 Ashby, M. F., Materials and the Environment: Eco-informed Material Choice, Elsevier, 2012.

Reference Books

1 Hauschild, M. Z., Rosenbaum, R. K., & Olsen, S. I. (Eds.), Life Cycle Assessment: Theory and Practice, Springer, 2018.

2 Seidel, M. (Ed.), Green Supply Chain Management: Product Life Cycle Approach, Springer, 2017.

3 Allwood, J. M., & Cullen, J. M., Sustainable Materials: With Both Eyes Open, UIT Cambridge, 2012.

4 Atkinson, G., Dietz, S., & Neumayer, E., Handbook of Sustainable Manufacturing, Edward Elgar Publishing Limited, 2007.

5 Fiksel, J., Design for Environment: A Guide to Sustainable Product Development, McGraw Hill, 2009.

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Motorsports Engineering (22PEME8014T)		

Prerequisites:

1. Knowledge of materials technology (metallic and non-metallic materials).
2. Basics of Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD).
3. Fundamentals of automotive prime movers.
4. Fundamentals of electronics devices and sensors.

Course Objectives:

1. To provide knowledge of advanced materials and their manufacturing techniques applied in motorsport vehicles.
2. To enable learners to understand and apply scientific and engineering principles that govern high performance in motorsports.
3. To develop skills in design, structural analysis, and optimization techniques for competition vehicles.
4. To impart analysis and optimization skills for vehicle powertrain, transmission, aerodynamics and data acquisition technologies relevant to motorsport engineering.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Evaluate the performance specifications of metallic and non-metallic materials to justify their selection for diverse motorsport applications.	L5	Evaluate
CO2	Apply design and simulation techniques to analyze and evaluate motorsport vehicle structures.	L4	Analyze
CO3	Analyze vehicle stability using tire dynamics, suspension geometry, and control systems.	L4	Analyze
CO4	Design of high-performance motorsport powertrains to optimize vehicle performance.	L6	Create
CO5	Analyze the performance of motorsport aerodynamics components.	L4	Analyze
CO6	Describe the need for data acquisition and analysis in motorsports.	L2	Understand

Motorsports Engineering (22PEME8014T)

Course Contents

Unit-I **08 Hrs.**

Introduction to Advanced Materials, Application, and Manufacturing

History of motorsport and its development; Competition vehicle categories; sporting and technical regulations.
The physical and metallurgical properties of high-strength steels, stainless steels, metal matrix composites, aluminium, titanium alloys, rubbers, elastomers, plastics, and honeycomb structures.
Case studies on the application of advanced materials in the motorsport industry, which includes material forms, performance, selection, advanced manufacturing technologies, and joining techniques in the context of motorsports.

Unit-II **08 Hrs.**

Design, Analysis, and Optimization of Competition Vehicles

Introduction to structural design principles for competition vehicles; finite element modelling and simulation for structural analysis; shape and topology optimization methods; identification and analysis of common structural failure modes; non-destructive testing (NDT) techniques.

Unit-III **10 Hrs.**

Vehicle Stability

Concept of vehicle stability and controllability; tire mechanics and force generation, slip angle, cornering stiffness, and tire models; suspension geometry and chassis interactions; role of springs, dampers, and anti-roll bars in stability; longitudinal and lateral stability including understeer, oversteer, rollover, and load transfer; stability control systems (ABS, TCS, ESP, active suspension and steering); introduction to differentials and brake balancing simulation tools.

Unit-IV **06 Hrs.**

Powertrains in Motorsport

Role and evolution of powertrain, features of high performance of SI, CI engines, performance optimizations, tuning of intake, exhaust, fuel systems, turbocharging, combustion, etc, importance of dyno and simulation data analysis.
Transmission systems, gear ratios analysis and optimization, engine matching, shift point, and max. top speed estimation.
Hybrid and electric powertrains employed in motorsports. Sustainable and future technologies.

Unit-V **05 Hrs.**

Motorsport Aerodynamics

Role of aerodynamics in motorsports, evolution of aero components, boundary layers, flow regimes, pressure distribution, lift/downforce, drag, side forces, and their analysis. Aerodynamic devices: Airfoil design, characteristics, function and tuning, drag and downforce optimization, DRS, vortex generators, and active aero.

Introduction to CFD tools, importance, meshing strategies, modeling, and simulation setup for motorsport applications, wind tunnels, flow visualization techniques, and motorsport regulations.

Unit-VI **05 Hrs.**

Data Acquisition and Analysis in Motorsports

Role of data in modern racing, system overview of ECUs, sensors, data loggers and telemetry, sensor calibration, data logging software, signal conditioning and filters, data analysis of powertrain, vehicle dynamics, driver performance, importance of real-time data and telemetry in race strategy optimization and live tuning.

Books Recommended

Reference Books

1 Andrew Livesey, Advanced Motorsport Engineering, Routledge, London, 2012.

2 Simon McBeath, Competition Car Composites: A Practical Handbook, Veloce Publishing, Dorchester, 2016.

3 John C. Dixon, Suspension Geometry and Computation, John Wiley & Sons, Hoboken (NJ), 2009.

4 William F. Milliken and Douglas L. Milliken, Race Car Vehicle Dynamics, SAE International, Warrendale (PA), 1995.

5 Herb Adams, Chassis Engineering: Chassis Design, Building & Tuning for High Performance Cars, HP Books/Penguin Publishing Group, London, 1993.

6 Michael F. Ashby, Materials Selection in Mechanical Design, Butterworth-Heinemann, Burlington, 2005.

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Project Management (22PEME8015T)		

Prerequisites:

1. Basic concepts of Management.

Course Objectives:

1. To familiarize the students with the use of a structured methodology/approach for every unique project undertaken, utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

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 project management life cycle and the various project phases, as well as the role of the project manager.	L2	Understand
CO2	Apply selection criteria and select an appropriate project from different options.	L3	Apply
CO3	Create a work breakdown structure for a project and develop a schedule based on it. Manage project risk strategically.	L6	Create
CO4	Evalute the project performance and status by justifying results derived from Earned Value techniques.	L5	Evaluate
CO5	Analyze project phase data to identify and document lessons learned for future organizational reference.	L4	Analyze

Project Management (22PEME8015T)

Course Contents

Unit-I **08 Hrs.**

Project Management Foundation

Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical), Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Introduction to project leadership, ethics in projects, Multicultural and virtual projects, Project management in various organizational structures, PM knowledge areas as per the Project Management Institute (PMI).

Unit-II **08 Hrs.**

Initiating Projects

How to get a project started, selecting a project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating a charter, Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.

Unit-III **10 Hrs.**

Project Planning

Work Breakdown Structure (WBS) and linear responsibility chart, Project cost estimation and budgeting, top-down and bottom-up budgeting. Networking and Scheduling techniques, PERT, CPM, Crashing project time, Resource loading and levelling, Goldratt's critical chain, GANTT chart, Project Stakeholders and Communication plan, Introduction to Project Management Information System (PMIS). Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks.

Unit-IV **08 Hrs.**

Monitoring and Controlling Projects

Planning, monitoring, and controlling cycle, Information needs and reporting, engaging all stakeholders of the projects, communication, and project meetings. With Earned Value Management techniques for measuring the value of work completed, using milestones for measurement, change requests, and scope creep, Project audit. Project Contracting Project procurement management, contracting and outsourcing.

Unit-V **08 Hrs.**

Closing the Project

Customer acceptance, Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report, doing a lessons learned analysis, acknowledging successes and failures.

Books Recommended

Textbooks

1 Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India.

2 Project Management: The Managerial Process, 6th edition, Erik Larson, Clifford Gray, McGraw Hill Education.

Reference Books

1 A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed. Project

2 Management Institute PA, USA.

3 Project Management, Gido Clements, Cengage Learning.

4 Project Management, Gopalan, Wiley India.

5 Project Management, Dennis Lock, 9th Edition, Gower Publishing England.

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Entrepreneurship Development and Management (22PEME8016T)		

Prerequisites:

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Course Objectives:

1. To develop entrepreneurial abilities by providing background information about support systems, skill sets, financial and risk covering institutions.
2. To appraise the students with the fundamentals that can help them make the right decisions for.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Develop idea generation, creative and innovative skills.	L6	Create
CO2	Prepare a Business Plan.	L6	Create
CO3	Compare different entrepreneur-supporting institutions.	L4	Analyze
CO4	Correlate a suitable MSME scheme for an entrepreneur.	L4	Analyze
CO5	Interpret the financial and legal aspects of a business.	L4	Analyze

Entrepreneurship Development and Management (22PEME8016T)

Course Contents

Unit-I **08 Hrs.**

Meaning of Entrepreneur

Evolution of the concept, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur- an emerging class, Concept of Entrepreneurship, Evolution of Entrepreneurship Development of Entrepreneurship Entrepreneurial, Culture Stages in the entrepreneurial process: Develop idea generation, creative, and innovative skills

Unit-II **08 Hrs.**

Business Planning Process

Meaning of business plan, Business plan process, Advantages of business planning Marketing plan, Production/operations plan, Organization plan, Financial plan, Final Project Report with Feasibility Study, Preparing a model project report for starting a new venture.

Unit-III **08 Hrs.**

Institutions Supporting Entrepreneurs

Small industry financing in developing countries, A brief overview of financial institutions in India, Central level and state level institutions - SIDBI-NABARD-IDBI-SIDCO, Indian Institute of Entrepreneurship System. District Industries Centers - Single Window.

Unit-IV **09 Hrs.**

Micro, Small, and Medium Enterprises (MSMES)

MSMEs - Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes, Forms of Business; Make-In India, Start-Up India, Stand-Up India. Women Entrepreneurship; Rural Entrepreneurship; Family Business and First-Generation Entrepreneurs.

Unit-V **09 Hrs.**

Finance, Accounting, Costing, and Legal Aspects of Business

Funding new ventures: Conventional Source of Finance, bootstrapping, crowd sourcing- angel investors, VCs, debt financing, due diligence, Legal aspects of business (IPR, GST, Labour law)- Cost, volume, profit, and break-even analysis - Margin of safety and the degree of operating leverage. Capital budgeting for comparing projects or opportunities, Product costing- Product pricing- Introduction to financial statements - Profit & Loss statement, Balance sheet - Cash flow-Closure of Business

Books Recommended

Reference Books

1 Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization - by Robert D. Hisrich Veland Ramadani, Springer Publication (2017)

2 Entrepreneurship-Theory, Process Practice -by Donald F.Kuratko, Cengage Learning(2014)

3 Entrepreneurship 6/E-by Robert D. Hisrich McGraw-Hill Education (India) (2011)

4 Entrepreneurship and small business- by Burns, P. New Jersey: Palgrave. (2001).

5 Innovation and entrepreneurship by Drucker. F. Peter, Harper business, (2006).

6 Entrepreneurship development small business enterprises, Poornima M Charantimath Pearson Publication (2013)

7 Entrepreneurial Development -Jayshree Suresh, Margham Publishers, Chennai

8 The Design of Business- by Martin Roger, Harvard Business Publishing (2009)

9 Entrepreneurship-by Roy Rajiv Oxford University Press (2011)

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Business Analytics (22PEME8021T)		

Prerequisites:

1. Basic knowledge of statistics and probability.
2. Fundamentals of programming and data handling.

Course Objectives:

1. To understand the fundamental concepts, processes, and types of business analytics and their applications across industries.
2. To develop the ability to manage, pre-process, and visualize data using appropriate tools and technologies for informed decision-making.
3. To be able to apply statistical methods, predictive modeling, and machine learning techniques to analyze and interpret business data.
4. To formulate prescriptive analytics models for optimization and decision support in real-world business contexts.
5. To evaluate emerging trends, ethical considerations, and industry practices in business analytics for strategic advantage.

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 role and scope of business analytics in supporting organizational decision-making.	L2	Understand
CO2	Organize structured and unstructured data using SQL, Python, R, and visualization tools.	L3	Apply
CO3	Perform descriptive, predictive, and prescriptive analytics using statistical and machine learning techniques.	L3	Apply
CO4	Design dashboards, reports, and visualizations to communicate analytical findings effectively.	L6	Create
CO5	Develop business analytics models for applications such as customer churn prediction, segmentation, and risk detection.	L6	Create
CO6	Analyze industry trends, implement best practices, and address ethical and privacy considerations in business analytics projects.	L5	Evaluate

Business Analytics (22PEME8021T)

Course Contents

Unit-I **07 Hrs.**

Fundamentals of Business Analytics

- Introduction to business analytics: Definition, need, importance, and evolution
- Mechanical datasets (e.g., CNC sensor logs, HVAC energy data)
- Introduction to database management
- Types of analytics: descriptive, diagnostic, predictive, prescriptive
- Business intelligence vs. Business analytics
- Data-driven decision-making and business applications of analytics
- Big data, AI, and ML in business analytics
- Applications and case studies

Unit-II **07 Hrs.**

Business Analytics Process and Tools

- Business analytics process: Data collection, cleaning, analysis, and interpretation
- Tools and technologies: Overview of Python, R, SQL, Tableau, Power BI, and Excel for industry-standard reporting
- Data types and sources: Structured vs. unstructured data, internal vs. external data
- Databases and data warehousing: OLTP vs. OLAP, Extract, Transform, Load (ETL)
- SQL for data management: Basics of relational databases, normalization, SQL queries
- Jupyter Notebooks, Visual Studio code, and GitHub for documentation and collaboration.

Unit-III **07 Hrs.**

Descriptive Analytics and Data Visualization

- Data visualization: principles of effective visualization, tools, dashboards, and reporting tools
- Descriptive analytics: Data summarization, central tendency, dispersion, data distributions
- Exploratory Data Analysis (EDA): Identifying patterns and trends

Unit-IV **07 Hrs.**

Predictive Analytics and Statistical Modeling

- Introduction to predictive analytics: Concepts and applications
- Statistics for analytics: Probability distributions, hypothesis testing, confidence intervals
- Regression analysis: Simple and multiple linear regression, logistic regression
- Time series forecasting: ARIMA, exponential smoothing

- Classification techniques: Decision trees, random forest, SVM
- Clustering techniques: K-means, hierarchical clustering
- Model evaluation metrics: RMSE, R-squared, ROC curve, confusion matrix
- Applications and case studies

Unit-V **07 Hrs.**

Advanced Machine Learning and Prescriptive Analytics

- Machine learning in BA: Supervised vs. unsupervised learning
- Neural Networks (NN): Basics, topology, training algorithms
- Optimization models
- Recommendation systems: Collaborative filtering, content-based filtering
- Prescriptive analytics: Optimization for decision-making, supply chain analytics
- Applications and case studies

Unit-VI **07 Hrs.**

Applications, Trends, and Ethics in Business Analytics

- Text mining and sentiment analysis: Natural Language Processing (NLP) for business insights
- Social media and web analytics: Google analytics, customer sentiment analysis
- Risk and fraud analytics: Credit risk modeling, fraud detection techniques
- Ethical considerations and data privacy in BA
- Emerging trends: AI-driven analytics, cloud-based analytics, edge computing
- Model deployment practices using Flask or Streamlit
- Applications and case studies

Note : Applications, numerical, and case studies should be related to mechanical and allied engineering domains only.

Books Recommended

Textbooks

1 Foster Provost & Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media, Sebastopol, USA, 2nd Edition, 2013.

2 S. Christian Albright & Wayne L. Winston, Business Analytics: Data Analysis & Decision Making, Cengage Learning, Boston, USA, 6th Edition, 2016.

3 Ramesh Sharda, Dursun Delen & Efraim Turban, Business Intelligence, Analytics, and Data Science: A Managerial Perspective, Pearson, London, UK, 5th Edition, 2024.

4 Galit Shmueli, Peter C. Bruce, Nitin R. Patel & Mia Stephens, Machine Learning for Business Analytics, Wiley, Hoboken, USA, 2nd Edition, 2023.

5 James Evans, Business Analytics: Methods, Models, and Decisions, Pearson, London, UK, 2nd Edition, 2015.

Reference Books

1 Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, O'Reilly Media, Sebastopol, USA, 2nd Edition, 2017.

2 Trevor Hastie, Robert Tibshirani & Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer, New York, USA, 2nd Edition, 2009.

3 Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, Hoboken, USA, 1st Edition, 2014.

4 Hadley Wickham & Garrett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, Sebastopol, USA, 1st Edition, 2017.

5 Ian H. Witten, Eibe Frank & Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, Burlington, USA, 4th Edition, 2016.

Web References

1 Business Analytics For Management Decision : https://nptel.ac.in/courses/110105089

2 Business Intelligence & Analytics : https://nptel.ac.in/courses/106106361.

3 Business Analytics & Text Mining Modeling Using Python: https://nptel.ac.in/courses/110107129.

4 Business Analytics & Data Mining Modeling Using R Part II: https://nptel.ac.in/courses/110107095.

5 Introduction to Business Analysis for Engineers: https://nptel.ac.in/courses/110106050.

6 Business Statistics : https://nptel.ac.in/courses/110107114

7 Business analytics and data mining Modeling using R : https://nptel.ac.in/courses/110107092.

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Energy Audit and Management (22PEME8022T)		

Prerequisites:

1. Fundamentals of mechanical, electronics, and electrical engineering.
2. Fundamentals of chemistry, physics, and engineering mechanics.

Course Objectives:

1. To emphasize the significance of energy security and sustainability in industrial and commercial applications.
2. To explore various methodologies used in energy audits and understand their practical implications.
3. To evaluate and optimize the energy performance of electrical and thermal systems for enhanced efficiency.
4. To analyze energy data effectively to identify opportunities for reducing energy consumption.
5. To apply energy management strategies for industrial, commercial, and residential applications.

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 present energy scenario and the importance of energy security and conservation.	L2	Understand
CO2	Demonstrate knowledge of the principles, methodologies, and significance of energy audits.	L2	Understand
CO3	Assess and improve the energy performance of electrical installations to identify conservation opportunities.	L5	Evaluate
CO4	Evaluate the energy efficiency of thermal installations and propose optimization measures.	L5	Evaluate
CO5	Analyze energy audit data and recommend strategies for enhancing energy efficiency and sustainability.	L5	Evaluate
CO6	Apply financial analysis techniques for assessing energy-saving investments and project feasibility.	L3	Apply

Energy Audit and Management (22PEME8022T)

Course Contents

Unit-I **06 Hrs.**

Energy Scenario and Policies

Present energy scenario, energy pricing, energy sector reforms, energy security and conservation (Energy Conservation Act-2001), basics of energy forms, material and energy balance. National and renewable energy policies, carbon trading, renewable energy certification, and the clean development mechanism (CDM).

Unit-II **08 Hrs.**

Energy Audit

Definition, need for energy audit, types of energy audit, role and responsibilities of energy auditor and manager, energy management (audit) approach including understanding energy costs, bench marking, energy performance, matching energy use to requirement, optimizing the input energy requirements, fuel and energy substitution, elements of monitoring & targeting, energy audit instruments, energy audit report, use of modern simulation tools/softwares for energy consumption analysis and audit.

Unit-III **08 Hrs.**

Energy Management and Energy Conservation in Electrical System

Electricity billing, electrical load management and maximum demand control; power factor improvement, energy efficient equipment 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, compressors, blowers, industrial drives, induction motors, motor retrofitting, soft starters, and variable speed drives.

Unit-IV **08 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 the boiler system, refrigeration, and HVAC system.

Unit-V **06 Hrs.**

Energy Conservation in Buildings

Energy conservation building codes (ECBC): green building, LEED rating system, integration of non-conventional and renewable energy sources in buildings.

Unit-VI **06 Hrs.**

Energy Economics and Investment Appraisal

Need, criteria, and financial analysis techniques - break-even analysis, simple payback period, return on investment (ROI), net present value (NPV), internal rate of return (IRR), discounted cash flows (DCF)., debt service coverage ratio (DSCR). Financing options for energy efficiency projects, Energy service company (ESCO) concept, Economic feasibility, and decision-making.

Books Recommended

Textbooks

1 Thumann, A., & Mehta, D. P., Handbook of Energy Engineering, The Fairmont Press, 2020.

2 Geofry Stokes, Handbook of Electrical Installation Practice, Blackwell Science, Oxford, 2018.

3 Anil Valia, Designing with Light: Lighting Handbook, Lighting System, Mumbai, 2019.

4 W.C. Turner, Energy Management Handbook, John Wiley and Sons, New York, 2019.

5 Sharma, K., Industrial Energy Conservation Techniques, CRC Press, 2015.

6 Capehart, B. L., Turner, W. C., & Kennedy, W. J., Guide to Energy Management, The Fairmont Press, 2016.

7 A.K. Tyagi (Ed.), Handbook on Energy Audits and Management, Tata Energy Research Institute (TERI), New Delhi, 2020.

Reference Books

1 Bureau of Energy Efficiency (BEE), Energy Manager and Auditor Guidebooks (Vol. 1 to 4), Ministry of Power, India, 2021.

2 Soni, M. S., Gupta, J. P., & Bhatnagar, R. P., A Course in Electrical Power, Dhanpat Rai & Sons, 2020.

3 C.B. Smith, Energy Management Principles, Pergamon Press, Oxford, 2020.

4 Dale R. Patrick, S. Fardo, Ray E. Richardson, Energy Conservation Guidebook, Fairmont Press, Georgia, 2021.

5 Albert Thumann, W.J. Younger, T. Niehus, Handbook of Energy Audits, CRC Press, Boca Raton, 2021.

Web References

1 Bureau of Energy Efficiency (BEE), India: https://beeindia.gov.in

2 Energy Manager Training: https://www.energymanagertraining.com

3 Energy Audits - Open Access Research Papers: https://www.sciencedirect.com

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Human Resource Management (22PEME8023T)		

Prerequisites:

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Course Objectives:

1. To introduce the students to basic concepts, techniques, and practices of human resource management.
2. To provide an opportunity of learning Human Resource Management (HRM) processes, related to the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students with the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders, and managers.

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 concepts, aspects, techniques, and practices of human resource management.	L2	Understand
CO2	Describe the Human Resource Management (HRM) processes, functions, changes, and challenges in today's emerging organizational perspective.	L2	Understand
CO3	Illustrate the latest developments and trends in HRM.	L2	Understand
CO4	Apply behavioral and interpersonal skills to manage diverse inter-group environments in engineering and organizational contexts.	L3	Apply

Human Resource Management (22PEME8023T)

Course Contents

Unit-I **08 Hrs.**

Introduction to HR

Human Resource Management- Concept, Scope, and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.
Human resource development (HRD): changing role of HRM, Human resource Planning, Technological change, Restructuring, and rightsizing. Empowerment, TQM, and Managing ethical issues.

Unit-II **10 Hrs.**

Organizational Behaviour (OB)

Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary Issues.
Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness. Perception: Attitude and Value, Effect of perception on Individual Decision-making. Attitude and Behaviour.
Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor);
Group Behaviour and Group Dynamics: Work groups, formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team.
Case study.

Unit-III **08 Hrs.**

Organizational Structure & Design

Structure, size, technology, Environment of organization; Organizational Roles conflicts: Concept of roles; role dynamics; role conflicts and stress.
Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.
Power and Politics: Sources and uses of power, Politics at the workplace, Tactics and strategies.

Unit-IV **08 Hrs.**

Human Resource Planning

Recruitment and Selection process, Job-enrichment, Empowerment-Job Satisfaction, employee morale.
Performance Appraisal Systems: Traditional & modern methods, Performance Counselling. Career Planning.
Training & Development: Identification of Training Needs, Training Methods.
Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making: Strategic Intent-Corporate Mission, Vision, Objectives, and Goals.

Unit-V **08 Hrs.**

Labor Laws and Industrial Relations and Emerging Trends in HR

Labor Laws and Industrial Relations:
Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act.
Emerging Trends in HR
Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment.
Cross-Cultural Leadership and Decision Making: Cross-Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women, and ageing people, intra-company cultural differences among employees motivation.

Books Recommended

Reference Books

1 Stephen Robbins, Organizational Behavior, 16th Ed, 2013.

2 V SP Rao, Human Resource Management, 3rd Ed, 2010, Excel Publishing.

3 Aswathapa, Human Resource Management: Text & Cases, 6th edition,

4 C. B. Mamoria and SV Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015

5 P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing

6 Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications.

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Logistic and Supply Chain Management (22PEME8024T)		

Prerequisites:

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Course Objectives:

1. To acquaint with the concept of key drivers of supply chain performance and their inter-relationships with strategy.
2. To acquaint with the design problems and develop an understanding of information technology in supply chain optimization.
3. To acquaint with the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

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 functional strategy map of supply chain management.	L3	Apply
CO2	Analyze the determinants of Supply Chain and Transportation networks design.	L4	Analyze
CO3	Demonstrate the need of coordination and sourcing decisions in supply chain.	L3	Apply
CO4	Describe pricing, revenue management and role of IT in supply chain.	L2	Understand
CO5	Describe various sustainability aspects of a supply chain.	L2	Understand

Logistic and Supply Chain Management (22PEME8024T)

Course Contents

Unit-I **08 Hrs.**

Introduction to Supply Chain

Understanding the Supply Chain: Objective, Importance, Decision Phases, Process Views.
Achieving Strategic Fit and Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope, Challenges to Achieving and Maintaining Strategic Fit.
Supply Chain Drivers and Metrics: Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.
Creating the Responsive Supply Chain: Product push versus demand pull, The Japanese philosophy, The foundations of agility, A route-map to responsiveness.

Unit-II **10 Hrs.**

Designing the Supply Chain and Transportation Networks

Designing Distribution Networks: The Role of Distribution in the Supply Chain, Factors Influencing Distribution Network Design, Design Options for a Distribution Network.
Network Design in the Supply Chain: The Role of Network Design in the Supply Chain, Factors Influencing Network Design Decisions, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.
Designing Global Supply Chain Networks: The Impact of Globalization on Supply Chain Networks, The Offshoring Decision: Total Cost, Risk Management in Global Supply Chains, Discounted Cash Flows, Evaluating Network Design Decisions Using Decision Trees.
Transportation in a Supply Chain: The Role of Transportation in a Supply Chain, Modes of Transportation and their Performance Characteristics, Design Options for a Transportation Network, Trade-Offs in Transportation Design, Tailored Transportation.

Unit-III **08 Hrs.**

Coordination and Sourcing Decisions in Supply Chain

Coordination in a Supply Chain: Lack of Supply Chain Coordination and the Bullwhip Effect, The Effect on Performance of Lack of Coordination, Obstacles to Coordination in a Supply Chain, Managerial Levers to Achieve Coordination, Continuous Replenishment and Vendor-Managed Inventories, Collaborative Planning, Forecasting, and Replenishment.
Sourcing Decisions in a Supply Chain: The Role of Sourcing in a Supply Chain, In-House or Outsource, Third- and Fourth-Party Logistics Providers, Using Total Cost to Score and Assess Suppliers, Supplier Selection-Auctions and Negotiations, Contracts, Risk Sharing and Supply Chain Performance, Design Collaboration, The Procurement Process.

Unit-IV **08 Hrs.**

Pricing,Revenue Management and IT in a Supply Chain

Pricing and Revenue Management in a Supply Chain: The Role of Pricing and Revenue Management in a Supply Chain, Pricing and Revenue Management for Multiple Customer Segments, Pricing and Revenue Management for Perishable Assets, Pricing and Revenue Management for Seasonal Demand,

Pricing and Revenue Management for Bulk and Spot Contracts.
Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework, Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, Managing the supply chain as a network, Seven major business transformations, From 3PL to 4PL. The Future of IT in the Supply Chain.

Unit-V **08 Hrs.**

Sustainable Supply Chain and Future

Creating a Sustainable Supply Chain: The Role of Triple Bottom Line, Key Metrics for Sustainability, Greenhouse gases and the supply chain, Reducing the transport-intensity of supply chains, Beyond the carbon footprint, Reduce, reuse, recycle, Sustainability and Supply Chain Drivers.
Introduction to the Supply Chain of the Future: Emerging Megatrends.

Books Recommended

Reference Books

1 Logistics & Supply Chain Management, Martin Christopher, Pearson Education Limited, 2016.

2 Supply Chain Management Strategy, Planning, and Operation, Sunil Chopra and Peter Meindl, Pearson, 2016.

3 Essentials of Supply Chain Management, Michael H. Hugos, Wiley, 2018.

4 Supply Chain Management For Dummies, Daniel Stanton, Wiley, 2020.

5 Global Supply Chain and Operations Management A Decision-Oriented Introduction to the Creation of Value, Dmitry Ivanov, Alexander Tsipoulanidis and Jörn Schönberger, Springer International Publishing, 2016.

6 Supply Chain Management, Sinha, McGraw-Hill Education (India) Pvt Limited, 2012.

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
IPR and Patenting (22PEME8025T)		

Prerequisites:

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Course Objectives:

1. Understanding, defining, and differentiating different types of intellectual properties (IPs)
2. Assessing different IP management (IPM) approaches
3. Exposure to the Legal management of IP and understanding of real-life practice of IPM.

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 concepts of IPR, types, and legal frameworks.	L2	Understand
CO2	Explain patent and trademark laws for registration and infringement cases.	L2	Understand
CO3	Apply provisions of copyrights and industrial designs.	L3	Apply
CO4	Analyze GI, PVP, and layout design protection systems.	L4	Analyze
CO5	Evaluate strategies integrating IPR with business and competition law.	L5	Evaluate

IPR and Patenting (22PEME8025T)

Course Contents

Unit-I **08 Hrs.**

Concept of Intellectual Property Law

Idea/Expression dichotomy, Introduction, and the need for intellectual property rights (IPR), Intellectual Property laws, IPR in India: Genesis and development, IPR abroad, Major International Instruments concerning Intellectual Property Rights: Paris Convention, the Berne Convention, the Universal Copyright Convention, the WIPO Convention, the Patent Cooperation Treaty, the TRIPS Agreement, incentive theory, types of IPR, India's New National IP Policy, 2016, Govt. Schemes in IPR IP.

Unit-II **10 Hrs.**

Patents and Trademarks

Elements of Patentability: Novelty, Non-Obviousness, Industrial Application, Non Patentable Subject Matter, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties, Patent Office and Appellate Board, Case study of existing patents related to software, healthcare, and devices. Concept of Trademarks, Different kinds of marks (brand names, logos, signatures, symbols, well-known marks, certification marks, and service marks), Non Registrable. Trademarks, Registration of Trademarks, Rights of holder and assignment and licensing of marks, Infringement, Remedies & Penalties, Trademarks registry and appellate board.

Unit-III **08 Hrs.**

Copyrights and Designs

Copyrights: Nature, Subject matter: original literary, dramatic, musical, artistic works, cinematograph films and sound recordings, Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright, Infringement, Remedies & Penalties, Related Rights, distinction between related rights and copyrights, Design: meaning and concept of novel and original, procedure for registration, effect of registration and term of protection.

Unit-IV **08 Hrs.**

GI, PVP, and LDP

Geographical indication: meaning, difference between GI and trademarks, procedure for registration, effect of registration, and term of protection. Plant variety protection: meaning, benefit sharing, farmers' rights, procedure for registration, effect of registration, and term of protection. Layout Design protection: meaning, procedure for registration, effect of registration, term of protection.

Unit-V **08 Hrs.**

Beyond IP

Introduction to Competition Law: concept of competition, relationship and Interaction between IPR and competition law, IP and competition issues, Technology transfer agreements. EU experience with IP and Competition Law, the Indian Competition Act, and IPR protection, IPR issues in mergers

and acquisitions, harmonization of IP protection, and competition Law in India.

Books Recommended

Reference Books

1 Feroz Ali, The Law of Patents, LexisNexis

2 Ronald D. Slusky, Invention Analysis and Claiming - A Patent Lawyer's Guide, Second Edition, American Bar Association, 2012.

3 Feroz Ali, The Touchstone Effect: The Impact of Pre-grant Opposition on Patents, LexisNexis, 2009.

4 Innovation and entrepreneurship by Drucker. F. Peter, Harper's Business, (2006).

5 Intellectual Property Rights, Deborah. E. Bouchoux, Cengage Learing.

6 Intellectual Property Rights-Unleash The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,

7 The Design of Business- by Martin Roger, Harvard Business Publishing (2009).

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Environmental Management (22PEME8026T)		

Prerequisites:

1. Basic Knowledge of Probability and Statistics

Course Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarize with environment-related legislation
4. Understand Environmental Auditing Procedures.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Explain environmental issues and the fundamental concepts of ecosystem and environmental management.	L2	Understand
CO2	Interpret environmental policies, legal aspects, and EM system standards within a professional context	L3	Apply
CO3	Explain the Environmental Impact Assessment.	L2	Understand
CO4	Explain Environment Auditing procedures.	L2	Understand
CO5	Describe Environmental Management Techniques.	L2	Understand

Environmental Management (22PEME8026T)

Course Contents

Unit-I **08 Hrs.**

Principles of Environmental Management (EM)

Introduction of EM, Definition, Ecosystem concept, Participants in EM, Ethics and the environment, International Environmental Movement, Environmental issues relevant to India.

Unit-II **09 Hrs.**

Policy, Legal Aspects and Standards of EM

Policy and Legal Aspects of EM: - Introduction to various Environmental Policies, Indian and International Environmental laws and legislation.
EM system Standards: Core Elements, Benefits, Certification Body Assessment Documentation for EMS, ISO-14000 Standards.

Unit-III **09 Hrs.**

Environmental Impact Assessment (EIA)

Purpose, steps, hierarchy of EIA, Environmental Impact Statement and Impact Indicators, Evolution of IA in India and worldwide. Preliminary stages of EIA, Impact, Prediction, Evaluation and Mitigation.

Unit-IV **08 Hrs.**

Environmental Auditing (EA)

Objectives, Scope and Types of EA, Audit Methodology, Elements of Audit Process, Auditing of EMS.

Unit-V **08 Hrs.**

Environmental Management Techniques

Environmental Monitoring and Modelling, Environmental technology Assessment and Environmental Risk Assessment, Eco-mapping.

Books Recommended

Textbooks

1 Environmental Management, T V Ramachandra and Vijay Kulkarni, TERI Press.

2 Environmental Management: Principles and Practice, CJ Barrow, Routledge Publishers, London, 1999.

Reference Books

1 A Handbook of Environmental Management, Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing.

2 Indian Standard Environmental Management Systems - Requirements with Guidance for Use, Bureau Of Indian Standards, February 2005.

3 Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000.

4 Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press.

5 Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015.

Program: Mechanical Engineering	Final.Y. B.Tech.	Semester: VIII
Internship (22INTME8030L)		

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 (22INTME8030L)

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)

Program: Mechanical Engineering	Final Y. B.Tech.	Semester: VIII
Disaster Management and Preparedness(22MDME8040T)		

Prerequisites:

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Course Objectives:

1. To provide a basic understanding of hazards, disasters, and various types and categories of disasters occurring around the world.
2. To identify the extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize them.
4. To understand the roles and responsibilities of individuals and various organizations during and after a 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 a disaster.

Course Outcomes:

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

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Apply disaster management principles & guidelines.	L3	Apply
CO2	Analyze risk assessments.	L4	Analyze
CO3	Demonstrate community awareness & participation.	L3	Apply
CO4	Use Science & Technology tools (GIS, GPS).	L3	Apply
CO5	Prepare disaster management plans.	L3	Apply

Disaster Management and Preparedness(22MDME8040T)

Course Contents

Unit-I **06 Hrs.**

Understanding Disasters & Hazards

Definition and types of disasters: Natural, Man-made and hybrid disasters.
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.
Hazard & Vulnerability profiles of India (seismic zones, flood-prone areas).
India's vulnerability to disasters, and the impact of disasters on National development.

Unit-II **06 Hrs.**

Disaster Risk Reduction (DRR) & Mitigation

Disaster Management Cycle: Prevention, Mitigation, Preparedness, Response, Recovery. Need for disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction.
Risk Assessment & Vulnerability Analysis.
Science & Technology: Use of information management, Geo informatics like RS, GIS, GPS and remote sensing mitigation measure.

Unit-III **04 Hrs.**

Disaster Preparedness & Response:

Preparedness Planning, Early Warning Systems (EWS), & Communication.
Emergency Response: Search & Rescue, Logistics, Medical Aid.
Psychological Response & Management (Trauma, Stress).
Role of IT, Media, Govt., NGOs, & Community.

Unit-IV **04 Hrs.**

Recovery, Rehabilitation & Reconstruction

Post-disaster damage assessment.
Rehabilitation, Reconstruction, & Livelihood Restoration.
Sanitation, Hygiene, & Waste Management.

Unit-V **04 Hrs.**

Policy, Governance & Capacity Building:

Geo-informatics in Disaster Management (RS, GIS, GPS and RS)
National Disaster Management Authority (NDMA) & Legislation.

Institutional Mechanisms & Community Mobilization. Non-Structural Mitigation: Community based disaster preparedness, capacity development and training, awareness and education, contingency plans.

Unit-VI **04 Hrs.**

Case studies on disaster (National /International)

Case study discussion of National Disasters: Tsunami (2004), Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, 26th July 2005 Mumbai flood.
Case study discussion of International Disasters: Hiroshima – Nagasaki (Japan), Cyclone Phailin (2013), Fukushima, Daiichi nuclear disaster (2011), Chernobyl meltdown.

Books Recommended

Reference Books and Reports

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 manager'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 to reports published at the national and international levels and updated information available on authentic websites.)