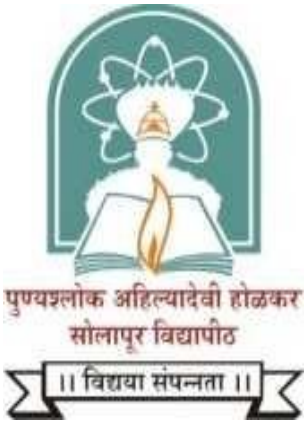
Punyashlok Ahilyadevi Holkar Solapur University, Solapur



NAAC Accredited2015 'B'Grade (CGPA2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus: Mechanical Engineering

Name of the Course: Final Year B. Tech.

(Syllabus to be implemented from w.e.f. June : 2021-2022)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Mechanical Engineering
Semester-VII

Choice Based Credit System (CBCS) Structure of Final Year B.Tech. Mechanical Engineering w.e.f. 2021-2022

Theory Courses

Course Code	*Name of Theory Course*	*Hrs./week*				*Credits*	*Examination Scheme*			
		L	*T*	*P*	*D*		*ISE*	*ESE*	*ICA*	*Total*
ME411	Refrigeration and Air Conditioning	3	-	-	-	3	30	70	-	100
ME412	Automobile Engineering	3	-	-	-	3	30	70	-	100
ME413	Robotics and Artificial Intelligence	3				3	30	70		100
ME414x	Professional Elective-V	3	-	-	-	3	30	70	-	100
ME415y	Open Elective	3	-	-	-	3	30	70	-	100
	Sub Total	**15**	**-**	**-**	**-**	**15**	**150**	**350**		**500**

Laboratory / Tutorial Courses

Course Code	*Name of Laboratory/Tutorial Course*	*Hrs./week*				*Credits*	*Examination Scheme*				
		L	*T*	*P*	D		*ISE*	*ESE*		*ICA*	*Total*
								POE	*OE*		
ME411	Refrigeration and Air Conditioning	-	-	2	-	1	-	25	-	25	50
ME412	Automobile Engineering	-	-	2	-	1	-	-		25	25
ME413	Robotics and Artificial Intelligence			2		1				25	25
ME414x	Professional Elective-V	-	-	2	-	1	-	-		25	25
ME415y	Open Elective	-	1	-	-	1	-	-	-	25	25
ME416	Project Work Stage-I Seminar	-	-	4	-	2	-	-	-	25	25
ME417	Industrial Training	-	1	-	-	1	-	-	25	50	75
	Sub Total	-	2	12	-	8	-	50		200	250
	Grand Total	**15**	**2**	**12**	**-**	**23**	**150**	**400**		**200**	**750**

Abbreviations: *L- Lectures, P –Practical, T- Tutorial, D-Drawing, ISE-In Semester Examination, ESE-End Semester Examination (University Examination for Theory & / POE & / Oral), ICA-Internal Continuous Assessment.*

Professional Elective-V:	***Open Elective:***
ME4141 Production and Operations Management	ME4151 *Costing and Cost Control*
ME4142 Computational Fluid Dynamics	ME4152 *Entrepreneurship Development*
ME4143 Process Engineering	ME4153 *Business Development*
ME4144 Finite Element Method	ME4154 *Product Life Cycle Management*
ME4145 Tribology	ME4155 Business *Economics*
ME4146 Railway Systems Management	ME4156 *Reliability Engineering*

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology

Mechanical Engineering

Semester-VIII

Choice Based Credit System (CBCS) Structure of Final Year B.Tech. Mechanical Engineering w.e.f. 2021-2022

Theory Courses

Course Code	Name of Theory Course	Hrs./week				Credits	Examination Scheme			
		L	T	P	D		ISE	ESE	ICA	Total
ME421	Project Work Stage-II Seminar	-	-	-	-	-	-	-	-	-
ME422	Project Work Stage-III Seminar	-	-	-	-	-	-	-	-	-
ME423	Project Work (Report Submission &	-	-	-	-	-	-	-	-	-
	Sub Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**-**

Laboratory / Tutorial Courses

Course Code	Name of Laboratory / Tutorial Course	Hrs./week				Credits	Examination Scheme				
		L	T	P	D		ISE	ESE		ICA	Total
								POE	OE		
ME421	Project Work Stage-II Seminar	-	-	2	-	1	-	-	-	50	50
ME422	Project Work Stage-III Seminar	-	-	2	-	1	-	-	-	50	50
ME423	Project Work (Report Submission & Presentation)	-	-	4	-	2	-	50	-	50	100
	Sub Total	**-**	**-**	**8**	**-**	**4**	**-**	**50**		**150**	**200**
	Grand Total			**8**		**4**		**50**		**150**	**200**

Abbreviations: *L –Lectures, P –Practical, T– Tutorial, D-Drawing, ISE– In Semester Examination, ESE – End Semester Examination (University Examination for Theory & / POE & / Oral), ICA– Internal Continuous Assessment.*

Note:

1. At Final Year B-Tech level Batch Size for the practical/tutorial shall be of 15 students. On forming the batches, if the strength of remaining student exceeds 7, then a new batch shall be formed.
2. Industrial Training (evaluated at B. Tech Semester-VII) of minimum 30 days shall be completed in any vacation after B. Tech. Semester-III, but before B. Tech. Semester-VII & the report shall be submitted and evaluated at B. Tech. Semester-VII.
3. Project group for B. Tech. Semester-VII and Semester-VIII shall not be of more than 4 students, however in exceptional cases group size may be of 5 students.
4. ICA assessment shall be a continuous process based on student's performance in–class tests, assignments, homework, seminars, quizzes, and laboratory books and their interaction and attendance for theory and lab sessions, as applicable.
5. In Semester - VIII, students/project groups are expected to undergo internship in any industry and should complete a project sponsored by the same industry. In case students are unable to get industry internship and sponsored project, such students/project groups can undergo any other project work of their choice or assigned by concerned guide. Such students are required to complete one audit course in any emerging area in the field of Engineering from the list given below.
    i. Electric Vehicles
    ii. 3-D printing
    iii. Renewable energy
    iv. Automation and Robotics
    v. CNC Programming
    vi. Artificial Intelligence
    vii. Machine Learning
    viii. CAD/CAM/CAE

    Teaching-learning process and method of assessment of such course will be decided by concerned institute. Evaluation will be done at institute level itself. Project Assessment of the concerned students be done after satisfactory completion of the course.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME411 : Refrigeration and Air Conditioning

Teaching Scheme	Examination Scheme
Lectures:03Hours/week, 03Credits	**ESE:70Marks**
Practical :02Hours/week, 01Credit	**POE : 25 Marks**
	ISE: 30Marks
	ICA: 25Marks

Course Introduction:

The **course** consists of different **refrigeration** cycles such as Air refrigeration cycle, Vapour Compression cycle, Vapour absorption cycle. It also covers properties of refrigerants and various alternative refrigerants and understanding of psychrometric and psychrometric processes used for the purpose of **air-conditioning**. Further, the comfort **air-conditioning** and indoor environment health are also addressed in this **course**.

CourseObjectives:

During this course, student is expected to:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. To understand basic refrigeration processes.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. To acquire the skills required to design and analyze refrigeration and air conditioning components and systems.

CourseOutcomes:

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

1. Evaluate performance of various types of refrigeration systems.

2. Select appropriate refrigerant considering necessary properties.

3. Use Psychrometric chart and tables and analyze psychrometric process for obtaining required air

conditions.

4. Describe comfort chart and compare duct design methods.

Section I

Unit-1:Basic Refrigeration Cycles and Refrigerant No. of lectures- 7

A) Air Refrigeration

Refrigeration, Units of refrigeration, Reversed Carnot cycle with vapour as refrigerant, Air Refrigeration Systems, Bell Coleman Cycle (B.C.C), Calculation of C.O.P., Advantages and Disadvantages of B.C.C. (Numerical Treatment).

B) Air Craft Refrigeration

Necessity, Simple, Boot Strap, Regenerative and Reduced ambient systems. **(Descriptive Treatment).**

C) Refrigerant

Classification, Desirable Properties, Nomenclature of Refrigerants, Selection of refrigerant, Secondaryrefrigerants, Effect on Ozone depletion and Global warming, Total equivalent warming impact (TEWI),Alternative Refrigerants, Use of any Software for Refrigerants' properties.

Unit-2: Vapour Refrigeration Systems No. of lectures- 8

A) Vapour Compression Refrigeration Systems

Vapour compression systems Working of simple vapour compression system, representation of different vapour compression cycle (VCC) on T-s and P-h diagram, Vapour compression cycle, Sub cooling, Superheating, Analysis and Performance calculations of above cycles. Effect of operating parameters on performance of VCC, actual VCC, methods of improving COP**(Numerical Treatment).**

B) Vapour Absorption Refrigeration Systems

Introduction, Working of simple vapour absorption system (VAS), Practical vapour absorption system,desirable properties of binary mixture (aqua-ammonia), COP of an ideal Vapour Absorption Refrigeration System, Li-Br absorption system, three fluid system (Electrolux refrigeration), applications of VAS, comparison between VCRS and VARS.**(Descriptive Treatment).**

Unit-3:Multiple pressure Refrigeration Systems No. of lectures- 5

A) Introduction, Multistage compression, Flash gas removal, Flash inter cooling, Complete Multi stagesystem, Multi evaporator systems

B) Introduction to cryogenics Limitations of vapour compression systems for the production of low temperature, Cascade Refrigeration System, Linde System for liquefaction of air. Applications ofCryogenics. (Descriptive Treatment).

Section II

Unit-4:Psychrometry **No. of lectures-7**

Introduction, Psychometrics terms, Dalton's law of partial pressure, Psychometrics relations, Enthalpy of moist air, Use of psychometric tables and Charts, Psychometrics Processes, Combinations And Calculations, SHF, BPF, ADP Coil condition line, Air Washer and it's applications. (Numerical Treatment)

Unit-5: Heating and Cooling Load Calculations **No. of lectures-8**

A) Representation of actual air conditioning process by layout and on Psychometric chart.

Load analysis by RSHF, GSHF, Enumeration and brief explanation of the factors forming load on refrigeration and air conditioning systems. ***(Numerical Treatment).***

B) Comfort Conditions

Human Comfort Thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, concept of infiltration and ventilation, indoor air quality requirements.

No. of lectures- 5

Unit-6: Air Distribution Systems

A) Ducts Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, Methods of duct system design: equal friction, velocity reduction, static regain method (numerical on duct system design)

B) Air handling unit Air handling unit, Fan coil unit, types of fans used air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, smoke).

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

Group 1 (Study, Demonstration of any four assignments on following)

1. Study of Refrigeration methods
2. Study of Refrigeration Equipments
3. Study of Refrigeration Systems–Domestic refrigerator, Split air conditioner, IcePlant, Deep freezer etc.
4. Study of charging, leak testing of refrigeration systems
5. Case Study (Any One of the following)
    a) Refrigeration and Air-Conditioning systems used in Space Station/Satellites/ Rockets/Submarines
    b) Refrigeration and Air-Conditioning systems used in Automobiles
    c) Methods used for cooling Super Computers and Servers

Group II (Any three experiments out of the following)

1. Trial on Refrigeration primer / bench
2. Trial on mini ice plant
3. Trial on Vapour Absorption system
4. Trial on Air conditioning tutor
5. Trial on Heat Pump

Group III(Any oneout of the following)

1. Visit to Refrigeration plant or Central Air Conditioning plant
2. Performance evaluation of any one trial of Group-II by using MATLAB/C Programming

Text Books:

1. Refrigeration and Air Conditioning by R.S. Khurmi& J.K. Gupta
2. 'Refrigeration & Air Conditioning' by C.P. Arora
3. Refrigeration & Air Conditioning' by Arora&Domkundwar
4. Refrigeration and Air-conditioning' by S. N. Sapali

Reference Books

1. Principles of Refrigeration 'by Roy J Dossat
2. Air Conditioning Applications & design' by W.P.Jones
3. Refrigeration &Air Conditioning by Stocker
4. Refrigeration &Air Conditioning byManohar Prasad

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME412 : Automobile Engineering

TeachingScheme
Lectures:03 Hours/week, 03 Credits
Practical : 02Hours/week, 01 Credit

Examination Scheme
ESE: 70 Marks
ISE : 30 Marks
ICA : 25 Marks

Course Introduction:

Automobile engineering is an important automotive sector component. An automobile engineer helps to design and ensure the standard and efficient working of existing automobile and invent new technologies in this area. This area of engineering is intensive in research and requires professionals in their automotive engineering specialties to be educated and committed. Their efficiency, comfort and safety have been greatly improved. The worldwide manufacturing and use of automobiles has increased dramatically. This has given mechanical engineers the opportunity to work in the automobile sector.

CourseObjectives:

During this course, student is expected to:

1. To make the students conversant with fundamentals of Automobile system
2. To develop the competencies of students in performance analysis of Automobiles
3. To make the students conversant with Automobile safety and Electrical Systems.
4. To understand the students importance of emerging trends of Hybrid Vehicles like Electric and Solar Vehicles.

CourseOutcomes:

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

1. Demonstrate various systems in an automobile
2. Describe importance and features of different elements like axle, differential, brakes, steering, suspension, wheel balancing, electrical systems etc.
3. Explain principle of operation, construction and applications of various sensors used in modern automobiles.

Section I

Unit-1: ***Introduction to Automobiles:*** **No. of lectures-04**

Broad classification of Automobiles. Major Components and their functions. Types of vehicle layouts, Front engine rear wheel drive, Front engine front wheel drive, Rear engine rear wheel drive, All wheel drive**,** specifications of vehicles. Types of bodies, Body construction and materials, and safety devices.

Unit-2: ***Performance of Automobiles &Electrical Systems*** **No. of lectures-08**

Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Grade ability and draw bar pull, Traction and Tractive effort, Distribution of weight, Power required for

vehicle propulsion, Selection of gear ratio, Rear axle ratio. (Numerical).Automotive batteries, automotive lighting system, Starting system, charging system, Electric horn, Electric fuel Gauge-thermostatic & balancing coil type, Wiper & side indicator circuit, electric Speedo meter.

Unit-3: ***Transmission System*** **No. of lectures-08**

Requirements of transmission system, Automobile clutch- requirements, types & functions,Single plate, Multi-plate, Centrifugal, Electromagnetic & Fluid flywheel. Types of automotivegearboxes, Working of sliding mesh, Constant mesh and Synchromesh gearbox, Overdrive,Principle of operation of automatic transmission, Torque converter, Epicyclical gear trains,Propeller shaft, Universal and slip joint, Final drive and its types, Differential, Construction andtypes of rear axles, Introduction to wheels and tyres.

Section II

Unit-4: ***Steering System:*** **No. of lectures-06**

Function of steering, Steering system layout, Automotive steering mechanism- Ackerman and Davis, Types of steering gear boxes, Condition for true rolling, Steering geometry-Camber, Caster, King pin inclination, Included angle, Toe-in and Toe-out, Wheel alignment, Slip angle, Under steer & over steer, Types and working of power steering (Numerical).

Unit-5: ***Braking System:*** **No. of lectures-06**

Function of automotive brake system, Types of braking mechanism, internal expanding & Disc brake, Mechanical, Hydraulic & Air brake system, power brakes, Anti lock braking, Calculation of braking force required, stopping distance and dynamic weight transfer.(Numerical).

Unit-6: ***Suspension System & Modern trends in Automobiles*** **No. of lectures-08**

Suspension requirements, Sprung and Unsprung mass, Types of automotive suspension systems. Conventional and Independent, Shock absorber, Types of springs, Hotch- kiss and Torque tube drive, Reaction members-Radius rod, Stabilizer bar, Air suspension system.Engine electronic control modules, Introduction to Sensors and actuators used in automobile controls, Electronic Control Unit, traction control devices, fuel cells Hybrid vehicles- Electrical vehicles, Solar vehicles.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Study and demonstration of four wheeler chassis layout. Two-wheel & four wheelsdrive layouts.
2. Study and Demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gearbox, final drive and differential.
4. Study and demonstration of working Hydraulic braking system.
5. Study and demonstration of front wheel steering geometry and steering mechanism.
6. Study and demonstration of suspension system of a four-wheeler.
7. Study and demonstration of battery and electrical starting system

8. Study and demonstration of (a) Electric horn. (b) Electric fuel Gauge. (c) Flasher unit. (d) Wiper circuit
9. Experiment on wheel balancing & front wheel alignment.
10. Visit to servicing station for study of vehicle maintenance, repairs and report.

Text Books:

1. Kirpal Singh - Automobile Engineering – Standard publisher.
2. Automobile Mechanics -.N. K. Giri
3. Automobile Electrical Equipment -P. S. Kohli

Reference Books

1. K. Newton and W. Seeds, T.K. Garrett,Motor Vehicle, Elsevier publications
2. Hans Hermann Braess, Ulrich Seiffen, handbook of Automotive Engineering, SAEPublications
3. William H. Crouse. Automotive Mechanics - Tata McGraw Hill Publishing House
4. Joseph Heitner, Automotive Mechanics -C.B.S Publishers And Distributors
5. SAE Manuals and Standard

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME413 : Robotics and Artificial Intelligence

Teaching Scheme	**Examination Scheme**
Lectures : 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Practical : 02 Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

This course is designed to give the student an in depth understanding of manipulative robotics, mobile robotics, and its applications. It covers the following topics.

Automation types, introduction to industrial robotics, Anatomy of an industrial robot, robot history, AGVs, service robots, Cobots, configurations, sensors and actuators, end effectors.

Kinematics of multi-degree-of-freedom systems. Jacobean matrices, kinematics, and dynamics. Robot trajectories.

Machine Vision using Scilab/MATLAB/Octave or any free/commercial vision software.This course requires the students to take part in site visits and case study presentations. This course covers the fundamentals of artificial intelligence such as agents, reasoning, searching, machine learning and associated terminology. It also covers Fuzzy Logic, Artificial Neural Networks and Genetic algorithms at a basic level.

Course Objectives:

During this course, student is expected to:

1. Understand the basic construction and applications of an industrial robots, AGVs, Cobots
2. Acquaint with existing market distribution and future trends.
3. Understand the technology behind a modern robot such as sensors, actuators, grippers, controllers, machine vision etc.
4. Understand fundamentals of AI, its types, and applications.

Course Outcomes:

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

1. Explain construction and applications of different types of robots.
2. Explain types of sensors and actuators and end effectors used in the construction of robots.

3. Solve simple forward and inverse kinematics problems for jointed arm robots.
4. Define Artificial Intelligence and explain concepts such as searching, reasoning and other associated terminology.
5. Explain fuzzy logic, ANN, GAs, and their applications.
6. Explain components of machine vision and image processing fundamentals.

Section I

Unit 1 – Introduction to Robotics **No. of lectures - 07**

History and fundamentals of Industrial Robots, Definition as per ISO & IFR, Technology Evolution, components of industrial robots, configuration, typical specifications, current market scenario, "Collaborative Robots", Service Robots.

AGVs, classification, navigation techniques, applications.

Mobile robots: Classification, wheeled and tracked robots, autonomous navigation and control methods and applications, Humanoid robots, Bio mimetics.

Unit 2 – Sensors, Actuators & End Effectors **No. of lectures - 07**

Sensors: Sensor classification, joint angle sensors, rotary encoders, proximity sensors & switches, range sensors, GPS, INU,

Actuators: Compare Hydraulic, Pneumatic and Electric drives, Review of DC motors and stepper motors, AC motors, speed control of AC motors, VFD drives, and drive selection criteria.

End Effectors: End effectors & grippers, classification, applications, design, and selection criteria.

Unit 3 – Kinematics, Dynamics & Control **No. of lectures - 06**

Forward kinematics, Inverse Kinematics for 2 DOF and 3 DOF planar manipulators.

Dynamics: Velocity Jacobian, singularities,

Control architecture of robots, Overview of advanced control techniques such as force control, PID control adaptive control, PWM control.

Trajectory planning, joint space schemes, Cartesian space schemes, issues in trajectory planning.

(Derivations and Numerical Exercises on simple 2 DOF & 3 DOF manipulators)

Section II

Unit 4 – Fundamentals of AI **No. of lectures - 08**

Introduction to Artificial Intelligence. Applications- Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, machine learning, deep learning.Problem Solving: State space search; Production systems, search space control: depth-first, breadth-first search. Heuristic search - Hill climbing, best-first search, branch and bound.

Unit 5 – AI for Mechanical Engineering Applications **No. of lectures - 065**

Fuzzy Logic: History and background, Fuzzification, Rule Evaluation, Defuzzification, Fuzzy ControllersANN: History and background, Neuron Cell, Feedforward Neural Nets, Learning algorithms for Neural Nets,Genetic Algorithms: History and background, Coding, Selection, Reproduction, Mutation.

Unit 6 – Vision System for AI **No. of lectures - 06**

Machine Vision definition and system components, lighting techniques, Image processing fundamentals: Edge detection, shape analysis, segmentation, object identification, template matching, Cameras (CCD, CMOS, Area Scan, Line Scan), camera specification and selection, camera calibration.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Survey assignment on robots, AGVs, manufacturers and applications.
2. Theory assignment on sensors, actuators, and grippers.
3. One assignment on kinematic and dynamics supported by suitable software.
4. One assignment on robot control and trajectory planning.
5. One theory assignment on AI fundamentals
6. One assignment on Fuzzy Logic using suitable software
7. One assignment on ANN using suitable software
8. One assignment on Problem Solving
9. One theory assignment on Machine Vision.
10. One assignment on Image Analysis using suitable software.

Text Books:

1. S.K Saha, Introduction to Robotics, McGraw-Hill.
2. MikellGroover et.al, Industrial Robotics, McGraw Hill.
3. Stuart Russel& Peter Norvig, Artificial Intelligence a Modern Approach.

4. E. Rich and K. Knight, “Artificial intelligence”,TMH.

5. N.J. Nilsson, “Principles of AI”, Narosa Publ. House, 2000.

Reference Books

1. AsitavaGhosal, Robotics: Fundamental Concepts and Analysis, Oxford Press.

2. Siegwart et.al, Autonomous Mobile Robots, Prentice Hall India.

3. Robin R Murphy, Introduction to AI Robotics, PHI Publication, 2000.

4. Bishop et.al, Handbook of Mechatronics, CRC Press.

5. Schilling, Fundamentals of Robotics, Prentice Hall India.

6. Robert Babuška, Fuzzy Modeling for Control, Springer.

7. Dan Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall.

8. International Federation of Robotics - https://www/ifr.org

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4141 : Production and Operations Management

Teaching Scheme	Examination Scheme
Lectures : 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Practical : 02Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

Strategic growth & competiveness of organizations are depending upon the effective utilization of the critical production resources of the organization. Production / operations function is concerned with design & control systems responsible for the productive use of raw materials, human resources, equipment and facilities in the development of a product or services. The syllabus is divided into two sections, each section contains four chapters.

Course Objectives:

During this course, student is expected to:

1. Develop knowledge about the principles of production and operations management.
2. Solve organizational problems related to production as well as operations management.
3. Empower students to handle case studies related to industrial problems.

Course Outcomes:

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

1. Explain importance, scope and need of production and operation management.
2. Evaluate the future demands using different forecasting methods.
3. Apply the concept of capacity planning and aggregate planning to various types of manufacturing systems
4. Explain the importance of production planning and control, and inventory management in production process and its elements.
5. Apply the concept of plant maintenance.
6. To get acquainted with various advanced techniques such as Lean manufacturing ,value engineering, six sigma, Kanban, Supply chain management.

Section I

Unit-1:Introduction to Production and Operation Management No. of lectures-03

Definitions, objectives, Scope and History of Production Management, Manufacturing system and their types

Unit-2:Forecasting No. of lectures-06

Need, types of Forecasting, Statistical method, Moving average method, exponential smoothing method, Least square method, Regression and Co-relation method. (Numerical Treatment)

Unit-3:Capacity Planning No. of lectures-05

Concept, measurement and measures of capacity, factor affecting, capacity planning procedure, Aggregate planning, Investment decision and replacement analysis. (Numerical Treatment)

Unit 4–Production Planning and Control No of lectures – 06

Objectives, Functions, Co-ordination of PPC with other Department, Routing Scheduling, Loading and Sequencing, Line balancing, Production Control – Dispatching, Function and documents, Follow up, Evolution.

Section II

Unit-5: Inventory Management No. of lectures- 06

Inventory concepts, objectives, types of Inventory, different costs of Inventory, EOQ model, Economic batch quantity (EBQ) model, Inventory control techniques, ABC analysis, MRP, Fixed period and fixed quantity system. (Numerical Treatment)

Unit-6:Plant Maintenance No. of lectures-06

Definition, Need, Importance, Functions, scope and organization of maintenance department Types of maintenance- preventive, break down, Identification of break down using fishbone diagram, and TPM, Reliability and life testing

Unit-7:Value Engineering and Value Analysis No. of lectures-04

Definition, objectives and use of value analysis, reason of unnecessary cost, value analysis procedure, phases of value analysis.

Unit 8–Advanced manufacturing System No of lectures –04

Lean Manufacturing Basics , Just- in Time (JIT), Kanban System, KAIZAN, Zero defect, six sigma , Supply chain Management.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

(Minimum eight case studies or assignments based on all topics)

1. Case study on different manufacturing systems.
2. Numerical treatment on different forecasting techniques.
3. Numerical treatment on capacity planning.
4. Assignment on Production planning and control.
5. Numerical treatment on inventory management.
6. Assignment on plant maintenance.
7. Case study on value analysis.
8. Case study on Six Sigma .
9. Case study on Lean Manufacturing.
10. Case study on Supply chain Management.

Text Books:

1. Industrial engineering and Production management by MartandTelsang. (S. Chand)
2. Elements of Production Planning and Control by Samuel. (Universal Pub.)
3. Modern Production/Operation Management by BuffaSarin. (Wiley)
4. Industrial Engineering and Management by O. P. Khanna

Reference Books

1. Production and Operation Management by M. E. ThukaramRao. (New Age International Pub)
2. Sunil Chopra and Peter Meindl“ Supply Chain Management – Stratergy , Planning , and Operation “,6thEditiom ,Peason Education Asia , 2016.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B. TECH. (Mechanical Engineering)

Semester-VII

ME4142: Computational Fluid Dynamics

Teaching Scheme	**Examination Scheme**
Lectures:03Hours/week, 03 Credits	**ESE:70 Marks**
Practical:02Hours/week, 01 Credit	**ISE:30 Marks**
	ICA:25 Marks

Course Introduction:

Course Objectives:

During this course, student is expected to:

1. To introduce Governing Equations of viscous fluid flows
2. To introduce numerical and turbulence modeling in the field of fluid flow and heat transfer
3. To enable the students to understand the various discretization methods and solving methodologies.
4. To create confidence to solve complex problems in the field of heat transfer and fluid dynamics
5. To introduce the student with the techniques in the numerical solution of fluid equations

Course Outcomes:

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

1. Express numerical modeling and its role in the field of fluid flow and heat transfer.
2. Apply the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems
3. Interpret the knowledge, capability of analyzing and solving any concept or problem associated with heat energy dynamics and utilization.
4. Illustrate the working concepts of thermal engineering.
5. Understand the issues that arise in the numerical solution of fluid flow equations

Section I

Unit-1: Governing Equations & Boundary Conditions **No. of lectures-8**

Introduction and Basic Concepts: Introduction of CFD, Types of fluids and basic equations of flow, Mass Conservation, Newton's second law of motion, The Mass Balance Equation, Momentum Balance Equation, The Energy Balance Equation, The General Equation, – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

Unit-2:Discretization Methods **No. of lectures- 4**

Discretization Methods: The Finite Difference Method, The Finite Element Method, The Finite Volume Method, Spectral Methods, Comparison of Discretization techniques.

Unit-3: Finite Difference & Finite Volume Methods for Diffusion **No. of lectures- 8**

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

Section II

Unit-4: Finite Volume Method for Convection & Diffusion **No. of lectures- 8**

Introduction to finite volume philosophy Integral approach, discretization and higher order schemes, Application to complex geometry, Solving the Fluid Dynamic Equations, Finite Volume Method for One-Dimensional Steady State Diffusion Problems, Steady State one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Hybrid, Power-law, QUICK Schemes.

Unit-5: Flow Field Analysis **No. of lectures- 6**

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

Unit-6: Turbulence Models & Mesh Generation. **No. of lectures- 6**

Turbulence models, mixing length model, Two equation (k-?) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Assignment on 1D, 2D& 3D steady state diffusion (Cartesian Coordinates)
2. Assignment on 1D, 2D &3D steady state diffusion (Spherical Coordinates)
3. Assignment on 1D Unsteady Heat Conduction (Polar Coordinates),
4. Assignment on 1D Unsteady Heat Conduction (Spherical Coordinates),
5. Assignment on Steady State Convection-Diffusion
6. Assignment on Higher order differencing schemes for convection-diffusion problems
7. Assignment on of Transient Convection-Diffusion using QUICK scheme
8. Assignment on Pressure-Velocity Coupling in Steady State Flow
9. Assignment on Pressure-Velocity Coupling in Transient flow
10. Assignment on Turbulence Model & Mesh Generation

Text Books:

1. Hoffmann, K.A. and Chiang, S.T., Computational Fluid Dynamics for Engineers, Engineering Education Systems, 2000.
2. Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, 2nd ed., Taylor & Francis, 1997
3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.
4. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H K Versteeg, W Malalasekera, Pearson Education Ltd.
5. Introduction to Computational Fluid Dynamics, Anil W Date, Cambridge University Press.

Reference Books

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J., "Computational Fluid Dynamics", Cambridge University, Press, 2002. 3
3. Prodi Niyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
4. Anil W. Date, "Introduction to Computational Fluid Dynamics", Cambridge University Press, 2005

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4143 : Process Engineering

Teaching Scheme	Examination Scheme
Lectures : 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Practical : 02Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

This course gives selection of correct operation, process, machine, tools and other equipment etc. and also correct selection & design leads to compact & less cost of system .process planning, design & development, for an optimum process of a given job type component in a given situation. Process planning, design & development, for an optimum process of a given batch type component in a given situation. Process planning, design & development, for an optimum process of a given mass type component in a given situation. Comparison of the processes on the basis of parameters like cost and processing time

Course Objectives:

During this course, student is expected to:

1. To familiarize with the significance of process engineering with its relevance to manufacturing operations.
2. To prepare a skills in preparing machining sequence and estimate manufacturing time.
3. To acquaint with the significance of part print and control of tolerance in design & manufacturing.
4. To appraise with basics of process and operation planning activities.
5. To prepare the student to design & develop an optimum process for a given component in a given situation.

Course Outcomes:

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

1. Determine machine sequences to cater to the manufacturing requirements.

2. Analyze part prints.
3. Construct process picture, process routing/process sheets.
4. Devise process plan for a given component for job, batch and mass production
5. Develop process plan for product within optimum time and cost

Section I

Unit-1: Introduction **No. of lectures- 7**

Manufacturing system, Input & Output of manufacturing system, characteristics of manufacturing system,Categories of manufacturing system, Manufacturing Engineering, organization chart,Position of product & process Engineering Department in organization, Function of product & process Engineering.

Unit-2: Fundamentals of process planning **No. of lectures- 9**

Aims & objectives, Design & manufacturing cycle, Causes of work-piece variations, variables influencing work-piece control, Dimensional control and geometrical control for the job , Process planning activities, Documents released by product & process engineering department, Part print analysis & details of different steps involved in part print analysis, Route sheets, operation list, tooting list, list of cutting parameters, process chart symbols, Input & output of process planning, process planning & production planning, Process planning methods., General guidelines for manual process planning, advantage & limitations.

Unit-3:Drawing interpretation **No. of lectures-4**

Introduction to limits, fits and tolerances, Interchangeability, standardization, selective assembly, Process tolerance, tolerance stacks- types, effects, Methods to control the tolerance stack

Section II

Unit-4:Feasibility study & selection of sequence of operation No. of lectures-4

Technical, economical & managerial aspects, Procedure to study feasibility, Classification of operations, Factors deciding the sequence, combining & eliminating the operation, Factors affecting method selection, Study of alternative methods.

No. of lectures-6

Unit-5:Selection of equipments& Selection of tooling

Factors in equipments selection – Technical & operational factors, economic & managements consideration, Various sources of information, Selection criteria for GPM'S, SPM'S for processing., Factors in tool selection, constraints in tool selection, operating requirements for tool selection, Technical specification for standard cutting tool & gauges required various machining operations

No. of lectures-10

Unit-6: Preparation of process sheet for machining of components for job, batch & mass production

Drawing interpretation, Classifying operations (Study of Basic Processes Operations, Principal Processes and Auxiliary Processes, identification of major, critical, qualifying, re-qualifying and supporting operations), product and process critical area, Process m/c selection & sequencing of process & operations, Tooling selection, setting correct cutting parameters, selecting proper work holding devices, process pictures, symbols, process pictures for operations, Selection of proper Inspection method required, Documenting process plan, Costing the process plan, Process bench marking.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1A) Study of process planning of a component on job basis in industry

1B) Study of process planning of a component on batch basis in industry

2. Process plan for processing of component on job basis. (2 Exercises)

3. Process plan for processing of a component on batch basis. (2 Exercises)

4A) Process plan for processing of a component on mass basis. (2 Exercises)

4B) Process pictures for various operations for a given component. (2exercises)

(These exercises shall include the components requiring processing on at least3 machines)

Process sheet shall include -

a. Sequence of operation including m/c selected, holding method, and machiningdata for each set up, time estimate.

b. Specification of gauges & inspection equipments.

c. ISO or any commercial Specification of each tool.

5. Industrial visit to study process planning of component & its report.

6. Process planning of given component on CNC/VMC.

Text Books:

1. A textbook of Production Engineering – P.C Sharma (Millenium editor).

2. Process planning and cost estimation by Vijayaramanath and Kesavan, New Age International Publications

3. Standard Manual of ISO, QS, TS etc.

4. Manufacturing catalogues for cutting tools & Inspection equipments

Reference Books

1. Process planning : Peter Scallen (BH publication)

2. Process Engineering for manufacturing – Eary& Johnson

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B. TECH. (Mechanical Engineering)

Semester-VII

ME4144 : Finite Element Method

Teaching Scheme	**Examination Scheme**
Lectures : 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Practical : 02Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

The Finite Element Method (FEM) or Finite Element Analysis (FEA) is a numerical technique to find approximate solutions of partial differential equations. FEM is an integral part of CAE and is extensively used in analysis and design of real life complex problems. Several sophisticated commercial and free FEM software are available in the market, but to use these effectively and to understand & analyze the results theoretical foundations of FEM are essential. This course is designed to cover both aspects (theory and software) of FEM. This course will enable the student to formulate and solve the mathematical equations for 1D, 2D and 3D finite by hand and using FEM software.

Course Objectives:

During this course, the student is expected to:

1. Understand general procedure involved in FEM as applied to structural & thermal problems.
2. Apply direct method to formulate FEM equations for 1D, 2D and 3D elements.
3. Understand the use of variational formulation and method of weighted residuals in solving field problems.
4. Use the latest FEM software in solving problems for research and industry.

Course Outcomes:

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

1. Implement general procedure of FEA for structural and thermal problems.
2. Write down shape functions for 1D, 2D and 3D elements.
3. Solve 1D, 2D and 3D problems using FEA procedure.
4. Solve boundary value problems using variational calculus and weighted residuals methods.

5. Analyze of 1D, 2D and 3D problems for static and dynamic loads in commercial or open source FEA software.
6. Analyze of 1D, 2D and 3D problems for linear and non-linear responses in commercial or open source FEA software.

Section I

Unit -1: FEA fundamentals, Mathematical Background **No. of lectures - 8**

History and fundamentals of FEA, General FEM procedure, direct formulation for uniaxial elements using matrix methods, applications of FEM, comparison to other computational techniques such as FDM, BEM, FVM and their applications, merits and demerits of FEM compared to exact solutions and experimentation. Types of elements, interpolation function definition.Variational calculus, Ritz method, methods of weighted residuals such as, Elimination Method, Penalty Method, (Simple numerical exercises on Ritz Method and Galerkin-Bubnov method only, simple problems on elimination and penalty method)

Unit -2 : Model Validity, Solvers, Software capability and comparison **No. of lectures - 6**

Model validity, mesh design & refinement, element distortion. Sub modelling and sub structuring. Overview of solvers, selection of solvers.Overview review of free and commercial software, comparison of capabilities, Preprocessors, Solvers, Post Processors, Comparison of capabilities of free and commercial software packages.

Unit -3: Finite element formulation for 1D elements **No. of lectures - 6**

Types of 1D elements, interpolation functions for 1D elements such as truss, beams and thermal elements, shape functions for the same, formulation of system equations for trusses and beam elements, calculation of stresses and strains. Shape functions for 1D elements in global and natural coordinates. Applications of 1D elements.(Derivations using Lagrangian Polynomials and Simple Numerical Exercises)

Section II

Unit - 4: Finite element formulation for 2D elements **No. of lectures - 6**

2D Elements such as triangles and quadrilaterals, Pascal triangle for formulating interpolation functions, shape functions for 2D elements, LST, CST, linear and parabolic quads, axisymmetric elements, 2D shell elements. Shape functions for 2D elements for in global and natural coordinates. Applications of 2D elements.(Derivations using Lagrangian Polynomials and Simple Numerical Exercises)

Unit -5: Finite Element Formulation for 3D elements **No. of lectures - 6**

3D elements such as tetrahedrons and brick elements, Interpolation functions for 3D elements, Pascal

Tetrahedron, shape functions, formulation of system equations, calculation of stresses and strains. Applications of 3D elements(Derivations using Lagrangian Polynomials and Simple Numerical Exercises)

Unit - 6: Nonlinear and Dynamic Analysis **No. of lectures - 8**

Nonlinear elasticity problems: Material, geometric and boundary condition non-linearity, contact and gaps.Dynamic Problems: Modal Analysis, transient response analysis, harmonic analysis, spectrum analysis, transient thermal analysis. Introduction to explicit analysis, fatigue

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. One assignment on FEA fundamentals and comparison with other techniques.
2. One assignment with numerical exercises on variational formulation and method of weighted residuals formulation
3. One software assignment supported by hand calculations on 1D structural and thermal analysis..
4. One software assignment (supported by hand calculations if applicable) on 3D Structural and thermal analysis.
5. One software assignment (supported by hand calculations if applicable) on 3D structural analysis.
6. One software assignment on non-linear FEA.
7. One software assignment on dynamic FEA.
8. One assignment on Natural Coordinates and Isoperimetric formulation
9. One assignment on FEA applications and future developments.
10. One software assignment on fatigue analysis using FEA

Note: All software results must be supplemented with hand calculations wherever possible.

Text Books:

1. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill Education Pvt. Ltd.
2. P. Seshu, Text book of Finite Element Analysis, PHI Learning Private Ltd., New Delhi.
3. U. S. Dixit, Finite Element Methods, Cengage Learning.
4. S.S Bhavikatti, Introduction to Finite Elements, New Age International Publications.
5. Daryl Logan, A First Course in the Finite Element Method, Cengage

Reference Books

1. R. D. Cook, et al., Concepts and Applications of Finite Element Analysis. Wiley, India
2. K. J. Bathe, Finite Element Procedures Prentice, Hall of India (P) Ltd., New Delhi.
3. O. C. Zienkiewicz, R. I. Taylor, The Finite Element Method, Butterworth - Heinemann
4. M. J. Fagan, Finite Element Analysis, Theory and Practice, Pearson Education Limited.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4145: Tribology

TeachingScheme

Lectures:03Hours/week, 03Credits

Practical :02Hours/week, 01Credits

Examination Scheme

ESE:70Marks

ISE: 30Marks

ICA: 25 Marks

Course Introduction:

The study of friction, wear and lubrication has long been of enormous practical importance, since the functioning of many mechanical, electrochemical and biological systems depends on the appropriate friction and wear values. In recent decades, this field, termed tribology, has received increasing attention as it has become evident that the wastage of resources resulting from high friction and wear is greater than 6% of the Gross National Product. The potential savings offered by improved tribological knowledge, too, great.

Tribology deals with design of fluid containment systems like seals and gaskets. Lubrication of surfaces in relative motion to achieve reduced friction and wear. The structure of bearing and the nature of fluid flow determine the loads that can be supported. Modeling systems as hydrostatic, squeeze film and elasto-hydrodynamic lubrication will be studied as infinite and later finite structures. Surface engineering covers design of surface modification, modification of surface properties using suitable technique, characterization of modified surfaces and implementation, standardization of the approach of surface modification for given application have been described.

Course Objectives:

During this course, student is expected to:

1. To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
2. To select proper grade lubricant for specific application.
3. To understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
4. To introduce the concept of surface engineering and its importance in tribology.
5. To understand the behavior of Tribological components.
6. To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.

Course Outcomes:

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

1. The course will enable the students to know the importance of Tribology in Industry.
2. The course will enable the students to know the basic concepts of Friction, Wear, Lubrications and their measurements.
3. This course will help students to know the performance of different types of bearings and analytical analysis thereof.
4. This course will help students to apply the principles of surface engineering for different applications of tribology.

Section I

Unit 1: Introduction to Tribology **No. of lectures- 07**

Importance of Tribology in Design, Tribology in Industry, Economic Considerations, Lubrication- Definition, Lubricant properties, Viscosity, its measurements- Numerical, basic modes of lubrication, types of lubricants, Standard Grades of lubricants, selection of lubricants, commonly used lubricants and Hazards, Recycling of used oil, Disposal of used oil, bearing materials, bearing construction, oil seals and gaskets.

Unit-2:Friction and Wear **No. of lectures- 06**

Introduction, Laws of friction, kinds of friction, causes of friction, area of contact, friction measurement, theories of friction.Types of wear, various factors affecting wear, measurement of wear, wear between solids and flowing liquids, theories of wear

Unit 3: Hydrodynamic Lubrication **No. of lectures- 07**

Theory of hydrodynamic lubrication, mechanism of pressure development in an oil film. Two dimensional Reynolds equation, Petroff's equation, pressure distribution in journal bearings - long & short, Load Carrying capacity, Somerfield number and its importance- Numerical. Introduction to Hydrodynamic Thrust Bearing

Section II

Unit 4: Hydrostatic Lubrication **No. of lectures- 06**

Introduction to hydrostatic lubrication, hydrostatic step bearing, load carrying capacity and oil flow through the hydrostatic step bearing- Numerical.

Hydrostatic squeeze film : basic concept, circular and rectangular plate approaching a plane-

Numerical

Unit 5: Elasto-hydrodynamic lubrication and Gas Lubrication **No. of lectures- 06**

Elasto - hydrodynamic lubrication: Basic concept, Elasto-hydrodynamic lubrication between two contacting bodies, different regimes in EHL contacts.

Gas lubrication: Introduction, merits and demerits, applications, externally pressurized gas bearings, porous gas bearings, and Dynamic characteristics of gas lubricated bearing.

Unit 6: Surface Engineering **No. of lectures- 08**

Concept and scope of Surface engineering, surface topography, apparent and real area of contact, tribological behavior of asperities contact- contact stress, surface roughness and hydrodynamic action- Numerical, surface coating-plating, fusion process, vapor phase processes, selection of coating for wear and corrosion resistance. Behavior of tribological components- selection of bearings, plain bearings, gears, wire ropes, seals and packings, conveyor belts, other tribological measures.

Internal Continuous Assessment (ICA):

Term Work shall consist of following assignments:

A] Any one case study of the following

1. Friction in sliding/ rolling contact bearing.
2. Wear of cutting tool.
3. Surface Coating.
4. Sliding/ rolling contact bearing Performance

B] Assignment based on the Tribological design of the system like I C Engine, Machine Tool, Rolling Mill.

OR

Industrial Visit: Students should visit the industry to study the lubrication systems or to study the techniques of surface coating.

Text Books:

1. Basu S.K., Sengupta S. N. and Ahuja B.B. “Fundamentals of Tribology” PHI Learning, Ltd. India.
2. Majumdar B. C. "Introduction to Tribology and Bearings", S. Chand and Company Ltd., New Delhi.

Reference Books

1. Bharat Bhushan, “Principles and Applications of Tribology”, John Wiley and Sons. 5.
2. Sahu P., “Engineering Tribology”, PHI Learning, Ltd. India
3. Fuller D.D. "Theory and Practice of Lubrication for Engineers". John Wiley and Sons
4. Neale M. J. "Tribology hand Book", Butterworths. London.
5. Orlov P., "Fundamentals of Machine Design", Vol. IV, MIR Publication.
6. Cameron A. "Basic Lubrication Theory", Wiley Eastern Ltd.
7. Hailing J., "Principles of Tribology", McMillan Press Ltd., 1975.
8. Ghosh M.K., Mujumdar B.C. and Sarangi M., “Theory of lubrication”, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME 4146 : Railway System and Management

TeachingScheme	**Examination Scheme**
Lectures:03Hours/week, 03Credits	**ESE:70Marks**
Practical:02Hours/week, 01Credit	**ISE: 30Marks**
	ICA: 25Marks

Course Introduction: This course seeks to provide abasic knowledge of railway systems & their management techniques. The first half of the syllabus covers various railway systems like Suspension & Braking System, Coupling, Bogie Assembly, HVAC System, Drive Train, Traction and Signal System, whereas section half gives idea about the maintenance and Rehabilitation Practices followed in railway workshops and manufacturing units also vehicle Safety & Environment related issues are highlighted. Various Railway Management Systems like Traffic management, Ticket reservation system, rolling stock management, Digital technologies used in traffic control, Freight management are also explained.

CourseObjectives:

During this course, student is expected to:

1. Differentiate between various suspension & Braking Systems used in railways.
2. Analyze the design of bogies considering various mechanisms and HVAC system.
3. Correlate the generation of tractive effort traction and Signal System
4. Study Track maintenance procedures. Scrap management
5. Evaluate the impact of traffic composition on environment and safety considerations in vehicle.
6. Study the working of various Railway Management Systems

CourseOutcomes:

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

1. Understand working of various suspension & Braking Systems used in railways.
2. Understand the assembly of bogies and working of various mechanisms used in bogies.
3. Understand the generation of power for tractive effort through various units and working of each unit
4. Conduct maintenance trial on bogies and Rehabilitation practices.
5. Analyze the importance of environmental awareness while designing a train service

Section I

Unit-1:Suspension & Braking System No. of lectures-08

Suspension System: Sprung and unsprang mass, types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydro gas, rubber suspension, interconnected suspension, self-leveling suspension (active suspension), damping and shock absorbers, Dampers- Fresh Air Dampers, Diversion Dampers. Suspension systems of Diesel locomotives and effect on tractive effort.

Braking System: Types of brake systems - air brakes, vacuum brakes, dynamic brakes, servo and power braking, ABS, Recuperative braking system.

Friction braking, Regenerative braking system, Utilization of generated power, Selection of appropriate braking system.Emergency braking system.

Unit-2:Coupling, Bogie Assembly and HVAC System No. of lectures-06

Railway coupling: Mechanism used to connect rolling stocks, Screw coupler, Janney coupler, CBC Coupler.

Bogie Assembly: Components and design consideration.

HVAC System: Air Conditioning- Heating, Ventilation and cooling, heat exchangers to preheat or precool incoming air. Ventilation Cut-Out Switch, Freeze Protection

.

Unit-3:Drive Train, Traction and Signal System No. of lectures-06

Drive train and traction: Power generation units,OHE (Catenary) System, Pantograph electric system, Transformer system, AC to DC conversion- Rectifier. Traction motors, Batteries. Lighting System & Accessories.

Signal System: Classification of Signals- Manual and Automatic, Working of signal system

Modern signal system

Section II

Unit-4:Vehicle maintenance and Rehabilitation *Practice* No. of lectures-06

Schedule maintenance chart of a vehicle, overhauling and periodic overhauling, servicing of engine, gear box, chassis,wheels, suspension, brakes system, couplers, electrical system, HVAC systems.

Rolling stock interior maintenance.Rolling stock parts replacement and upgradationTrack maintenance. Scrap management.

Unit-5:Vehicle Safety & Environment **No. of lectures-08**

Vehicle safety: active, passive safety, Rolling stock interior and ergonomics, comfort, Safetyconsiderations of rolling stock design, Disaster management.

Environment: Natural environment of the railway, Air pollution, soil and water pollution, Visual annoyance, Acoustic annoyance, Ecosystem disturbance, Disturbance of local resident activities, Ground-borne noise and vibrations. Green Initiatives in railway sectors. Solar Trains. Rain water harvesting in Railways. Human waste management: Bio toilets, Modular toilet, Vacuum toilet, CDTS toiles.

Unit-6: Railway Management Systems No. of lectures-06

Traffic management: Approach, Planning, Rostering of crews, Time table management.

Ticket reservation system: Reservation of Train, Coach as a private unit

Rolling stock management: Train, Locomotive, Coaches and wagons.

Digital technologies used in traffic control: RFID, LIDAR, Li-Fi.

Freight management: selection criteria.Dedicated Freight Corridors (DFC)- WDFC, EDFC

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

(minimum 4 from group A and B, and all from Group C)

Group A (Study group)

1. Assignment on Suspension & Braking System
2. Assignment on Coupling, Bogie Assembly and HVAC System
3. Assignment on Drive Train, Traction and Signal System
4. Assignment on Vehicle maintenance and Rehabilitation Practice
5. Assignment on Vehicle Safety & Environment
6. Assignment on Railway Management Systems

Group B (Trial group)

1 Case study on Selection of rolling stock.

2 Case study on HVAC system.

3 Case study on Freight railway transport.

4 Case study on Railway safety.

5 Case study on Ecosystem in railway.

6 Case study on Economic profitability of a railway system.

Group C

1 Visit to manufacturing or repairing unit.

Text Books:

1. Railway Transportation Systems – Design, Construction and Operation, Christos N. Pyrgidis, 2019, CRC Press.
2. Indian Railway Transportation Management, Vinod Pal, Bahri Brothers, (2018) edition 5.
3. A Text Book of Railway Engineering, S.C. Saxena, S.P.Arora, DhanpatRai Publications (p)Ltd.-new Delhi, 2010.

Reference Books

1. Technology in Rail Transport Management,PrabhaShastriRanade,ICFAI Books; UK ed. edition (20 October 2009)
2. Indian Railway Track, M. M. Agarwal, Ruby Jubilee.
3. Principles of Railway Engineering, S.C. Rangawala, Charotar Publication, 2015.
4. Railway Management and Engineering, V Profillidis, Routledge; 1 edition (29 Nov. 2017).

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4151 : Costing and Cost Control

TeachingScheme	**Examination Scheme**
Lectures:03Hours/week, 03Credits	**ESE:70Marks**
Tutorial:01Hours/week, 01Credit	**ISE: 30Marks**
	ICA: 25Marks

Course Introduction:

Strategic growth & competiveness of organizations are depending upon the raw material utilization in the organization and cost of raw material and cost of manufacturing ultimately the profit of the organization depend upon effective use of resources. The syllabus is divided into two sections, each section contains three chapters.

CourseObjectives:

During this course, student is expected to:

1. Develop knowledge about the principles of costing and cost control.
2. Solve organizational problems related to cost as well as cost control.
3. Empower students to handle case studies related to cost control problems.

CourseOutcomes:

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

1. Explain importance, scope and need of cost and cost Estimation.
2. Evaluate the cost control methods for weight and material.
3. Apply the concept of cost and cost Estimation to various types of manufacturing systems.
4. Explain the machine hour rate and different costs associated with labour.
5. Apply the concept of cost control.
6. Determine the applications of value analysis and value engineering.

Section I

Unit-1:Introduction to Cost and Cost Estimating **No. of lectures- 08**

Concept of cost, classification of cost, different costs for different purposes. Definition of costing, cost-price-profit equation. Definition, purpose and functions of estimation, role of estimator, constituents of

estimates, estimatingprocedures.

Unit-2:Estimation of Weight and Material Cost **No. of lectures-05**

Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost. Review of purchasing procedure, recording of stock and consumption of material by LIFO, FIFO, and Weighted average method

Unit-3:Estimation of fabrication cost **No. of lectures-07**

a) Constitutes, direct cost, indirect cost, Procedure of estimation of fabrication cost

b) Estimation of foundry cost: Direct & indirect cost, Procedure of estimation of foundry cost

c) Estimation of forging cost: Direct & indirect cost, Procedure of estimation of forging cost.

d) Estimation of machining cost: Direct & indirect cost, Procedure of estimation of machining cost.

Section II

Unit-4: Machine &Labour Cost **No. of lectures-08**

Steps forestimation of machine hour rate for conventional machines (like lathe, drilling, milling, CNC, VMC etc.), Direct and indirect labour cost, Workmen classification, Definition of wages, Methods of remuneration

Unit-5:Cost Control **No. of lectures-06**

Different cost control techniques such asbudgetary control, standard cost, variance analysis, marginal cost, Zero Base Budgeting and break even analysis

Unit-6:value Analysis and value engineering **No. of lectures-06**

Concept, Definitions of Value, value engineering, value analysis, valuemanagement, habits, road blocks and attitudes and their relation to value engineering

Internal Continuous Assessment (ICA):Assignments/Case Studies, etc.

(Minimum at least **SIX**Assignments/Case Studies)

1. Estimation of weight and material cost for an assembly of three to five components.
2. Valuation of inventory by LIFO, FIFO, Weighted average method
3. Estimation for machine hour rate for representative machines – one conventional machine and one CNClathe or machining center
4. Case study on estimation of overheads for a manufacturing unit
5. Study of different methods for allocation, apportionment, absorption of overheads

6. Case study in any one industry using any of the method of costing.
7. Different examples illustrating cost control
8. Case studies of cost reduction

Text Books:

1. Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)
2. Costing Simplified: Wheldom Series – Brown &Owier (ELBS)
3. Cost Accounting: B. Jawaharlal (TMH)
4. Cost Accounting: R.R. Gupta.
5. Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)

Reference Books

1. Cost Accounting: Jain, Narang (Kalyani Publishers)
2. A Text Book of Estimating and Costing Mechanical – J.S. Charaya& G. S. Narang(SatyaPrakashan)
3. Mechanical Estimation and Costing – TTTI, Chennai (TMH)
4. Theory & Problems of Management & Cost Accounting – M.Y. Khan, P. K. Jain (TMH)

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4152 : Entrepreneurship Development

TeachingScheme	**Examination Scheme**
Lectures: 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Tutorial : 01 Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

Entrepreneurship education in India has gained relevance in today's context. Education in the area of entrepreneurship helps students to develop skills and knowledge, which could benefit them for starting, organizing and managing their own enterprises. Entrepreneurship education encourages innovation, fosters job creation, and improves global competitiveness. This course will focus on key attributes of Entrepreneurship: Qualities required to become a successful entrepreneur, Entrepreneurship Development Programmes, Ideation Techniques, Business Plan Formulation and its Appraisal, Problems faced by Entrepreneurs and ways to get through, Different Government Agencies and Policies, Taxation, Marketing, Export-Import and so on. To sum up, the course will make students to have an understanding of the complete entrepreneurial ecosystem.

CourseObjectives:

During this course, student is expected to:

1. To familiarize with entrepreneurship and identify suitable business opportunities.
2. To develop skills required to establish and run a successful enterprise.
3. To acquaint with the options available with new entrepreneurs.
4. To develop feasible ideas to implement in their entrepreneurial career.
5. To formulate business plan/project report for a startup.
6. To acquaint with Government policies and agencies associated with entrepreneurialDevelopment

CourseOutcomes:

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

1. Identify the business opportunities that fit the individual or the group.
2. Explain factors influencing on entrepreneurial development.
3. Analyze various options available for deciding entrepreneurial career.
4. Explain various methods and sources for idea generation.
5. Develop a feasible project report suitable for individual or group.
6. Select financial institutions for getting financial assistance and establishing new enterprise.

Section I

Unit-1: Introduction to Entrepreneurship **No. of lectures- 10**

a) Concept, meaning and definitions of entrepreneur and entrepreneurship,

b) Importance and significance of growth of entrepreneurial activity,

c) History of entrepreneurship development in India,

d) Corporate entrepreneurship (intrapreneurship),

e) Social entrepreneurship,

f) Characteristics and qualities of entrepreneurs,

g) Factors influencing entrepreneurial development and motivation,

h) Market Survey: Methods, Importance in Entrepreneurial development,

i) Classification and types of entrepreneurs.

Unit-2:Entrepreneurship Development **No. of lectures- 10**

a) Entrepreneurial development programmes (EDP): Introduction, Curriculum, Phases, Problems faced by EDPs.

b) Problems faced by new entrepreneurs: Managerial, marketing, financial & technological and their probable solutions

c) Options available to entrepreneurs - franchising, Mergers and outsourcing (characteristics, advantages, limitations, suitability of each option)

d) Special Economic Zone

Section II

Unit-3:Entrepreneurial Project Development **No. of lectures- 10**

a) Idea generation – sources and methods

b) Identification and classification of ideas.

c) Creativity: Steps in Creativity, Innovation and invention

d) SWOT analysis

e) lean canvas model

f) Preparation of a project report/business plan including : market plan, financial plan, operational plan, HR plan, Significance of project report, etc

g) Project appraisal - Aspects and methods: Economic oriented appraisal, Financial appraisal, Market oriented appraisal, Technological appraisal, Managerial competency Appraisal

h) Industrial Development Corporation: Role, Land Allotment etc.

Unit-4:Micro-Small-Medium Enterprises and Support Systems **No. of lectures- 10**

a) Meaning and definition of micro, small & medium enterprises

b) MSME: UdyogAadhaar, Role, Importance, Registration etc.

c) Ownership patterns: sole proprietorship, partnership, private limited company

d) Steps in setting up a small unit

e) Role of Central and state Government in Subsidies

f) Funding options available: angel investors, venture capitalists, commercial banks, financial institutions, Bank loan Procedure and documents required.

g) Support agencies: SIDBI, SISI, NABARD, DIC, MCED, EDII, NIESBUD, EPC etc. – Their role in the Development of SMEs

h) Technology business incubation (TBI) centers

i) Export Potential of SMEs, Export procedure, Incentives and facilities to exports entrepreneurs

j) Types of Taxes and Taxation benefits for SME sector

Internal Continuous Assessment (ICA): List of Case Studies.

1. Case study on male entrepreneur
2. Case study on female entrepreneur
3. Case study on social entrepreneur
4. Interview of a local entrepreneur
5. SWOT analysis of existing enterprises (minimum 2)
6. Preparation of project report/business plan for starting a small unit and presentation on the same (including details of business idea, market survey, business model, different plans, etc)

Text Books:

1. Management of small scale industries - J.C. Saboo, MeghaBiyani, Himalaya Publishing House
2. Small-Scale Enterprises and Entrepreneurship - Vasant Desai, Himalaya Publishing House
3. Entrepreneurial Development, S. S. Khanka, SChand Publications

Reference Books

1. Dynamics of Entrepreneurial Development and Management - Dr. Vasant Desai, Himalaya Publishing House
2. Entrepreneurship - Robert D Hisrich, Michael P Peters and Dean A. Shepherd, McGraw Hill Education
3. Social Entrepreneurship For The 21st Century: Innovation Across The Nonprofit, Private, And Public Sectors - Georgia LevensonKeohane, McGraw Hill Education
4. Corporate Entrepreneurship , Paul Burns, Macmillan International Higher Education

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4153 : Business Development

TeachingScheme	**Examination Scheme**
Lectures: 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Tutorial : 01Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

Business development encompasses a wide scope of ideas, activities, and initiatives that a business owner and management implement with the goal of making the business better. Business development can include many objectives, such as marketing and sales growth, business expansion, the formation of strategic partnerships, awareness of Company laws and Government Aids, to increased profitability. Successful business development impacts every department within a company, including sales, marketing, manufacturing, human resources, accounting, finance, product development, and vendor management.

CourseObjectives:

During this course, student is expected to:

1. To understand basic Business analysis Techniques and IPR
2. To understand concept of business expansion
3. To acquaint with Government policies and agencies associated with entrepreneurial development
4. To understand sales management, its function and responsibility in Business Development
5. To understand the concept of marketing management, market segmentation and how they are integrated in practice
6. To understand marketing Mix, place and promotion mix and strategy; its relevance in a developing economy

CourseOutcomes:

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

1. To familiarize basic Business analysis Techniques and IPR
2. To familiarize concept of business expansion.
3. To Select financial institutions for establishing new enterprise
4. To familiarize with sales management, its function and responsibility in Business Development
5. To familiarize with marketing and its concepts also To acquaint with new marketing trends and

the marketing environment..

6. To study the components of the marketing mix, place and promotion mix identify how the firms marketing strategy, marketing mix evolve

Section I

Unit-1: Introduction to Business Development **No. of lectures- 8**

Business Development:Benefits, Responsibilities in the organization. Development of BD Basic questions. Business model Analysis, Business analysis Techniques(MOST,SWOT, MoSCoV, CATWOE, Six Thinking Hats),Startups: Introduction, Opportunities ,issues and challenges, government Initiatives and Technology business incubation (TBI),Leadership, teamwork and organizational performance

Intellectual property rights: industrial properties, patents, industrial designs, trademarks, trade secrets, plant varieties, integrated circuits, geographical indicators.

Copyright literary: novel, poem, plays, films, musical, artistic drawings , photographs, performing arts, sculptures, software

Business Expansion – ancillarisation, franchising and outsourcing, mergers and acquisitions (characteristics, advantages, limitations, suitability of each option)

Unit-2: Company act and Government Funding agencies **No. of lectures- 6**

Company act: Characteristics, types, Process of company incorporation, distinction between MOA and AOA, Meetings: types ,procedure. Comparison of Acts

Policies governing SMEs ,Funding options available : angel investors, venture capitalists, commercial banks, financial institutions Support agencies: SIDBI, SISI, NABARD, DIC, MCED, EDII, NIESBUD, EPC etc. – Their role in the development of SMEs ,Export Potential of SMEs, Export procedure

Unit-3: Sales Management **No. of lectures-6**

Introduction, Concept, Evaluation of sales Management, Objective of sales management, Importance of sales management, Nature of sales management, Sales management process/ functions, Role of sales management in marketing, Salesmanship concept, Classification of salesmanship, Specific characteristics of successful salesman, Sales manager function and responsibility.

Section II

Unit-4:Basics of Marketing and market segmentation **No. of lectures- 8**

Introduction, Nature & scope of marketing, the core concepts of marketing, Marketing Planning process, Differentiation between Sales and Marketing. Introduction to Services marketing

Market segmentation-Meaning and concept, benefits of segmentation, Bases for market segmentation, Market targeting, Selection of segments, Product positioning

Unit-5:Marketing Mix **No. of lectures-6**

A Product Mix: concept of product, product characteristics, product life cycle (PLC) concept, product elimination, product diversification, new product development.

B. Branding and packaging: concept of branding and packaging, advantages and disadvantages of branding and packaging, features and functions of packaging.

C. Price mix: Meaning, elements, importance of price mix, Factors influencing pricing, pricing methods and recent trends, price determination policies.

Unit-6:Place & Promotion mix **No. of lectures- 6**

A. Place mix: meaning and concept of channel of distribution. Types of channel of distribution or intermediaries, factors influencing selection of channels, types of distribution strategies, intensive, selective and extensive, recent changes in terms of logistics and supply chain management.

B. Promotion mix: meaning, elements of promotion mix, advertising: definition, importance, limitations, types of media, 5 M's of advertising. Distinction between advertising and publicity

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Preparation of case study report on any one Start up
2. Business analysis of existing enterprises (minimum 2)
3. Preparation of case study report on any two(ancillarisation /franchising /outsourcing/ mergers / acquisitions)
4. Select any product related to technology and service,submit a report about selling strategies employed
5. Select any product along with its competitor and study Segmentation, Targeting, and Differentiation and Positioning. Submit a report.
6. Online exercise: visit any website of FMCG organization, study its marketing mix with respect to product or price and submit a report.
7. In the same organization (FMCG) visited online, study its marketing mix with respect to place and promotion and submit a presentation on any one mix (Place/promotion) in the class.
8. Select any organization and study its supply chain management

Text Books:

1. Sales Management –S.A.Chunawalla, Himalaya Publishing House
2. Management of small scale industries - J.C. Saboo, MeghaBiyani, Himalaya Publishing House
3. Marketing Management-Ramswamy V. S., Namakumari S., Macmil lion Pub lishers India Ltd. • Marketing Management-Raj an Saxena, Tata McGrawHill..
4. Marketing Management: Text and Cases-Tapan Panda, Excel Books. Marketing-Etzel, Walker B., Stanton W., Pandit A., Tata McGrawHill.
5. Marketing Management- Karunakarn K-Himalaya Publication, New Delhi. • Reference Books:

Reference Books

1. Sales Management –S.A.Chunawalla, Himalaya Publishing House
2. Dynamics of Entrepreneurial Development and Management - Dr. Vasant Desai, Himalaya Publishing House
3. Marketing Management-a south asian perspective: Kotler Phillip, Keller Kevin Lane, KoshyAbrahamandJhaMithileshwar, Pearson.
4. Marketing Management: A South Asian Perspective-Kotler P., Keller K.,Koshy A., Jha M., Pearson PrenticeHall

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4154 : Product Life Cycle Management

TeachingScheme	**Examination Scheme**
Lectures: 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Tutorial : 01Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

Product lifecycle management (PLM) refers to the handling of a good as it moves through the typical stages of its product life: development and introduction, growth, maturity/stability, and decline. This handling involves both the manufacturing of the good and the marketing of it.

CourseObjectives:

During this course, student is expected to:

1. Familiarize with various strategies of PLM
2. Understand the concept of product design and simulation
3. To study the significance of digital manufacturing
4. To develop new product management system and supporting systems
5. To understand product life cycle environment
6. To apply different analysis tools

CourseOutcomes:

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

1. Describe the concepts of product of life cycle management and its applications in product development process.
2. Apply the models of Product Life Cycle for product development process
3. Emphasize the significance of digital manufacturing and product structures.
4. Analyze the strategies of Product life Cycle Management and supporting systems
5. Explore the product life cycle environment
6. Select the appropriate product life cycle management tools

Section I

Unit-1:Introduction to Product Life Cycle Management No. of lectures-06

Background, Overview, Need, Benefits, Concept of Product Life Cycle.Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement.

Unit-2:Constructing PLM & Driving Environment No. of lectures-08

Product Life cycle model- plan, design, build, support & dispose. Threads of PLM computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM).Weaving the threads into PLM, comparison of PLM to Engineering resource planning (ERP). PLM characteristics- singularity, cohesion, traceability, reflectiveness, Information Mirroring Model. External drivers- scale, complexity, cycle times, globalization & regulation. Internal drivers - productivity, innovation, collaboration & quality.Board room drivers – income, revenues & costs.

Unit-3:Digital Manufacturing – PLM No. of lectures-06

Digital manufacturing, benefits manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, manufacturing the rest, production planning.

Section II

Unit-4:Product Life Cycle Management System No. of lectures-06

Product life cycle management system- system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system. Reasons for the deployment of PLM systems

Unit-5:Product Life Cycle Environment No. of lectures-08

Product Data issues – Access, applications, Archiving, Availability, Change, Confidentiality. Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM.

Unit-6:Types of Analysis Tools **No. of lectures-06**

Design for manufacturing - machining - casting and metal forming - optimum design - Design for assembly and disassembly - probabilistic design concepts - FMEA - QFD -Taguchi Method for design of experiments -Design for product life cycle. Estimation of manufacturing costs, reducing the component costs and assembly costs, Minimize system complexity.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Assignment on Product Life Cycle Management
2. Assignment on Product Life cycle model
3. Assignment on Digital Manufacturing
4. Assignment on Product Life Cycle Management System
5. Assignment on Product Life Cycle Environment
6. Assignment on PLM Analysis Tools
7. One hands on case assignments on PLM software

Text Books:

1. Grieves, Michael. Product Lifecycle Management, McGraw-Hill, 2006.
2. Product Design & Process Engineering, McGraw Hill – Kogalkusha Ltd., Tokyo,1974.
3. Product Design & Development – by Kari Ulrich and Steven D. Eppinger, McGraw Hill International Edns, 1999.
4. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004.
5. A.K. Chitale; R.C. Gupta, “Product Design and Manufacturing” Prentice Hall India

Reference Books

1. Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006. ISBN 0071452303
2. AnttiSaaksvuori, AnselmiImmonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer-Verlag, 2004. ISBN 1852338105.
4. Product Life Cycle Management - by AnttiSaaksvuori, AnselmiImmonen, Springer, 1st Edition (Nov.5, 2003)

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4155 : Business Economics

TeachingScheme	**Examination Scheme**
Lectures: 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Tutorial : 01Hours/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction: In today's world, knowledge of Economics is necessary for everybody in all walks of life. In the days of globalization and free economy, every engineer in any discipline and any businessman must have the knowledge of fundamental concepts of economics to take correct decisions for any firm or business. With this purpose, the course covers various concepts of demand, supply, cost and cost estimation, time value of money, make or buy decisions, elementary economic analysis, project management life cycle, value analysis and value engineering.

CourseObjectives:

During this course, student is expected to:

1. Analyze factors affecting demand and supply.
2. Determine various costs and total cost, apply break even analysis.
3. Calculate worth using different techniques in time value of money.
4. Take correct decisions regarding make or buy, process or design modifications based on elementary economic analysis.
5. Carry out better maintenance; take appropriate decisions regarding replacement of assets.
6. Prepare project appraisals and compare various alternatives on economic basis, apply value analysis and value engineering for a product.

CourseOutcomes:

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

1. Analyze factors affecting demand and supply.
2. Determine various costs and total cost, apply break even analysis.
3. Calculate worth using different techniques in time value of money.
4. Take correct decisions regarding make or buy, process or design modifications based on elementary economic analysis.
5. Carry out better maintenance; take appropriate decisions regarding replacement of assets
6. Prepare project appraisals and compare various alternatives on economic basis, apply value analysis and value engineering for a product.

Section I

Unit-1: Fundamentals of Business Economics **No. of lectures- 08**

Definition of Economics, Definition and scope of Business Economics, major topics in Engineering Economics, importance of economics in a business, concept of efficiency, Theory of Demand, Law of demand, determinants of demand, Price Elasticity of Demand, profit and loss, total revenue, average revenue, marginal revenue, Income Elasticity of Demand, Cross Price Elasticity of Demand, Supply and law of Supply, relationship between demand and supply, Market equilibrium, Indifference Curves, Welfare Analysis

Unit-2: Costs, Cost Estimation and Break Even Analysis **No. of lectures- 07**

Concept of Cost, difference between cost and price, types of costs, implicit and explicit costs in a business or a firm, historical and current costs, sunk and incremental costs, fixed and variable costs, long run and short run costs, Elements of cost, direct and indirect costs, material cost, labour cost, prime cost, overheads, factory cost, production cost, total cost, Break Even Analysis, Profit/Volume ratio, applications

Unit-3: Time Value of Money **No. of lectures- 05**

Time Value of Money, inflation, causes, consequences and control of inflation, interest formulae and their applications, cash flow diagram, present worth method, future worth method, annual equivalent or annuity method, E.M.I., rate of return method, applications of these to determine worth.

Section II

Unit-4: Make or Buy Decision and Elementary Economic Analysis **No. of lectures- 08**

Make or Buy decisions, importance in a business, factors affecting make or buy decision, various aspects of make or buy decision, break-even point in make or buy decision, elementary economic analysis, material selection for a product, raw material selection and substitution, design selection and modification, process selection and modification, engineering and economic approach

Unit-5: Maintenance Management and Replacement **No. of lectures- 06**

Maintenance and its importance, objectives of plant maintenance, types of maintenance practices, cost of maintenance, types and causes of failure, strategies to prevent them, planned and unplanned maintenance, preventive and breakdown maintenance, routine maintenance, predictive maintenance, opportunistic maintenance, design out maintenance, condition based monitoring and modern techniques, need of replacement of an asset, defender and challenger, replacement decision, lives of an asset - economic life, useful life, physical life, ownership life

Unit-6: Project Management Life Cycle and Value Engineering **No. of lectures- 06**

Project, various definitions of project, features of a project, importance of projects in a firm or business, types of projects, project management life cycle and its block diagram, project appraisals - technical appraisal, financial appraisal, economic appraisal, social appraisal, market appraisal, ecological appraisal, value of a product, types of values, performance of a product, functions of a product, value analysis, phases of value analysis, value engineering, aims of value engineering, value engineering procedure, applications of value engineering and value analysis

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Assignment on Fundamentals of Business Economics with a case study on determination of PED or IED.
2. Assignment on Costs, Cost Estimation and Break Even Analysis with a case study on determination of total cost of any part used in engineering practice.
3. Assignment on Time Value of Money with numerical problems on worth calculation and cash flow diagram.
4. Assignment on Make or Buy Decision and Elementary Economic Analysis
5. Assignment on Maintenance Managementand Replacement
6. Assignment onProject Management Life Cycle and Value Engineering with a case study on value analysis of any product.

Text Books:

1. Fundamentals of Engineering Economics: Pravin Kumar, Wiley India Pvt. Ltd., New Delhi.
2. Engineering Economics, R. Panneerselvam: PHI Learning Pvt. Ltd., Delhi.
3. Industrial Engineering and Production Management: MartandTelsang, S. Chand & Company Pvt. Ltd., Delhi.

Reference Books

1. Managerial Economics: Varshney and Maheshwari, Sultan Chand & Sons, New Delhi.
2. Principles of Engineering Economic Analysis: John White, Kenneth Case, David Pratt, Wiley India Pvt. Ltd., New Delhi.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME4156: Reliability Engineering

TeachingScheme	**Examination Scheme**
Lectures:03Hours/week, 03Credits	**ESE:70Marks**
Tutorial:01Hours/week, 01Credit	**ISE:30Marks**
	ICA:25Marks

Course Introduction:

The course includes topics on model product failure time and analysis of data to determine reliability characteristics and other general data- driven decisions required to ensure the reliability of a product.Reliability is described as the ability of a system or component to function under stated conditions for a specified period. Components such as testability, maintainability and maintenance are often defined as a part of Reliability Engineering. Reliability Engineering is essentially the study, evaluation, and life-cycle management of reliability. It is also defined as the ability of a system or component to perform its required functions under stated conditions for a specified period of time. The course focuses on costs of failure caused by system downtime, costs of spaces, repair equipment, personnel and costs of warranty claims, besides particularly dangerous system failure modes.

CourseObjectives:

During this course, student is expected to:

1. Understand the basic concepts of reliability, various models of reliability
2. Apply knowledge to system requirements, design, manufacturing and testing, with real-worldexamples
3. Understand in detail Asset Management, Maintenance, Quality and Productiveness
4. analyze reliability of various systems

CourseOutcomes:

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

1. Understand and analyze different methods of failure
2. Calculate MTTF, MTBF, failure rate and hazard rate
3. Different probability methods applied to Reliability
4. Optimize Cost & reliability.
5. Perform FEMA, FMECA, DOE, Taguchi method.
6. Apply different methods to test reliability.

Section I

Unit-1:Fundamental concepts of Reliability **No. of lectures- 8 hrs.**

Reliability terminologies, Role of the reliability function in the organization, Interrelationship of safety,quality and reliability, life characteristic phases, Product Liability-Significance, importance of reliability,Introduction to maintainability, availability.

Concepts of Failure, failure density, failure Rate, hazard rate, pdf, cdf. Modes of failure, Mean Time ToFailure (MTTF), Mean Time Between Failure (MTBF), Numerical based on calculation of failure rate,hazard rate.Warranty Management and Life cycle cost.

Unit-2:Probability Concepts and System Reliability **No. of lectures- 6 hrs.**

Basic probability concepts, Laws of probability, Introduction to independence, mutuallyexclusive,conditional probability, Discrete and continuous probability distributions, Comparison of probabilitydistributions -binomial, normal, lognormal, Poisson, Weibull, exponential,Standard deviation, variance, mean, mode and Central Limit Theorem.

Analysis of series, parallel, mixed configurationsystems,Concept of k- out of n structure, Conditionalprobability method, delta-star method for conditional probability analysis, Tie-set and Cut Set method(Concepts and Numerical).

Unit-3:System reliability Analysis **No. of lectures- 6 hrs.**

Reliability Improvement- Redundancy, element redundancy, unit redundancy, standbyredundancytypes of stands by redundancy, parallel components single redundancy, multiple redundancies(Numerical).

Introduction to Reliability allocation or apportionment, reliability apportionment techniques – equalapportionment, AGREE, ARINC, Minimum effort method (Numerical).

Section II

Unit-4:Reliability Management **No. of lectures- 8 hrs.**

Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability,system down time, availability - inherent, achieved and operational availability (Numerical treatment).Introduction to Reliability Centered Maintenance.

Design for maintainability and its considerations, Reliability and costs, Costs of Unreliability, Standardsfor Reliability-MIL Handbook 217F &Carderock Model. Technology aspects in ReliabilityManagement, BIT (Built in testing).

Unit-5:Reliability in Design & Development **No. of lectures-6 hrs.**

Reliability techniques- Failure mode, effects analysis (FMEA),Failure mode, effects and criticalityanalysis (FMECA)-Case Studies, Basic symbols, Fault Tree construction and analysis, Monte CarloSimulation.

Introduction to Design of Experiments (DOE) and Taguchi Method.

Human factors in design and design principles

Unit-6:Reliability Testing **No. of lectures-6 hrs.**

Introduction to reliability testing, Stress strength interaction, Introduction to Markov modelTesting for Reliability and Durability- Accelerated Life Testing and Highly Accelerated Life Testing(HALT), highly accelerated stress Screening (HASS).

Reliability in manufacturing- Production FRACAS.Reliability Data- Acquisition &graphical analysis.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Assignment on Fundamental concepts of Reliability
2. Assignment on Probability Concepts and System Reliability
3. Assignment on System reliability Analysis
4. Assignment on Reliability Management
5. Assignment on Reliability in Design & Development
6. Assignment on Reliability Testing
7. Case studyon FMECA
8. Problems on improvement of reliability due to preventive maintenance.

Text Books:

1. A. K. Gupta,"Terotechnology and Reliability Engineering", McMillan Publications.
2. L.S.Srinath, Reliability Engineering, EWP, 4th Edition 2011
3. Basu S.K, Bhaduri , Terotechnology and Reliability Engineering, Asian Books Publication
4. E. E. Lewis, Introduction to Reliability Engineering, John Wiley and Sons.
5. L. S. Srinath, Reliability Engineering, Affiliated East-West Press Pvt. Ltd., ISBN 81-85336-39-
6. R.M. Parkhi, Market Leadership by Quality and Reliability, Vidyanand Publications 2012

Reference Books

1. A. K. S. Jardine, "Maintenance, Replacement & Reliability" HMSO, London
2. Terotechnology-Reliability Engineering and maintenance, S. K. Basu, B. Bhadury, Asian books Pvt. Ltd (2003), ISBN 81-86299-40-6.
3. Reliability Engineering, S. S. Rao.
4. Charles E. Ebeling, Reliability and Maintainability Engineering, TMH 2009
5. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME416 : Project Work Stage-I Seminar

Teaching Scheme **Examination Scheme**

Practical:04Hours/week, 02Credits **ICA: 25Marks**

Course Introduction: Project work is kept in the final year of engineering so that students' will apply their knowledge gained through previous classes to create and evaluate innovative things. In this it is expected to solve some pressing problem related to industry or society. While carrying out the work many qualities are developed in students such as problem solving ability, modern tool usage, leadership, ethics, communication, project management & finance and lifelong learning etc.

CourseObjectives:

During this course, student is expected to:

1. Understand the basic concepts & broad principles of Industrial projects.
2. Demonstrate a sound technical knowledge of their selected project topic.
3. Demonstrate the ability to locate and use technical information from multiple sources.
4. Apply fundamental principles of science and engineering to design and fabricate models for diversified applications.
5. Select the suitable material and manufacturing process and approach for solving an engineering problem with minimum cost.

CourseOutcomes:

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

1. Identify the complex problem which is related to industry or society.
2. Apply basic engineering knowledge for solving the identified problem.
3. Carry out state of the art related to the problem identified.
4. Plan the work for solving the problem identified.

Guidelines for Project content & Mark Distribution:

a. Work diary and weekly reporting -05 marks

b. Synopsis- 10 marks

c. Progress report submission and presentation-10 marks

Project Term Work:

The term work under project submitted by students shall include:

a. Work diary and weekly reporting:

Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for:

1. Searching suitable project work
2. Brief report, preferably on Journals/ research or conference papers/ books or literature surveyed to select and bring out the project.
3. Brief report of feasibility studies carried to implement the conclusion.
4. Proposed diagram/ Design calculations, etc.

b. Synopsis:

The group should submit the synopsis (of 4-5 pages) in following form.

1. Title of Project
2. Names of Students
3. Name of Guide
4. Proposed work (Must indicate the scope of the work & weekly plan up to March end)
5. Approximate Expenditure (if any)

The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department.

Note:-1. The project group should consist not more than four students.

c. Progress report submission and presentation:

The group has to give a power point presentation in front of the faculty of department onthe progress completed till end of first semester along with the progress report.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME417 : Industrial Training

Teaching Scheme	**Examination Scheme**
Tutorial : 01Hours/week, 01 Credit	**ICA : 50 Marks**
	OE : 25 Marks

Course Introduction: Industrial training is must for every engineering student. Students know the theoretical knowledge but practical application of same in industry need to be understood. Students should understand working of industry, machinery, quality process, manufacturing process etc for which training is important. Student has to undergo a training of Two weeks at core Mechanical Industry either in summer vacation after second year Part – I or Third year Part - I or after Third year Part - I, i. e in winter vacation/summer vacation. This will help student to understand industrial culture, working, role of an engineer in industry.

Course Objectives:

During this course, student is expected to:

1.Be aware of Industrial culture.

2. Be aware about technical report writing.

3. Be aware about organization structure.

4. Be aware about various departments in Industry.

5. Be aware about professional ethics.

6. Be aware about functions of management

Course Outcomes:

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

1. Write technical report and give presentation.

2. Correlate theoretical knowledge with the practical things in Industry

3.Understand Responsibility and role of Engineer in Industry

4. Understand the Industrial culture & Organizational setup

Procedure for Assessment of Industrial Training done by student

· Every student should do Industrial Training of minimum Two Weeks.

· Student should prepare a report of training done in a prescribed format before end of Part I Semester of BE. (along with a certificate from the concerned industry)

· Format of the report will be decided by the concerned guide.

· The report shall be comprehensive and presented in duplicate, typed on a standard A4 size sheet and bound.

· Every student should give presentation to project guide on industrial Training Report.

· The University oral examination will be based on the training report.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VIII

ME421 :Project Work Stage-II Seminar

TeachingScheme **Examination Scheme**

Practical:02Hours/week, 01Credits **ICA: 50Marks**

CourseObjectives:

During this course, student is expected to:

1. Understand concept of project and production management.
2. Design the basic components by applying various design theories and principles.
3. Apply various softwares to develop model and analyze it.
4. Apply knowledge of various manufacturing processes to develop the model.
5. Understand various design of experiment techniques.
6. Understand various statistical techniques for analysis of results.
7.

CourseOutcomes:

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

1. Communicate with various stakeholders and perform the work in team.
2. Find out various dimensions of the various parts of the model.
3. Analyze various types of stresses and failures which will exist in the model using suitable software.
4. Select suitable manufacturing process to fabricate the model.
5. Apply suitable design of experiment technique.
6. Apply suitable statistical technique for analysis of results.

In project work stage-II following work is expected from the students:

1. Students should complete online course on research methodology and course on modeling and simulation by employing suitable software.
2. Development of virtual and physical model
3. Carry out testing by applying suitable Design of Experiment technique.

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VIII

ME422 :Project Work Stage-III Seminar

TeachingScheme **Examination Scheme**

Practical:02Hours/week, 01Credits **ICA: 50Marks**

CourseObjectives:

During this course, students is expected to:

1. Apply suitable statistical technique.
2. Analyze the results.
3. Develop technical writing skills.
4.

CourseOutcomes:

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

1. Select appropriate statistical technique for their work.
2. Interpret the results of experimentation.
3. Write project report and technical paper.

In project stage-III, following work is expected from the students:

1. Students should complete online audit course on statistical tools used in research with case study.
2. Carry out analysis of results by employing suitable statistical technique.
3. Interpretation/Analysis of the results.
4. Report writing and preparing presentation.
5. Students should write a technical paper and present it in the conference/journal.
6. Students should be able to commercialize their project in the society.

Project Report format:

Project report should be of 25 to 50 pages (More pages can be used if needed). For Standardization of the project reports the following format should be strictly followed.

1. Page size: Trimmed A4
2. Top Margin: 1.00 Inches
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inches

6. Para Text: Times New Roman 12 point font

7. Line Spacing: 1.5 Lines

8. Page Numbers: Right aligned at footer, font 12 point Times New Roman

9. Headings: New Times Roman, 14 point, Boldface

10. Certificate:

All students should attach standard format of Certificate as described by the Department. Certificate should be awarded to batch and not individual student Certificate should have signatures of Guide, Principal, and External Examiner. Entire Report has to be segmented chapter wise as per the requirement.

11. Index of Report:

i) Title Sheet

ii) Certificate from Guide/ College

iii) Acknowledgement

iv) Abstract (Brief content of the work)

v) List of Figures

vi) List of Table

1. Introduction (History, Importance of Project Area, Problem identification, Objective of the Project)

2. Literature Review

3. Design/ Experimentation/ Fabrication/ Production/ Actual work carried out for the same.

4. Observation/ Analysis/ Findings/Results

5. Discussion on Results and Conclusion

References:

12. References or Bibliography: References should have the following format

For Books: “Title of Book”; Authors; Publisher; Edition;

For Papers: Authors, Year of Publication, “Title of Paper”; Conference Details/General Details; Page No.

b) Presentation:

The group has to prepare a power point presentation on project report, project and present itin front of the faculty of department along with the demonstration of the project.

One copy of the report should be submitted to Institute/ Department, One copy to Guide andone copy should remain with each student of the project group.

(Sample Format for Project WorkDiary):

Project Progress Sheet

Activity Week: Date from…… to……..

Description of the Work Performed by the student:

(Literature Survey /Design/ Drawings /Purchase/ Manufacturing / Testing/Data Collection/Analysis/Algorithm/Flowchart/Simulation)

……

Space for Drawings:

Constraint / Problem Found:

……

……

……

Activity to be carried out in next week:

……

……

Remarks by the Guide/ Co - Guide:

……

……

……

Date: Sign of Guide/Co - Guide:

Punyashlok Ahilyadevi Holkar Solapur University

Final Year B.TECH. (Mechanical Engineering)

Semester-VIII

ME423 :Project Work (Report Submission & Presentation)

TeachingScheme

Practical:04Hours/week, 02Credits

Examination Scheme

ICA: 50Marks

POE : 50 Marks

CourseObjectives:

During this course, student is expected to:

1. Develop effective presentation skills.
2. Communicate effectively both in verbal/non-verbal and written form.
3. Defend their research work in front of the experts.
4.

CourseOutcomes:

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

1. Acquire various skills related to the presentation.
2. Demonstrate their work in front of various stakeholders.
3. Gain confidence and ability of lifelong learning.

In Project Work (Report Submission & Presentation), students are expected to complete the following work:

1. Students should submit the project report in the prescribed format.
2. Students should prepare the power point presentation and present it in front of examiners.