Punyashlok Ahilyadevi Holkar Solapur University, Solapur

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'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Mechanical Engineering

Name of the Course: B.E. IV (Sem.–VII & VIII)

(Syllabus to be implemented from w.e.f. June 2019)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-VII

ME411 **Automatic Control Engineering**

Teaching Scheme	**Examination Scheme**
Lectures – 03 Hours/week	**ESE-** 70 Marks
Practical – 02 Hour/week	**ISE -** 30 Marks
	ICA- 25 Marks

Course Introduction:

In recent years, importance of automatic control systems has been rapidly increasing in all the fields of engineering. The applications of control systems cover a very wide range, from the design of precision control devices such as delicate electronic equipment to the design of massive equipment such as those used for the manufacture of steel or other industrial processes. The principles of control theory are applicable to engineering as well as non-engineering fields.

Course Prerequisites:

1. Concepts in subjects like theory of machines, strength of materials, thermodynamics and mechanical measurements.
2. Mathematical equations of mechanical, electrical, thermal and fluid systems.
3. Mathematical concepts of calculus, linear and non-linear function

Course Objectives: During this course, student is expected to

1. Formulate mathematical model for different types control systems.
2. Compose the systems with the help of block diagram reduction rules to obtain closed loop transfer function.
3. Examine the modes of control in accordance with output of control system.
4. Analyze transient response of the systems, steady state condition and characteristics of a system when it is in equilibrium state.
5. Analyze root locus diagram, Bode plot and discuss stability of mechanical system.
6. Evaluate state space techniques for representing control systems.

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

1. Formulate mathematical model for different types of control systems.
2. Compose the systems with the help of block diagram reduction rules to obtain closed loop transfer function.
3. Examine the modes of control in accordance with output of control system.
4. Analyze transient response of the systems, steady state condition and characteristics of a system when it is in equilibrium state.
5. Analyze root locus diagram, Bode plot and discuss stability of mechanical system.
6. Evaluate state space techniques for representing control systems

Section I

Unit 1 Introduction of control systems No of lectures – 03

- **Prerequisite:** Concepts of mechanical measurements and control
- **Objectives:**
  1. To understand the types of control systems
  2. To understand the basics of control systems

- **Outcomes:**
  After completing this unit, student will be able to

  1. Explain the types of control systems
  2. Identify the types of control systems
  - **Unit Content:** Need for control, manual and automatic control, open loop and closed loop (feedback) control systems, modern control systems.
- **Content Delivery Methods:** Chalk and Board, Demonstrations Videos

Unit 2 Representation of control components and Systems No of lectures –10

- **Prerequisite:** 1. Basic equations of mass, spring, damper, resistor, capacitor, inductor etc. 2. Basic mechanical, electrical, thermal and fluid systems.

Objectives:

1. To Formulate mathematical model for different types of control systems
2. To obtain transfer function for the closed loop systems

- **Outcomes:**
  After completing this unit, student will be able to

  1. Formulate mathematical model for different types of control systems
  2. Compose different systems and obtain its transfer function.

  Unit Content: Mechanical – helical spring, viscous damper, tensional spring and damper, Electrical – resistor, inductor, capacitor, series and parallel electric circuit and mech. System, grounded chair representation. Analogs – direct and inverse analogs for mechanical, thermal and fluid systems. Linearization of non-linear functions, linearization of operating curves.

- **Content Delivery Methods:** 1.Chalk and Board

Unit 3 Block diagram Algebra No of lectures – 4

- **Objectives:**
  1. Reduce the block diagram and obtain its closed loop transfer function.
- **Outcomes:** After completing this unit, student will be able to
  1. Reduce the block diagram and obtain its closed loop transfer function.
  2.
- **Unit Content:**
  General representation of a feedback control system, transfer functions, rules of block diagram algebra, reduction of block diagram to obtain closed loop transfer function.
- **Content Delivery Methods:** 1. Chalk and Board

Unit 4 Modes of Control No of lectures – 03

- **Objectives:**
  1. Examine the modes of control in accordance with output of control system.
- **Outcomes:**
  After completing this unit, student will be able to

  1. Examine the modes of control in accordance with output of control system.

- **Unit Content:** ON/OFF, proportional (P), Integral (I), Derivative (D) and P+I, P+D, P+I+D controllers (No numerical treatment).
- **Content Delivery Methods:** Chalk and Board, Demonstrations, Videos

Section II

Unit 5 Steady state operation &Transient Response No of lectures – 06

- **Objectives:**
  1. To analyze transient response of the systems.
  2. To analyze steady state condition and characteristics of a system when it is in equilibrium state.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Analyze transient response of the systems.
  2. Analyze steady state condition and characteristics of a system when it is in equilibrium state.
- **Unit Content:** Steady state analysis for generalized block diagram for a feedback control system, steady state characteristics, equilibrium in a system, command signal plot, load line plot
  Types of inputs: unit, step, ramp & sinusoidal, general operational representation for a differential equation of control system, distinct, repeated and complex conjugate zeros, general form of transient response, Routh's stability criterion for a control system

- **Content Delivery Methods:** Chalk and Board

Unit 6 Root Locus Method No of lectures – 06

- **Objectives:**
  1. To draw and analyze root locus diagram.
  2. To discuss stability of a mechanical system.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Draw and analyze root locus diagram.
  2. Discuss stability of a mechanical system.

- **Unit Content:** Significance of Root locus, angle and magnitude conditions, branches of R.L., asymptotes and centroid, breakaway points, intersection with the imaginary axis, angles of departure and arrival, construction of Root locus using general rules and steps, comment on stability

- **Content Delivery Methods:** 1. Chalk and Board, Use of Software MATLAB/SCILAB

Unit 7 Bode Plots No of lectures – 05

- **Objectives:**
  1. To draw and analyze Bode plots.
  2. To discuss stability of mechanical system.
- **Outcomes:**
  After completing this unit, student will be able to

  1. Draw and analyze Bode plot.
  2. Discuss stability of mechanical system.
- **Unit Content:** Magnitude and Phase angle plots, standard form of open loop T.F. G(jω) H(jω), Bode plots for standard factors of G(jω) H(jω),steps to sketch Bode plots for following factors :System gain K, Poles & zeroes at the origin, simple poles & simple zeroes, frequency response specifications, calculation of Gain Margin and Phase margin from Bode plots, comment on stability from Bode plots

- **Content Delivery Methods: Chalk** and Board, Use of Software MATLAB/SCILAB

Unit 8 State Space Methods No of lectures – 03

- **Objectives:**
  1. To understand State space Representation of control system by various programming methods.
  2. To draw computer diagram for representation of control system.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Evaluate state space techniques for representing control systems.
  2. Draw computer diagram for representation of a control system.

- **Unit Content:** State space representation for control system by direct, parallel, series and general programming, matrix form of representation, computer diagram.
- **Content Delivery Methods: Chalk** and Board, Use of Software MATLAB/SCILAB
- **Term Work:** Any **six** of the following to be completed
  1. Fundamentals of control and control systems
  2. An experiment on DC/AC motor speed control (open loop / closed loop)
  3. An experiment to demonstrate various modes of control: P, P+I, P+D & P+I+D.
  4. Assignment on formulation of mathematical model for different types systems, linearization of nonlinear functions and operating curves.
  5. Assignment on reduction of block diagrams of control systems using block diagram algebra.
  6. Assignment on 'Root Locus Method'
  7. Assignment on 'Bode Plots'
  8. Assignment on 'State Space Methods'

  Every assignment must include a few theory questions and a variety of problems

  Software like 'MATLAB or SCILAB' may be used to solve some problems in assignment numbers Nos. 6 to 8.
- **Text Books:**

  1. Automatic control Engineering: F. H. Raven., McGraw Hill International editions, New Delhi, Fifth edition.
  2. Control Systems: U.A. Bakshi and V.U. Bakshi: Technical Publications, Pune, Fifth revised Edition – 2007.

- **Reference Books:**

1. Modern Control Engineering: K.Ogata, Prentice Hall of India Pvt. Ltd., New Delhi., 4 Edition.
2. Process Control: C. Johnson: Prentice Hall of India Pvt. Ltd., 1996.
3. Closed loop control systems: S.C.Goyal and U.A.Bakshi, Technical Publications, Pune, 2002.
4. Feedback Control systems: Bhide, Satyanarayana and Jalgoankar, Technova Publishers, Pune
5. Automatic control systems: B.C. Kuo, Prentice Hall of India Ltd.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-1
ME412 Refrigeration and Air Conditioning

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ESE–** 70 Marks
Practical –	**ISE -** 30 Marks
	ICA- 25 Marks
	POE- 25 Marks

Course Introduction:
This course deals with study of various refrigeration processes and refrigeration cycles such as Air refrigeration cycle, Vapour Compression cycle, Vapour absorption cycle. It also covers properties of refrigerants and various alternative refrigerants. In second part study of psychometric processes and its analysis for producing required air conditions are dealt. Further it deals with human comfort requirements and study of air distribution systems.

Course Prerequisite:
Student should have knowledge of basic concepts of thermodynamics and laws of heat transfer along with equations to calculate heat flow rate by various modes of heat transfer.

Course Objectives: During this course, student is expected to

1. Familiarize with the terminology associated with refrigeration systems and air conditioning systems.
2. To understand basic refrigeration processes.
3. To understand basics of psychrometry and practice of applied psychrometric.
4. To acquire the skills required to design and analyse refrigeration and air conditioning components and systems.

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

1. Explain Basic Refrigeration Processes
2. Analyze and Calculate Performance of Refrigeration Systems
3. Select proper Refrigerant for specific application
4. Define and Calculate Psychometric properties of air using chart and tables
5. Decide and Analyze Psychometric process for obtaining required air conditions
6. Explain Comfort chart and factors affecting human comfort.
7. Design Air distribution System

Section I

Unit 1. Basic Refrigeration Cycles — No of lectures – 10 hrs

- **Prerequisite:** Basics of thermodynamics.
- **Objectives:**
  1.To Study Various Refrigeration Cycles.
  2.To Analyze and Find Performance of Refrigeration Cycles.
- **Outcomes:**
  After completing this unit, student will be able to
  1.Define Refrigeration and its Units.
  2.Explain Working of Various Refrigeration Cycles and Calculate its Performance.
- **Unit Content:**
  Refrigeration, Units of refrigeration, Reversed Carnot cycle with vapour as refrigerant, Vapour compression cycle, Sub cooling, Superheating, Liquid – Suction heat exchanger, Analysis and Performance calculations of above cycles. Actual vapour compression cycle. (Numerical Treatment).
  Air Refrigeration Systems, Bell Coleman Cycle (B.C.C), Calculation of C.O.P., Advantages and Disadvantages of B.C.C. (Numerical Treatment).
  Air Craft Refrigeration-Necessity, Simple, Boot Strap, Regenerative and Reduced ambient systems. (Theoretical Treatment).
- **Content Delivery Methods:** Board, Chalk and Talk.

Unit 2– Multi Pressure Systems — No of lectures – 3 hrs

- **Prerequisite:** Basic Refrigeration cycles
- **Objectives:**
  1.To Study Multistage Refrigeration Systems.
  2.Compare with Simple V.C.C.
- **Outcomes:**
  After completing this unit, student will be able to
  1.Explain Necessity of Multistage Refrigeration Systems.
  2.Explain Types of Multistage Refrigeration Systems.
- **Unit Content:**
  Introduction, Multistage compression, Flash gas removal, Flash inter cooling, Complete Multi stage system, Multi evaporator systems (Descriptive Treatment).
- **Content Delivery Methods:** Board, Chalk and Talk

Unit 3– Refrigerants No of lectures – 3 hrs

- **Prerequisite:** Properties of pure substances

- **Objectives:**
  1.To Study Various Types & Properties of Refrigerant.
  2.To Study Effect of Refrigerant on Environment.

- **Outcomes:**
  After completing this unit, student will be able to
  1.Select Refrigerant for Specific Application.
  2.Explain Effect of Refrigerant on Environment.

- **Unit Content:**
  Classification, Desirable Properties, Nomenclature of Refrigerants, Selection of refrigerant, Secondary refrigerants, Effect on Ozone depletion and Global warming, Total equivalent warming impact (TEWI), Alternative Refrigerants.

- **Content Delivery Methods:** Board, Chalk and Talk

Unit 4– Vapour Absorption Systems No of lectures – 4 hrs

- **Prerequisite:** Properties of pure substances

- **Objectives:**
  1.To Study Vapour Absorption Systems
  2.To Find its Performance.

- **Outcomes:**
  After completing this unit, student will be able to
  1.Explain Various Types of Vapour Absorption Systems.
  2.To Find C.O.P. of Ideal Vapour Absorption system.

- **Unit Content:**
  Introduction, Simple Ammonia-Water Vapour absorption system, Practical Ammonia-Water Vapour absorption system, Comparison between Vapour Absorption and Vapour Compression system, COP of ideal Vapour Absorption System, Electrolux refrigerator, Lithium Bromide Absorption system. New Mixtures for Vapour Absorption System.

- **Content Delivery Methods:** Board, Chalk and Talk, Animations.

Section II

Unit 5– Psychrometry No of lectures – 7 hrs

- **Prerequisite:** Basics of Thermodynamics

- **Objectives:**
  1.To Study Properties of Moist Air.
  2.To Study Various Psychometric Processes.

- **Outcomes:**
  After completing this unit, student will be able to
  1.Find Properties of Moist Air.
  2.Analyze Various Psychometrics Processes.

- **Unit Content**
  Moist air as a working substance, Psychometrics properties of air, Use of psychometric tables and Charts, Processes, Combinations And Calculations, ADP, Coil condition line, Sensible heat factor, Bypass factor, Air Washer and it's applications. (Numerical Treatment)

  Content Delivery Methods: Board, Chalk and Talk.

Unit 6– Heating and Cooling Load Calculations No of lectures – 6 hrs

- **Prerequisite:** Heat transfer

- **Objectives:**
  1.To Study Various Loads on Refrigeration Systems.
  2.To Analyze Psychometric Processes for obtaining required Indoor Conditions.
- **Outcomes:**
  After completing this unit, student will be able to
  1.Calculate Loads on Refrigeration system.
  2. Decide and Analyze Psychometric Process
- **Unit Content:**
  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).

- **Content Delivery Methods:** Board, Chalk and Talk.

Unit 7– Comfort Conditions and Air Distribution Systems No of lectures – 4 hrs

- **Prerequisite:**
  Thermodynamics and Fluid Mechanics

- **Objectives**
  1.To Study Human Comfort requirements and Comfort Charts.
  2.To Study Air Distribution Systems.
- **Outcomes:**
  After completing this unit, student will be able to
  1.Explain Comfort Requirements for human.
  2.Explain Various Air Distribution Systems.
- **Unit Content:**
  Thermal exchange between human body and environment, Factors affecting comfort, Effective temperature Comfort Chart, Ventilation requirements. Duct classification, Duct material and construction, Equivalent diameter of a circular duct or rectangular duct, Duct design methods, losses in duct. (Theoretical Treatment).

  Content Delivery Methods: Board, Chalk and Talk.

Unit 8– Introduction to Cryogenics No of lectures – 3 hrs

- **Prerequisite:** Thermodynamics

- **Objectives:**

1. To Study Methods of producing low temperatures.
2. To Study Applications of Cryogenics.

- **Outcomes:**
  After completing this unit, student will be able to
  1.Explain Methods used to produce low temperatures.
  2.Explain Applications of Cryogenics.
- **Unit Content:**
  Introduction, Limitations of vapour compression systems for the production of low temperature, Cascade Refrigeration System, Claude System and Linde System for liquefaction of air. Applications of Cryogenics. (Theoretical Treatment).

  Content Delivery Methods: Board, Chalk and Talk

- **Term Work:**
  Group 1 (Study, Demonstration of minimum three assignments on following topics)
  1. Study of Refrigeration methods
  2. Study of Refrigeration Equipments
  3. Study of Refrigeration Systems–Domestic refrigerator, Split air conditioner, Ice Plant, Deep freezer etc.
  4. Study of charging, leak testing of refrigeration systems
  5. Study of nonconventional refrigeration systems

Group II (Minimum four experiments from following)

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

Group III

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

- **Text Books:**
  1. 'Refrigeration & Air Conditioning' by C. P. Arora
  2. 'Refrigeration & Air Conditioning' by Arora &Domkundwar
  3. '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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I.

ME413 OPERATIONS RESEARCH

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

Course Introduction:

Industries across the globe are facing the problems of global unrest due to multiple reasons. Hence they continuously try to adopt various optimization techniques in their organizations. which help them to reduce the time and cost of production. This course covers different optimization techniques assisting the organizations in managing their resources optimally, better decision making, transportation issues, effective planning, replacement policies and allied issues in conducting their activities. These optimization techniques are expected to offer maximum profit and reduced cost and time. The syllabus is divided into two sections, each section contains four chapters.

Course Prerequisite: Mathematics concepts, Probability Basics, Analytical Approach with exposure to industrial activities.

Course Objectives: During this course, student is expected to

1. Acquire knowledge of various techniques under operations research.
2. Study quantitative techniques in management decision-making and its applications by using mathematical models.
3. Create awareness about preparation of Project Plan.

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

1. Knowledge of basic optimization process and OR models.
2. Apply various optimization techniques to industrial applications.
3. Develop a project plan for the industry or organization.

Section I

Unit 1– Introduction & LPP No of lectures – **09**

- **Prerequisite:** Mathematics, Exposure to industrial activities.

- **Objectives:**

1. To enlighten the students about the basics of operations research.
2. To explain the concepts of LPP.

- **Outcomes:**

  After completing this unit, student will be able to

1. Apply LPP theory to solve the problems.
2. Formulate the LPP problems for industrial situations.

- **Unit Content:**

  History and development of OR, methodology in operation research, O.R. models and their applications. Introduction to LPP, Formulation of problem, Graphical solution, Simplex method, Big M method, Two phase method, Duality in LPP, Sensitivity analysis under different situation (No numerical problems).

- **Content Delivery Methods:** Board, Chalk and Talk.

Unit 2– Assignment Model No of lectures – **03**

- **Prerequisite:** Mathematics, Exposure to industrial activities.

- **Objectives:**

1. To enlighten the students about the basics of Assignment models.
2. To explain the concepts of Assignment models.

- **Outcomes:**

  After completing this unit, student will be able to

1. Apply the concept of Assignment models to minimize time for production.
2. Apply the concept of Assignment models to maximize profit.

- **Unit Content:**

  Mathematical statement, Methods to solve balanced and unbalanced assignment problems, Maximization problems, Assignment with restrictions, Traveling salesman problem.

- **Content Delivery Methods:** Board, Chalk and Talk.

Unit 3– Transportation Model No of lectures – **05**

- **Prerequisite:** Mathematics, Exposure to transportation related activities.

- **Objectives:**

1. To enlighten the students about the basics of Transportation models
2. To explain the concepts of Transportation models.

- **Outcomes:**

After completing this unit, student will be able to

1. Apply the concept of Transportation models to optimize available resources.
2. Apply the concepts of Transportation models to minimize the cost of transportation.

- **Unit Content:**

Mathematical formulation, methods to obtain initial basic feasible solution (IBFS), NWCR matrix minima method and VAM, conditions for testing optimality, MODI method for testing optimality solution of balanced and unbalanced problems, Degeneracy and its resolution..

- **Content Delivery Methods:** Board, Chalk and Talk.

Unit 4– Job Sequencing. No of lectures –**03**

- **Prerequisite:** Mathematics, Exposure to shop floor activities.

- **Objectives:**

1. To enlighten the students about the basics of Sequencing models
2. To explain the concepts of Sequencing models

- **Outcomes:**

After completing this unit, student will be able to

1. Apply the concept of sequencing models to optimize available resources.
2. Apply the concepts of sequencing models to minimize the total time.

- **Unit Content:**

Job sequencing, Johnson's Rule for optimal sequence of n jobs on 2 machines, process n Jobs on 3 Machines.

- **Content Delivery Methods:** Board, Chalk and Talk.

Section II

Unit 5–Games Theory: No. of lectures – 05

- **Prerequisite:** Linear algebra, theory of probability.

- **Objectives:**

1. To develop an awareness of strategic environments.
2. To empower students to formulate two person games.
3. To develop analytical capabilities to determine outcomes of situations.

- **Outcomes:**
  After completing this unit, student will be able-

1. To select best strategy among available alternatives.
2. To understand interactions and outcomes within players.

- **Unit Content:**
  Introduction, terminology, Minimax and Maximin principle, Solution of zero sum two person games –Saddle point, algebraic method, Dominance properties, Graphical method

- **Content Delivery Methods:** Board, Chalk and talk

Unit 6–Replacement Model No. of lectures – 04

- **Prerequisite:** Maintenance program, need of replacement.

- **Objectives:**

1. To introduce students with techniques used in replacement analysis in the organization.
2. To understand various policies of replacement.

- **Outcomes:**
  After completing this unit, student will be able to

1. Determine optimal replacement age of the equipment.
2. Apply individual and group replacement policies.

- **Unit Content:**
  Replacement problem, Replacement model for items whose maintenance cost increases with time (money value constant) and with change in money value, Selection of best machine, Replacement of items that fail suddenly, Individual and group replacement policies.

- **Content Delivery Methods:** Board, Chalk and talk

Unit 7–Inventory Control No. of lectures – 06

- **Prerequisite:** Procurement procedure, inventories in the business environment

- **Objectives:**

1. To develop awareness among students about inventory types and its need.
2. To understand various costs associated with inventories and study different models of inventory control.

- **Outcomes:**

  After completing this unit, student will be able to

1. Determine required level of inventory so that production and sales run smoothly.
2. Select best quantity and discount offer.

- **Unit Content:**

  Introduction, Classification of inventory, costs associated with inventory, Deterministic Inventory models- EOQ model with instantaneous replenishment with and without shortages, quantity discount model

- **Content Delivery Methods:** Board, Chalk and talk

Unit 8– CPM & PERT No. of lectures – 05

- **Prerequisite:** Project scheduling, theory of probability, statistics.

- **Objectives:**

1. To expose students with project planning and scheduling techniques.
2. To develop awareness of dependence of activities in a project and its importance.

- **Outcomes:**

  After completing this unit, student will be able to

1. Determine project duration and different floats.
2. Determine probability of project completion.

- **Unit Content:**

  Fundamentals of CPM / PERT networks, CPM – construction of networks, critical path, forward and backward pass, floats & their significance.

  PERT – Time Estimates, Construction of Networks, Probability of completing projects by scheduled date.

- **Content Delivery Methods:** Board, Chalk and talk

- **Text Books:**

1. Hamdy Taha, “Operations Research – An Introduction”, 7th edition PHI (2003)
2. S. D. Sharma, “Operation Research”, Kedarnath and Rannalt Pub.
3. Hira and Gupta, “Operation Research”, S. Chand and Co.
4. N. D. Vohra, “Quantitative Techniques in Management”, TMGH

- **Reference Books:**

1. Operations Research by Hillier and Lieberman TMGH
2. Swarop Kanti Gupta P.K. & Manmohan- OR Sultan Chand & Sons, New Delhi
3. Shrinath L.S.: PERT & CPM –Affiliate East West Press
4. R. Panneerselvam, “Operations Research”, PHI (2002)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester- I

ME414 (A): Professional Elective-V
Finite Element Method (FEM**)**

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week (3 Credits)	**ESE–**70 Marks
Practical – 2 Hour/week/batch (1 Credit)	**ISE –** 30 Marks
	ICA - 25 Marks
	Oral Exam – 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 equationsfor1D, 2D and 3D finite by hand and using FEM software. This course is designed give the students a hands on approach on FEM.

Course Prerequisites

Fundamentals of mechanics, elementary solid mechanics (SOM), elementary fluid mechanics, and principles of heat transfer, basic engineering mathematics (matrices, differential and integral calculus, numerical methods).

Course Objectives: During this course, 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 involving field problems.
4. Use 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. Formulate stiffness matrices for simple 1D, 2D and 3D elements.
3. Solve 1D, 2D and 3D problems using FEA techniques.
4. Solve boundary value problems using variational calculus and weighted residuals methods.
5. Analyze of 1D, 2D and 3D problems using commercial or open source FEA software.

Section I

Unit 1–FEA fundamentals — No of lectures – 5Hrs

Objectives

1. Understand the general procedure of FEM.
2. Understand various computational techniques like FEM, FDM, FVM, and BEM with regards to their efficacy and applications.

Outcomes

After completing this unit, student will be able to

1. Apply the direct method to develop Finite Element Equations
2. Recommend computational technique based on application domain.

Unit Content

History and fundamentals of FEA, General FEM procedure, direct formulation for uniaxial elements using matrix methods, applications ofFEM, comparison other computational techniques such as FDM, BEM, FVM and their applications, merits and demerits of FEM compared to exact solutions and experimentation, overview of free and proprietary computational software.

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software.

Unit 2–Finite element formulation for1D elements — No of lectures – 5 Hrs.

Prerequisite: Fundamentals of trusses and beams from basic mechanics, matrix algebra

Objectives

1. Understand basic formulation of 1D structural and thermal elements.
2. Learn to use FE software to solve 1D structural and thermal problems.

Outcomes

After completing this unit, the student will be able to

1. Formulate the elemental equations for trusses and beams and solve them.
2. Create 1D FE models in software, choose appropriate solver to compute the results and display results using post processing.

Unit Content

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 2Dand 3D trusses and beam elements, calculation of stresses and strains.
(Derivations & numerical examples on 1D elements only)

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software.

Unit 3–Finite element formulation for 2D elements No of lectures – 5Hrs.

Prerequisite: Basics of 2D stresses and strains from "Strength of Materials", Matrix Algebra

Objectives

1. Understand basic formulation of 2D structural and thermal elements.
2. Learn to use FE software to solve 2D structural and thermal problems.

Outcomes

After completing this unit, student will be able to

1. Formulate the elemental equations for 2D structural and thermal problems.
2. Create 2D FE models in software, choose appropriate solver to compute the results and display results using post processing.

Unit Content

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 element.

(Derivations & numerical exercises on linear elements only)

Content Delivery Methods: Chalk and talk, demonstration using software

Unit 4–Finite Element Formulation for 3D elements No of lectures – 5 Hrs.

Prerequisite: Basics of 3D stresses and strains from strength of materials, matrix algebra.

Objectives

1. Understand basic formulation of 3D structural and thermal elements.
2. Learn to use FE software to solve 3D structural and thermal problems.

Outcomes

After completing this unit, student will be able to

1. Formulate the elemental equations for 3D trusses and beams
2. Create 3D FE models in software, choose appropriate solver to compute the results and display results using post processing.

Unit Content

Interpolation functions for 3D elements, Pascal Tetrahedron, shape functions, formulation of system equations, calculation of stresses and strains.

(Derivations using Lagrangian Polynomials and Simple Numerical Exercises)

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software.

Section II

Unit 5–Mathematical Foundations of FEA No of lectures – 6 Hrs.

Prerequisite: Fundamental knowledge of differential and integral calculus and Matrix Algebra.

Objectives

1. Understand calculus of variations as applied to FEA.
2. Understand method of weighted residuals as applied to FEA.
3. Understand numerical techniques used in solvers of FEA software.

Outcomes

After completing this unit, student will be able to

1. Use the Ritz method to solve differential equations.
2. Use method of WR to solve differential equations.
3. Solve simultaneous equations using matrix algebra.

Unit Content

Variational calculus, Ritz method, methods of weighted residuals such as collocation, least squares, Galerkin-Bubnov, boundary conditions and general comments, Elimination Method, Penalty Method, Newton Raphson method, decomposition method.

(Simple numerical exercises on Ritz Method and Galerkin-Bubnov method only, simple problems on elimination and penalty method)

Content Delivery Methods: Chalk and talk.

Unit 6–Natural Coordinates and Higher order Elements No of lectures – 6 Hrs.

Objectives

- Understand the concept of local and natural coordinates.
- Understand higher order elements and its associated terminology.

Outcomes

After completing this unit, student will be able to

1. Derive the shape functions in terms of natural coordinates for 1D, 2D and 3D elements.
2. Solve problems deal with “mapping” local and global coordinates.

Unit Content

Shape functions in Natural coordinates, derivation of shape functions of 1D, 2D and 3D

Elements in natural coordinates, Lagrangian polynomials, Isoparametric elements, mapping and transformation in higher order elements, Jacobian, Completeness and convergence of solution

(Derivations using Lagrangian polynomials and Numerical Exercises involving mapping)

Content Delivery Methods: Chalk and talk, PPTs.

Unit 7–Nonlinear and Dynamic FEM No of lectures – 5 Hrs.

Objectives

1. Understand different nonlinearities associated with field problems.
2. Understand types of dynamic and modal analysis using FEA.

Outcomes

After completing this unit, student will be able to

1. Explain nonlinearities and dynamic considerations with regards to FE problems.
2. Solve simple nonlinear and dynamic problems using FEA software.

Unit Content

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, sub modeling and sub structuring.
(No Numerical Questions for exams)
Content Delivery Methods: Chalk and talk, PPT, demonstration using software.

Unit 8–Computational Techniques No of lectures – 4 Hrs.

Prerequisites: Basic knowledge of any 3D modeling software.

Objectives

1. Understand capabilities applications of free and commercial computational software.

Outcomes

After completing this unit, student will be able to

1. Select appropriate FEM software for field problems.
2. Demonstrate the capability of using at least one software at all levels of FEA (Preprocessing, Solution, Post Processing)

Unit Content

Review of free and commercial software, comparison of capabilities, Preprocessing, Solvers, Post Processing, Commercial finite element software, model validity,mesh design & refinement, element distortion.

Content Delivery Methods: Chalk and talk, PPT, demonstration using software.

Term Work

1) One assignment with numerical exercises on variational formulation and method of weighted residuals formulation.
2) One software assignment supported by hand calculations on 1D problem.
3) One software assignment supported by hand calculations on 2D problem.
4) One software assignment on 3D problem.
5) One software assignment on non-linearity problems.
6) One software assignment on dynamic problems.
7) One assignment on Natural Coordinates and Isoperimetric formulation.
8) One assignment on FEA applications and future developments.

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
4) S.S Bhavikatti, Introduction to Finite Elements, New Age International Publications.

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 Ltd.
5) Daryl Logan, A First Course in the Finite Element Method, Cengage

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I

ME414 (B): Professional Elective-V
Production and Operational Management

Teaching Scheme	**Examination Scheme**
Lectures– 3Hours/week, 3 Credits	**ESE–**70 Marks
Practical – 2Hour/week, 1 Credit	**ISE –**30Marks
	ICA-25 Marks
	OE-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 Prerequisite:

Exposure to Operations Research, Numerical Methods, understanding of basic industrial activities

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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. Analyze/Determine the applications of various advanced techniques such as value engineering, six sigma, Kanban, computer aided production management, etc.

Section I

Unit 1–Introduction to Production and Operation Management No of lectures –03

- **Prerequisite:** Fundamentals of Production, Various manufacturing methods

- **Objectives:**

1. Demonstrate a basic understanding of production and operations management.
2. Develop an understanding of and an appreciation for the production and operations management function in any organization.

- **Outcomes:**

  After completing this unit, student will be able to

1. Identify the different types of manufacturing systems.
2. Explain about production and operation management.

- **Unit Content:**

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

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 2–Forecasting No of lectures – 06

- **Prerequisite:** Curve fitting, Regression & Co-relation Analysis

- **Objectives:**

1. To empower students to understand the fundamental advantages and necessity of forecasting in various situations.
2. To equip students with various forecasting techniques and knowledge on modern statistical methods for analyzing different situations.

- **Outcomes:**

  After completing this unit, student will be able to

1. Analyze past patterns in time series data and develop appropriate models for forecasting
2. Estimate forecasting models with numerical treatment

- **Unit Content:**

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

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 3–Capacity Planning No of lectures – 05

- **Prerequisite:** Basic Mathematics, Operation Research

- **Objectives:**

1. To understand the relationship of the various planning practices of capacity planning, aggregate planning, project planning and scheduling
2. To understand the various production and operations design decisions and how they relate to the overall strategies of organizations

- **Outcomes:**

  After completing this unit, student will be able to

1. Gain an understanding and appreciation of the principles and applications relevant to the planning, design, and operations of manufacturing/service firms.
2. Summarize various aggregate production planning techniques

- **Unit Content:**

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

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

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

- **Prerequisite:** Understanding of basic industrial activities and functions

- **Objectives:**

1. To understand the importance of various PPC functions of organizations.
2. To develop an ability to apply PPC concepts in a various types of industries.

- **Outcomes:**

  After completing this unit, student will be able to

1. Recognize the objectives, functions, applications of PPC
2. Describe way of integrating different departments to execute PPC functions\

- **Unit Content:**

  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.

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Section II

Unit 5–Inventory Management No of lectures – 06

- **Prerequisite:** Operations Research, Mathematics

- **Objectives:**

1. To understand the roles of inventories and basics of managing inventories in various demand settings
2. To use basic concepts, strategies and techniques to analyze a variety of inventory systems

- **Outcomes:**

After completing this unit, student will be able to

1. Explain different Inventory control techniques
2. Apply and analyze methods used by organizations to obtain the right quantities of stock or inventory

- **Unit Content:**

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)

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 6–Plant Maintenance No of lectures – 06

- **Prerequisite:** Various manufacturing systems, Understanding of basic industrial activities

- **Objectives:**

1. To understand the need and importance of plant maintenance.
2. To study various maintenance techniques and effect of break down on production.

- **Outcomes:**

After completing this unit, student will be able to

1. Identify maintenance techniques to be used in different manufacturing industries.
2. Do the root cause analysis of any break down.

- **Unit Content:**

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

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 7–Value Engineering and Value Analysis No of lectures – 04

- **Prerequisite:** Understanding of basic industrial activities and functions

- **Objectives:**

1. To understand the importance of product and service design decisions and its impact on other design decisions and operations
2. Introduction to Value Management

- **Outcomes:**

After completing this unit, student will be able to

1. Identify and eliminate the unnecessary costs during production process.
2. Modify the design as per the requirement of the customer.

- **Unit Content:**

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

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 8–Advanced manufacturing System No of lectures –04

- **Prerequisite:** Understanding of basic industrial activities and processes.

- **Objectives:**

1. Obtain an understanding of quality management practice in organizations and how total quality management and six-sigma facilitate organizational effectiveness
2. To cultivate the ability to develop and implement new improved manufacturing processes resulting in creation and distribution of value in engineering applications

- **Outcomes:**

After completing this unit, student will be able to

1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design
2. Impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations

- **Unit Content:**

Just- in Time (JIT), Kanban System, KAIZAN, Zero defect, six sigma. Computer aided production management system.

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation
- **Term Work:**

Minimum eight case studies or assignments based on all topics.

- **Text Books:**

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

- **Reference :** 1. Production and Operation Management by M. E. Thukaram Rao. (New Age International Pub)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I

ME414 (C): Professional Elective-V
Automobile Engineering

Teaching Scheme	**Examination Scheme**
Lectures– 3Hours/week, 3 Credits	**ESE–**70 Marks
Practical – 2Hour/week, 1 Credit	**ISE –**30Marks
	ICA-25 Marks
	OE-25 Marks

Course Introduction:

There is all round development in the field of design and manufacture of automobile. This has resulted in vast improvement in their efficiency, comfort and safety. There is consequential tremendous increase in production and use of automobiles worldwide. This has opened the job opportunities for Mechanical engineers in Automobile sector.

Course Prerequisites:

4. Knowledge of elementary mathematics,
5. Basic knowledge of various core subjects like Theory of Machines, Manufacturing Process , Design engineering, Fluid Mechanics and Electrical Engineering, Engineering materials

Course Objectives: During this course, a student is expected to

1. Study basic principles of actual automobile systems
2. Study important systems in an automobile
3. Study recent and modern trends in automobile sector
4. To make the student conversant with automobile safety, electrical system
5. To make students aware about the entrepreneurial opportunities in automobile engineering field.

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

1. Demonstrate & explain various systems in an automobile
2. Describe importance and features of different elements like axle, differential, brakes, steering, suspension, wheel balancing etc.
3. Explain principle of operation, construction and applications of various sensors used in modern automobile and understand electric vehicles, hybrid electric vehicles and solar

Section I

UNIT 1. Introduction to Automobiles: 04

- **Prerequisite.** Knowledge of Materials
- **Objectives:**
  1. To study different layouts of an Automobile.
  2. To study different types of body and its construction of an Automobile.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Apply the knowledge of different layouts of an Automobile
  2. Apply the knowledge of different types of body and its constructionof an Automobile

Unit Content: Classification of automobiles. Major automobile components and their functions. Types of vehicle layouts- Front engine rear wheel drive, Front engine front wheel drive, Rear engine rear wheel drive and All wheel drive**,** Types of automotive bodies and Body construction materials.

- **Content Delivery Methods:** 1. Chalk and Board ,Demonstrations PPT and Videos

UNIT 2. Performance of Automobiles: 05

- **Prerequisite:** Basic Knowledge of Mathematics and Strength of Materials.
- **Objective**
  1.To study different parameters of performance of Automobile
  2**.**To study performance curve of an automobile.
- **Outcomes:**

After completing this unit, student will be able to

1.Solve the problems related to performance of an Automobile
2**.**Apply the knowledge of performance curve of an automobile.

Unit Content: Resistance to vehicle motion- Air, Rolling and Gradient resistance., Acceleration, Grade ability and draw bar pull., Traction and Tractive effort., Power required for vehicle propulsion. (Numerical
Content Delivery Methods: Chalk and Board, Demonstrations PPT and Videos

UNIT 3. Transmission System: 08

- **Prerequisite:** Knowledge of Materials, Friction, Toothed gear design.
- **Objectives:**
  1. To study the principles of various transmission components.
  2. To study characteristics and classification of various transmission components and Systems.
  3. To study construction of wheels and tyres.
- **Outcomes:**
  After completing this unit, student will be able to
  4. Apply the principle on various transmission components
  5. Select the suitable transmission components and Systems.
  6. Understand the construction of wheels and tyres.

Unit Content: Necessity of transmission system, Automobile clutch- requirements, types & functions of- Single plate, Multi-plate and Centrifugal clutches. Fluid flywheel. Types of automotive gearboxes- sliding mesh, Constant mesh and Synchromesh gearbox. Overdrive, Principle of operation of automatic transmission, Torque converter, Propeller shaft, Universal and slip joint, Final drive and its types, Differential, Construction and types of rear axles, Introduction to wheels and tyres.

- **Content Delivery Methods:** 1**.** Chalk and Board
  2. Demonstrations
  3. PPT and Videos

UNIT 4. Automobile Electricals: 03

- **Prerequisite: Basic p**rinciples of Electrical Engineering.
- **Objectives:**
  7. To study the principles of various Electrical systems and accessories.
  8. To study construction and working of various Electrical systems and accessories.
- **Outcomes:**
  After completing this unit, student will be able to
  9. Apply the principle on various Electrical systems and accessories

Understand the construction of and working of various Electrical systems and accessory**Unit Content:** Automotive batteries-construction and working of lead acid battery, Head light, Electric horn, Electric fuel Gauge- thermostatic & balancing coil type, Wiper, side indicator circuit, Speedo meter.

- **Content Delivery Methods:** 1**.** Chalk and Board
  2. Demonstrations
  3. PPT and Videos

Section II

UNIT 5. Steering System: 06

- **Prerequisite: Knowledge of Materials, Principle of steering, Friction, Toothed gear design.**

- **Objectives:**
  1. To understand steering layout various types of steering gear boxes
  2. To understand steering geometry, wheel alignment
  3. To understand Power steering
- **Outcomes:**
  After completing this unit, student will be able to
  1.Get basic knowledge ofsteering layout, steering geometry, wheel alignment,wheel alignment And methods to correct it
  2. Get basic knowledge of various power steering.

  Unit Content: Function of steering, Steering system layout, Automotive steering mechanism –Ackerman and Devis,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).
- **Content Delivery Methods:** 1. Chalk and Board

2. Demonstrations
3. PPT and Videos

UNIT 6. Braking System: **06**

- **Prerequisite: Knowledge of Materials, Friction**, Theory of machines

- **Objectives:**

1. To understand various Braking systems

2. To understand braking force, stopping distance, dynamic load calculations

- **Outcomes:**

After completing this unit,

1.Students get basic knowledge of various Braking systems

2. Students are able to do braking force, stopping distance, dynamic load calculations

Unit Content: Requirements and Function of automotive brake system, Classification of brakes, Drum & Disc brakes. Hydraulic & Air brake systems. Power brakes, Anti-lock braking, Calculation of braking force required, stopping distance and dynamic weight transfer.(Numerical)

- **Content Delivery Methods:** 1.Chalk and Board
  2. Demonstrations
  3. PPT and Videos

UNIT 7. Suspension Systems: 04

- **Prerequisite: Knowledge** ofMaterials, springs, Machine design.
- **Objectives:**

1. To understand various Suspension systems
2. To understand Hotchkiss and Toque tube drive

- **Outcomes:**

After completing this unit, student will be having basic knowledge of

1. VariousSuspension systems
2. Reaction members, Hotchkiss and Toque tube drive

Unit Content: Suspension requirements, Sprung and Un sprung mass, Types of automotive suspension systems- Conventional and Independent, Types of springs-Leaf spring and coil springs, Shock absorber, Reaction members-Radius rod, Stabilizer bar, Air suspension system. Hotchkiss and Toque tube drive

- **Content Delivery Methods:**1. Chalk and Board
  2. Demonstrations
  3. PPT and Videos

8. Modern Trends: **04**

- **Prerequisite: Basic** Knowledge ofElectrical and Electronics

- **Objectives:**

1. To understand various Electronic control modules, sensors and Actuators
2. To understand Recent trends in Vehicles, safety devices

- **Outcomes:**

After completing this unit, student will be having basic knowledge of

1. Various Electronic control modules, sensors and Actuators
2. Recent trends in Vehicles, safety devices

Unit Content: Engine electronic control modules, Introduction to Sensors and actuators used in automobile controls, Hybrid vehicles, Electrical vehicle layouts, solar vehicles, safety devices, fuel cells.

- **Content Delivery Methods:** 1. Chalk and Board
  2. Demonstrations
  3. PPT and Videos
- **Term Work:**
  Minimum six experiments from Group A and two experiment from Group B are to be performed

- **Group A.**
  1. Study and demonstration of four wheeler chassis layout.
  2. Study and Demonstration of working of automobile clutches.
  3. Study and demonstration of synchromesh gearbox.
  4. Study and demonstration of final drive and differential.
  5. Study and demonstration of working Hydraulic braking system.
  6. Study and demonstration of steering gear boxes.
  7. Study and demonstration of suspension systems used in four-wheeler.
  8. Study and demonstration of battery and electrical starting system
  9.Study and demonstration of (a) Electric horn. (b) Electric fuel Gauge.
  (c) Flasher unit. (d) Wiper circuit
- **Group B.**
  1. Demonstration of wheel balancing and wheel alignment.
  2. Visit to servicing station for study of vehicle maintenance, repairs and report.
  3. A case study presentation and report covering recent trends in automobiles.

Text Books:

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

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, SAE Publications
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
8. Narang G. B. S - Automobile Engineering - S. Chand and Company Ltd.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I
ME414 (D): Professional Elective-V

COSTING & COST CONTROL

Teaching Scheme	**Examination Scheme**
Lectures– 3Hours/week, 3 Credits	**ESE–**70 Marks
Practical – 2Hour/week, 1 Credit	**ISE –**30Marks
	ICA- 25 Marks
	OE- 25 Marks

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 ten chapters.

Course Prerequisite:

Exposure to production planning and controls, material management and OR understanding of basic industrial activities

Course Objectives: 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.

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

7. Explain importance, scope and need of cost and cost control.
8. Evaluate the future demands using different cost control methods.
9. Apply the concept of cost and cost control to various types of manufacturing systems.
10. Explain the importance of cost and cost control in the production process and its elements.
11. Apply the concept of cost control.
12. Analyze/Determine the applications of various advanced techniques such as value engineering

Section I

Unit 1–Introduction to Cost and Cost Control No Of Lectures –03

- **Prerequisite:** Fundamentals of Production, Various manufacturing methods

- **Objectives:**

1. Demonstrate a basic understanding cost and cost control.
2. Develop an understanding of and an appreciation for the cost and cost control function in any organization.

- **Outcomes:**

After completing this unit, student will be able to

1. Identify the different types of cost and cost control methods.
2. Explain about cost and cost control.

Unit Content:

(a) Concept of cost, cost unit, cost center, classification of cost, different costs for different purposes.
(b) Definition of costing, cost-price-profit equation, desirable conditions for a costing system.

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 2– Cost Estimating No of lectures – 05

- **Prerequisite:** material managements PPC, OR.

- **Objectives:**

1. To empower students to understand the fundamental advantages and necessity of cost estimation in various situations.
2. To equip students with various cost and cost control knowledge on modern statistical methods for analyzing different situations.

- **Outcomes:**

After completing this unit, student will be able to

1. Analyze cost and cost control past patterns in time series data and develop appropriate models for forecasting
2. Estimate cost and cost control models.

- **Unit Content:**

Definition, purpose and functions of estimation, role of estimator, constituents of estimates, estimating procedures.)

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 3– Estimation of Weight and Material Cost: No of lectures – 05

- **Prerequisite:** Basic Mathematics, Operation Research

- **Objectives:**

1. To understand the relationship of the various cost practices, project planning and scheduling
2. To understand the various production and operations design decisions and how they relate to the overall strategies of organizations

- **Outcomes:**
  After completing this unit, student will be able to

1. Gain an understanding and appreciation of the principles and applications relevant to the cost and cost control.
2. Summarize various cost and cost control. techniques

- **Unit Content:**
  a) Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost
  b) Review of purchasing procedure, recording of stock and consumption of material by LIFO, FIFO, and Weighted average method
- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 4– Estimation of fabrication cost : No of lectures – 05

- **Prerequisite:** Understanding of basic industrial activities and functions

- **Objectives:**

1. To understand the importance of various CCC functions of organizations.
2. To develop an ability to apply CCC concepts in a various types of industries.

- **Outcomes:**
  After completing this unit, student will be able to

1. Recognize the objectives, functions, applications of CCC
2. Describe way of integrating different departments to execute CCC functions

- **Unit Content:**
  a) Constitutes, direct cost, indirect cost,
  Procedure of estimation of fabrication cost
  b) Estimation of foundry cost: Constitutes, direct cost, indirect cost,
  Procedure of estimation foundry cost
  c) Estimation of forging cost: Constitutes, direct cost, indirect cost,
  Procedure of estimation of forging cost.
  d) Estimation of machining cost: Constitutes, direct cost, indirect cost,
  Procedure of estimation of machining cost.
- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Section II

Unit 5– Machine hour rate: No of lectures – 05

- **Prerequisite:** Operations Research, Mathematics

- **Objectives:**

1. To understand the roles of inventories and basics of managing inventories in various demand settings
2. To use basic concepts, strategies and techniques to analyze a variety of cost control systems

- **Outcomes:**

After completing this unit, student will be able to

1. Explain different cost control techniques
2. Apply and analyze methods used by organizations to obtain the right quantities of stock or inventory

- **Unit Content:**

definition, constituents, direct cost, indirect cost, steps for estimation of machine hour rate for conventional machines, CNC lathe and machining center

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 6– Labour Cost: No of lectures – 05

- **Prerequisite:** Various manufacturing systems, Understanding of basic industrial activities

- **Objectives:**

1. To understand the need and importance of plant costing.
2. To study various maintenance techniques and effect of cost on production.

- **Outcomes:**

After completing this unit, student will be able to

1. Identify costing techniques to be used in different manufacturing industries.
2. Do the roots cause analysis of any break down

- **Unit Content:**

Direct and indirect labour, Workmen classification, Definition of wages, Methods of remuneration

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 7– Cost Control: No of lectures –04

- **Prerequisite:** Understanding of basic industrial activities and processes.

- **Objectives:**

1. Obtain an understanding of quality management practice in organizations and how total quality management and six-sigma facilitate organizational effectiveness
2. To cultivate the ability to develop and implement new improved manufacturing processes resulting in creation and distribution of value in engineering applications

- **Outcomes:**

After completing this unit, student will be able to

1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design
2. Impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations

Unit Content: Use of cost data for policymaking and routine operation, control techniques such as budgetary control, standard cost, variance analysis, marginal cost and break even analysis

Unit 8– Cost Reduction Areas: No of lectures – 04

- **Prerequisite:** Understanding of basic industrial activities and functions

- **Objectives:**

1. To understand the importance of cost and cost control, service design decisions and its impact on other design decisions and operations
2. Introduction to Value Management

- **Outcomes:**

After completing this unit, student will be able to

1. Identify and eliminate the unnecessary costs during production process.
2. Modify the design as per the requirement of the customer.

- **Unit Content:**

Procedures and systems in product, methods and Layouts, administrative and marketing, rejection analysis, cost of poor quality, value Analysis and value engineering, Zero Base Budgeting

- **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

TERM WORK

Note: Use of computers is essential for at least one exercise.

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 CNC lathe 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

REFERENCE 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)
6. Cost Accounting: Jain, Narang (Kalyani Publishers)
7. A Text Book of Estimating and Costing Mechanical – J.S. Charaya & G. S. Narang (Satya Prakashan)
8. Mechanical Estimation and Costing – TTTI, Chennai (TMH)
9. Theory & Problems of Management & Cost Accounting – M.Y. Khan, P. K. Jain (TMH)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester- I
ME415 (A): Free Elective -I
Industrial Robotics (IR)

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week (3 Credits)	**ESE–**70 Marks
Practical – 2 Hour/week/batch (1 Credit)	**ISE –** 30 Marks
	ICA - 25 Marks

Course Introduction

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

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

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

Mobile robotics. Design, classification, navigation, AGVs, applications

Image Processing **using Scilab/Matlab/Octave or any free/commercial vision software**.

Design of installations. The work cell —concepts and design.

This course requires the students to take part in site visits and case study presentations. Students are also required to complete a simulation **in any Robot Simulation Software and image processing in Matlab/Scilab/Octave.**

Course Prerequisites

Fundamentals machines and mechanisms, basic differential and integral calculus, matrix algebra, fundamental of electrical and electronics, Matlab/Scilab/Octave programming.

Course Objectives: During this course, student is expected to

1. Understand the basic construction of an industrial robot.
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 and bridge the gap (regarding industrial robots) between text books & industry.

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

1. Solve simple kinematics and dynamics problems on robot motion.
2. Select appropriate robot specifications for industrial applications.
3. Use Matlab (or equivalent) toolboxes to demonstrate machine vision concepts.
4. Use any robot simulation software to simulate a robot and its work cell.

Section I

Unit 1–Introduction to Industrial Robots — No of lectures – 4Hrs.

Objectives

3. Understand the construction and types of industrial robots
4. Understand the market dynamics of industrial robots and their applications.

Outcomes

After completing this unit, student will be able to

3. Recall construction and classification of industrial robots
4. Evaluate and compare robots based on their specifications.

Unit Content

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".

Content Delivery Methods: Chalk and talk, PPTs, official documentation from International Federation of Robotics (IFR) and top robot manufacturers.

Unit 2–Sensors, Actuators & End Effectors — No of lectures – 8 Hrs.

Prerequisite: Basic electrical and electronics, fundamentals of measurement systems

Objectives

3. Be acquainted with type sensors, actuator and end effectors used in industrial robots.
4. Be acquainted with types grippers and end effectors and their applications

Outcomes

After completing this unit, the student will be able to

3. Evaluate and select sensors& drives used in the construction of an industrial robot and its work cell.
4. Evaluate and recommend end effectors based on potential applications.

Unit Content

Sensors: Sensor classification, joint angle sensors, rotary encoders, proximity sensors &switches, range sensors, vision sensors, other sensors for diagnostics, selection of sensors.
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.
Content Delivery Methods: Chalk and talk, PPTs.

Unit 3–Robot Kinematics and Dynamics No of lectures – 4Hrs.

Prerequisite: Theory of machines and mechanisms, basic differential and integral calculus, matrix algebra

Objectives

3. Understand forward kinematic and reverse equations for joined manipulators.
4. Understand dynamic considerations in manipulators.

Outcomes

After completing this unit, student will be able to

3. Solve forward and inverse kinematic equations for 2dof planar manipulators.
4. Formulate and solve velocity Jacobian and Euler-Lagrange equations.

Unit Content

Forward kinematics: Coordinate frames, transformations, arm equation.
Inverse Kinematics: Tool Configuration, inverse kinematics of 2DOF and 3DOF planar manipulator.
Dynamics: Velocity Jacobian, singularities, induced torque and forces, Lagrange's Equation, Dynamic models of two-axis planar robots.
(Derivations and Numerical Exerciseson simple 2DOFmanipulators only.)

Content Delivery Methods: Chalk and talk,demonstration using Matlab/Scilab/Octave

Unit 4–Robot Control and Trajectory No of lectures – 4 Hrs.

Prerequisite: Fundamentals of control systems, basic electrical and electronic engineering

Objectives

3. Understand fundamentals of manipulator control.
4. Understand modern control strategies used in industrial robots.

Outcomes

After completing this unit, student will be able to

3. Draw a generalized block diagram for robot joint control.
4. Identify control issues and suggest control techniques based on applications.

Unit Content

The control problem, state equations, actuator dynamics, set point tracking trajectory planning, joint space schemes, Cartesian space schemes, issues in trajectory planning. Overview of advanced control techniques such as force control, PID control adaptive control etc.
(Simple block diagrams and transfer function, simple trajectory calculations)

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software.

Section II

Unit 5–Robot Vision/Machine Vision No of lectures – 6 Hrs.

Prerequisite: Matlab/Scilab/Octave programming.

Objectives

4. Understand components of a machine vision system and its working.
5. Understand the fundamentals of image processing and analysis.
6. Understand the scope and applications of modern machine vision systems.

Outcomes

After completing this unit, student will be able to

4. Use the Image Processing toolbox in Matlab (or its equivalent in Scilab/LabView/Octave).
5. Use Image Analysis toolbox in Matlab (or its equivalent in Scilab/LabView/Octave).
6. Use Computer Vision toolbox in Matlab (or its equivalent in Scilab/LabView/Octave).

Unit Content

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.

Content Delivery Methods: Chalk and talk, PPTs,demonstration using software.

Unit 6 –Robot Workcells&Programming No of lectures – 4 Hrs.

Objectives

3. Understand robot workcell layout and their features.
4. Understand robot programming languages and types of programming.

Outcomes

After completing this unit, student will be able to

3. Explain robot workcell layout and their features.
4. Identify robot programing languages used by different robot manufacturers.

Unit Content

Robot cell layout, considerations in workcell design, workcell control, cell safety, human machine interface, robot cell controller.
Lead through programming, walk through programming, offline programming.

Content Delivery Methods: Chalk and talk, PPT, demonstration using software, field visit.

Unit 7–Industrial Robot Applications No of lectures – 6 Hrs.

Objectives

- Understandapplications of industrial robots in material transfer and machine tending.
- Understand applications of industrial robots in welding operations.
- Understand applications of industrial robots in assembly and inspection

Outcomes

After completing this unit, student will be able to

3. Explain applications of industrial robots in industry.
4. Select appropriate robot configuration and specifications for a given application.

Unit Content

General considerations for selecting robots (including layout and workcell) for material handling and machine tending, spot welding, continuous welding, sealant application, spray painting, assembly, inspection, electronics assembly.

Content Delivery Methods: Chalk and talk, PPTs, field visits.

Unit 8–AGVs &Mobile Robots No of lectures – 4 Hrs.

Prerequisites: Basic mechanical engineering.

Objectives

2. Understand the scope of AGVs and other mobile robots for industrial applications.

Outcomes

After completing this unit, student will be able to

3. Explain construction of typical AGV, classification and navigation techniques.
4. Select mobile configuration based on applications.

Unit Content

AGVs, classification, navigation techniques, applications.

Mobile robots: Classification, wheeled and tracked robots, autonomous navigation and control methodsand applications.

Content Delivery Methods: Chalk and talk, PPT, videos, field visits.

Note: All software are recommendations. One is free to use any equivalent free or commercial software.

Term Work

9) Survey assignment on robots industry and manufacturers and applications.
10) Theory assignment on sensors, actuators and grippers
11) One software assignment on kinematic and dynamics.
12) One softwareassignment robot motor control using Matlab/Scilab/Octave.
13) One assignment on Image Processing using Matlab/Scilab/Octave/LabView.
14) One assignment on Image Analysis using Matlab/Scilab/Octave Labview.
15) Survey assignment on AGVs and mobile robots.
16) One assignment on workcell simulation in **any robot simulation software**. (Robot Studio, RobCAD, Workspace, Delmia IGRIP, V-rep, Gazebo)

Text Books

6) S.K Saha, Introduction to Robotics, McGraw-Hill.
7) Mikell Groover et.al, Industrial Robotics, McGraw Hill.
8) James, Keramas, Robot Technology Fundamentals, Delmar Cengage Learning.
9) Spong & Vidyasagar, Robot Dynamics and Control, Wiley.
10) Gunter Ulrich, Automated Guided Vehicle Systems, Springer.

Reference Books

1) Asitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford Press.
2) Siegwart et.al, Autonomous Mobile Robots, Prentice Hall India.
3) Shimon Nof, Handbook of Industrial Robotics, Wiley
4) Schilling, Fundamentals of Robotics, Prentice Hall India.
5) International Federation of Robotics - https://www/ifr.org

Note: *Students are expected to go through websites of top industrial robot manufacturers such as ABB, Yasakawa, Fanuc, Comau, Kuka, Kawasaki, etc. in addition to the IFR website for up to date and real world information including statistical data. Content in text books is too generic and may not be up to date*

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester
ME415 (B): Free Elective -I
Sugar Technology

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week	**ESE–** 70 Marks
Tutorial: 2 hours /week	**ISE –** 30Marks
	ICA- 25Marks

Course Introduction:

India is the largest sugar consumer and second largest producer of sugar in the world. Industry has total turnover of Rs. 500 billion per annum. . As according to the statistics there is total number of 571 sugar factories in India have a production of total quantity of 19.2 million tones (MT) of sugar per annum. Jobs in Indian Sugar Industry have created ample employment opportunities in rural India. Today the Indian Sugar Industry has absorbed about 5 lakh rural people.

This course provides detail information about total sugar manufacturing process. Machines and equipments required for sugar manufacturing, This course also provide an introduction to different sections in the sugar industry such as, Mill section Boiler section, Quadriple section ,Pan section ,Centrifugal section , It introduces waste water treatment and management, treatment on distillery waste .It also covers precautions required for storage of sugar in godown. Course will give opportunities in Sugar Industry for Mechanical Engineers.

Course Prerequisite: Student shall have the knowledge of turbines, pumps, AC, DC electric motors, knowledge of thermodynamics, basics of heat and mass transfer, Theory of machine, Machine design.

Course Objectives: During this course, student is expected to

Course Objectives:

1. To prepare the students for knowing the basic nomenclature related to Sugar and sugarcane.
2. To familiarize the students with concepts of various concept of mechanical Engineering such as Design Construction and Working for various equipments, chemical processing of sugar manufacturing.
3. To prepare the students to understand the opportunities in Sugar Industry for Mechanical Engineers.

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

By the completion of the course, students must be able to:

1. Understand the nomenclature used in Sugar Engineering
2. Demonstrate the knowledge of various mechanical equipments/machinery and chemical processing of Sugar Industry.
3. Understand mechanical engineering concepts related to Sugar industry

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Section I

Unit 1– Cane Preparatory Devices No of lectures – 5

- **Prerequisite: Information of electric motors,shaft,bearing**

- **Objectives:**

1. Understand cane handling devices,
2. To acquire the knowledge of cane preparatory devices

- **Outcomes:**

After completing this unit, student will be able to

1. Explain the working of cane unloaded, feeder table
2. Describe cane kicker, cane knives, fibrizer

- **Unit Content**

1. Process of Sugar Manufacture in short. Cane unloader ,Feeder table, Main cane carrier- Objective, Length –(horizontal length .Inclined length .total length),Speed of cane carrier, Capacity of cane carrier, Slope, Width of carrier, Tramp Iron separator, Arcing of rollers, Cane preparation –Objective, cane preparatory index, Cane kicker or equalizer. Cane knives, Fibrizer . Shredder, mill setting

- **Content Delivery Methods:** chalk and talk., Videos

Unit 2–Juice Extraction No of lectures – …5….

- **Prerequisite:** knowledge of chain, sprockets, weighing machines

- **Objectives:**

1. To understand the knowledge of cold water and hot water imbibitions systems
2. To know the principle and working of automatic weighing machines

- **Outcomes:**

After completing this unit, student will be able to

1. Know maximum juice extraction is possible by using by spraying hot water on mill
2. Explain how total crushing capacity is calculated by weighing of juice

- **Unit Content:**

  Mill Section- Juice extraction from cane, mill drive, types of rollers, pressure in milling maceration and imbibitions, use of cold and hot water, maceration schemes and mill sanitation. Measurement and weighing of juice – Measuring tanks level meters, weighing machines – manually operated, semi-automatic

- **Content Delivery Methods:** Chalk and talk, power point presentation

Unit 3– Juice Heaters No of lectures – ……5.

- **Prerequisite:** knowledge of applied thermodynamics, heat and mass transfer

- **Objectives:**

1. To study and differentiate tubular and plate type juice heaters
2. To understand the construction and working of vapour line juice heater

- **Outcomes:**

  After completing this unit, student will be able to

1. Know how the juice is heated by using exhaust steam.
2. To know the use of last body vapours for heating of juice

- **Unit Content:**

  Clarification Section-Juice heaters, heat, exchangers, tubular and plate type and their operation, lime slaker, Juice sulphitation, dynamic juice heater, clear juice heater, Vapour Line Juice Heater. Juice clarifier, rotary vacuum filter

- **Content Delivery Methods:** Chalk and talk , Videos

Unit 4– Multiple effect evaporators No of lectures – 5

- **Prerequisite:** … knowledge of applied thermodynamics, heat and mass transfer ……...

- **Objectives:**

1. To understand the principle and working of Multiple effect evaporator
2. To understand the principle and working of long tube evaporators

- **Outcomes:**

  After completing this unit, student will be able to

1. Know juice is boiled at low temperature by using vacuum.
2. Know how large amount of vapors are generated by using long tube evaporators

- **Unit Content:**

  Quadriple Section-Evaporation – Study and operation of multiple effect evaporator, catchalls, scale formation and their removal, removal of condensate and incondensable gases, brix testing devices, entrainment, cleaning of evaporators Long tube vertical rising film evaporator (L.T.V.R.F.E)., Long tube vertical falling film evaporator (L.T.V.F.F.E). Syrup sulphitation

- **Content Delivery Methods:** Chalk and talk, Power point presentation

Section II

Unit 5– Crystallization and Vacuum Pan No of lectures – …5….

- **Prerequisite:** Fundamentals of Engineering Chemistry

- **Objectives:**

1. To understand the crystallization process in vacuum pan.
2. To understand the different types of boiling schemes

- **Outcomes:**

After completing this unit, student will be able to

1. Know the technique of growth of crystal
2. Know boiling schemes are used for maximum sugar extraction from the massecuite.

- **Unit Content:**

Pan Section-Aim of pan boiling, theory of pan boiling, Construction and working of vacuum pan ,massecuite boiling schemes , Graining, slurry preparation methods, crystal growth mechanism , crystallisers , types of crystallisers, hardening of grain, False grain and conglomerates-Formation of false grain and conglomerates, causes of formation false grain and conglomerates

- **Content Delivery Methods:** Chalk and talk, Power point presentation

Unit 6– Centrifugal Machines No of lectures – 5…….

- **Prerequisite:** Knowledge of theory of machines

- **Objectives:**

1. To understand the construction and working of batch type and continuous type centrifugal machines
2. To know centrifugation theory

- **Outcomes:**

After completing this unit, student will be able to

1. Know separation of the sugar crystals from the different massecuits
2. Know automation of centrifugal machines

- **Unit Content:**

Centrifugal Machine Section-centrifugal station**,** Centrifugal machines .- batch type and continuous type, Construction & working of each type, automation of centrifugal operation, Centrifugation theory, gravity factor, Advantages and disadvantages of batch / continuous centrifugal machines.

- **Content Delivery Methods:** Chalk and talk, Power point presentation

Unit 7– Sugar Drying and cooling No of lectures – …5….

- **Prerequisite:** basics of applied mechanics, theory of machines

- **Objectives:**

1. To understand different dryers used for sugar drying.
2. To understand the working of sugar graders.
3. To know the knowledge of storage sugar godowns.

- **Outcomes:**

After completing this unit, student will be able to

1. Know the process of moisture removal from wet sugar
2. Know dust produced from sugar is harmful to health and collected by using different dust collectors
3. Explain and describe condition required in sugar godowns for storage of sugar

- **Unit Content:**

Sugar bagging section-Sugar conveyors**,** sugar elevator ,Drying of sugar-rotary drier, fluidized bed drier , Sugar Grader ,deterioration of sugar, dilution indicator, safety factor. Sugar dust collectors, Sugar Godown – Location, staking of sugar bags.

- **Content Delivery Methods:** Chalk and talk, Power point presentation

Unit 8– Industrial Waste treatment No of lectures – …5….

- **Prerequisite:** Basics of applied chemistry

- **Objectives:**

1. To make student understand control waste water derived from the factory
2. To make student understand the control of Distillery waste
3. To know air pollution control

- **Outcomes:**

After completing this unit, student will be able to

1. Explain and describe aerobic and non aerobic water treatment
2. Describe air pollution control methods

- **Unit Content:**

Industrial waste treatment, Treatment of Sugar Factory waste water ,aerobic type , non aerobic type, and distillery effluents and their control, Air pollution control – Control measures for stack gases, SO_2, CO_2 and sugar dust.

- **Content Delivery Methods:** Chalk and talk, Power point presentation

- **Term Work:**

  Five written assignments based on above syllabus

  One Industrial visit must be arranged to observe the machinery, Instruments, layout etc

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- **Reference Books:**

1. Manufacture and refining of raw cane sugar by Baikow,V.E.,(1982-II Edition),Elsevier Publishing Co.
2. Hand book of cane sugar technology by Mathur ,R.B.L.,(1986-II) ,Oxford & IBH Publishing Co.
3. Unit operation s in cane sugar production by Payne, J.H., (1988-II0 Elsevier Publishing Co.
4. Cane Sugar Handbook by Chen , J.C.P.,91985-11TH Edition),Wiley Inter Science.
5. Principles of Sugar Technology Vol.-I by Pieter Honig(1953-Ist) Elsevier Publishing Co
6. Principles of sugar technology Vol.-II by Pieter Honig(1959-Ist) Elsevier Publishing Co.
7. Hand book of Cane Sugar engineering by E. Hugot ,(1986-IIIrd) Elsevier Publishing Co.
8. Cane Sugar Manufacturing in India by D.P. Kulkarni
9. Manufacture of Sugar from Sugar Cane by C.G.M. Park Term Work: 1

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I
ME415 (C): Free Elective -I
Entrepreneurship Development

Teaching Scheme	**Examination Scheme**
Lectures – 03 Hours/week 3 Credits	**ESE–**70 Marks
Practical – 02 Hour/week, 1Credit	**ISE –**30Marks
	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, Accounting, Marketing, Export-Import and so on. To sum up, the course will make students to have an understanding of the complete entrepreneurial ecosystem.

Course Prerequisite: Nil

Course Objectives: During this course, learners are expected

1. To familiarize with entrepreneurship and its significance in national development
2. To develop skills required to establish and run a successful enterprise
3. To acquaint with the options available with new entrepreneurs
4. To formulate business plan/project report for a startup
5. To acquaint with Government policies and agencies associated with entrepreneurial development

Course Outcomes: At the end of this course, learners will be able to

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

Course Curriculum:

Section I

Unit 1 – Entrepreneurship No of lectures – 10

- **Prerequisite:** Nil

- **Objectives:** During this unit, learners are expected -
  1. To get familiarized with entrepreneurship and its significance in national development
  2. To acquaint with entrepreneurial traits
  3. To study corporate entrepreneurship, social entrepreneurship, types of entrepreneurs

- **Outcomes :** After completing this unit, learners will be able to
  1. Describe role of entrepreneurship development in strengthening National economy
  2. Identify the qualities required to become a successful entrepreneur
  3. Classify entrepreneurs in various categories

- **Unit Content:**
  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) Role of culture in entrepreneurial development,
  i) Classification and types of entrepreneurs.

- **Content Delivery Methods:** Chalk and talk, presentation, case studies

Unit 2 – Entrepreneurship Development No of lectures – 10

- **Prerequisite: Nil**

- **Objectives:** During this unit, learners are expected -

1.To acquaint with Entrepreneurship Development Programmes
2.To recognize problems faced by entrepreneurs
3.To study different options available with entrepreneurs

- **Outcomes:** After completing this unit, learners will be able to

1.Describe entrepreneurship development programmes
2.Analyze problems faced by entrepreneurs
3.Select a suitable form of entrepreneurship for given set of entrepreneurial conditions

- **Unit Content:**
    a) Entrepreneurial development programmes (EDP): Introduction, Curriculum, Phases, Problems faced by EDPs.
    b) Managerial, marketing, financial & technological problems faced by new entrepreneurs and their probable solutions
    c) Options available to entrepreneurs - ancillarisation, franchising and outsourcing (characteristics, advantages, limitations, suitability of each option)

- **Content Delivery Methods:** Chalk and talk, presentation, case studies

Section-II

Unit 3 – Entrepreneurial Project Development No of lectures – 10

- **Prerequisite:** Nil

- **Objectives:** During this unit, learners are expected -

1.To study various ideation techniques
2.To understand SWOT analysis
3.To study preparation of a project report/business plan and its appraisal

- **Outcomes:** After completing this unit, learners will be able to

1.Apply different ideation techniques to find a good business idea
2.Evaluate a business idea by performing SWOT analysis
3.Formulate a project report/business plan for a startup
4.Evaluate feasibility of a project report/business plan

- **Unit Content:**
    a) Idea generation – sources and methods
    b) Identification and classification of ideas.
    c) Environmental Scanning and SWOT analysis
    d) Business model formulation, lean canvas model
    e) Preparation of a project report/business plan including : market plan, financial plan, operational plan, HR plan, Working capital management, Break Even Analysis, etc
    f) Significance of project report
    g) Project appraisal (feasibility study) – Aspects and methods : Economic oriented appraisal, Financial appraisal, Market oriented appraisal, Technological appraisal, Managerial competency appraisal

- **Content Delivery Methods:** Chalk and talk, presentation, case studies

Unit 4 – Small-Medium Enterprises and Support Systems No of lectures – 10

- **Prerequisite:** Nil

- **Objectives:** During this unit, learners are expected -

1.To understand concept of micro, small, and medium scale enterprise
2.To understand government policies and support system for entrepreneurship development
3.To study taxation benefits available for SMEs

- **Outcomes:** After completing this unit, learners will be able to

1.Define micro, small, medium enterprises
2.Describe government policies for entrepreneurship development
3.List government agencies established for entrepreneurship development
4.Explore taxation benefits provided for SMEs

- **Unit Content:**
  a) Meaning and definition (evolution) of micro, small & medium enterprises
  b) Steps in setting up a small unit
  c) Ownership patterns : sole proprietorship, partnership, private limited company
  d) Policies governing SMEs
  e) Funding options available : angel investors, venture capitalists, commercial banks, financial institutions
  f) Support agencies: SIDBI, SISI, NABARD, DIC, MCED, EDII, NIESBUD, EPC etc. – Their role in the development of SMEs
  g) Technology business incubation (TBI) centers
  h) Export Potential of SMEs, Export procedure
  i) Taxation benefits for SME sector
  j) Prospects and Turnaround strategies for SMEs

- **Content Delivery Methods:**
  Chalk and talk, presentation

In Semester Evaluation (ISE):

ISE shall be based upon student's performance in minimum two tests and mid-term
Written test conducted & evaluated at institute level.

In Semester Continuous Assessment (ICA):

Students of a batch should be divided into groups (consisting of maximum four members) to carry out the following tasks:

A] 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)

B] 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, Megha Biyani, 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 Levenson Keohane, McGraw Hill Education
4. Corporate Entrepreneurship , Paul Burns, Macmillan International Higher Educati

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester- I
ME415 (D): Free Elective -I
Process Equipment Design

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week 3 Credits	**ESE**– 70 Marks
Practical – 2 Hour/week, 2 Credit	**ISE** – 25 Marks
	ISA- 25 Marks

Course Introduction:

The Mechanical Engineers are often involved in the design of different types of process equipments such as pressure vessels, storage vessels, reaction vessels, heat exchangers, evaporators, filters, dryers and various types of supports used for pressure vessels. These process equipments are mainly used in sugar industries, dairy industries, petroleum industries, and in chemical industries. This course on Process Equipment Design includes design and construction features of different items of process equipments. This subject involves application of fundamental principles of machine design to specific items of equipment.

Course Pre-requisites:

Fundamental concepts of machine design and thin and thick pressure vessels

Course Objectives:

1. To acquire basic understanding of process design parameter.
2. To acquire complete knowledge of design procedures for commonly used process equipment and their attachments (e.g. internal and external pressure vessels, tall vessels, high pressure vessels, Supports etc.
3. To make students understand and learn about the Piping Design and process equipment design.
4. To acquire knowledge of Process Control, manufacture, inspection and erection of process Equipment and Applications of CAD to process Equipment Design

Course Outcomes:

After the completion of course students will be able to

1. Knowledge of basics of process equipment design and important parameters of equipment design
2. Considerably more in-depth knowledge of the major subject and ability to design internal pressure vessels and external pressure vessels.
3. Ability to design special vessels and various parts of vessels (e.g. heads)
4. Knowledge of Piping Design and process equipment design.
5. Deeper knowledge of Process Control, manufacture, inspection and erection of process Equipment
6. Knowledge of applications of CAD to process Equipment Design

SECTION-I

Unit 1 Basic Considerations in Process Equipment Design No of lectures – 04

- **Prerequisite:**

Basic knowledge of design of process equipments

- **Objectives:**

1. To understand different design considerations used for the design of process equipments.
2. To understand effect and influence of different factors in designing the process equipments.

- **Outcomes:**

After completing this unit, student will be able to
1. Know the different design considerations used for the design of process equipments.
2. Apply different types of factors for the design of process equipments.

- **Unit Content:**

Introduction, The general design procedure, Computer aided design, Fabrication techniques, Equipment classification, Power for rotational motion, Drives for process equipments, Stresses created due to static and dynamic loads, Design stress, Elastic instability, Combined stresses and theories of failure, Fatigue, Brittle fracture, Creep, Temperature effects, Radiation effects, Effects of fabrication methods, Economic considerations

- **Content Delivery Methods:**

Board, Chalk and Talk

Unit 2– Pressure Vessels No of lectures – 8 Hrs

- **Prerequisite:** Basis knowledge of thin and thick cylinders and components of pressure vessel
- **Objectives:**

1. To understand the different materials used for pressure vessels under different operating conditions.
2. To understand different design conditions and design the various components of pressure vessel.

- **Outcomes:**

After completing this unit, student will be able to
1. Select materials for pressure vessels for different operating conditions.
2. Design different components of pressure vessel

- **Unit Content:**

Introduction, Operating Conditions, Pressure Vessel codes, Selection of material, Vessels operating at low temperatures, Vessels operating at elevated temperatures, Design conditions and stresses, Design of shell and its components, Stresses from local load and thermal gradient, Thermal stresses in cylindrical shell, Review of unified pressure vessel codes, Inspection and tests, Numerical examples.

- **Content Delivery Methods:**

Board, Chalk and Talk, Power point presentation

Unit 3– High Pressure Vessels No of lectures – 4 Hrs

- **Prerequisite:** Basis knowledge of thin and thick cylinders and operating conditions of pressure vessel

- **Objectives:**

1. To study various constructional features, vessel closures and jackets of high pressure vessel.
2. To design the high pressure vessel considering different types of stresses.

- **Outcomes:**

After completing this unit, student will be able to

1. Know the construction and working of high pressure vessels.
2. Design the high pressure vessel.

- **Unit Content:**

Introduction, Constructional features, Materials for high pressure vessels, Solid walled pressure vessel, Multi-shell construction, Vessel closures, Jacket for vessels, Numerical examples.

- **Content Delivery Methods:**

Board, Chalk and Talk, Power point presentation

Unit 4– Storage Vessels No of lectures – 4 Hrs

- **Prerequisite:**

Vessels used for storing the fluids

- **Objectives:**

1. To study different types of tanks/vessels used to store the fluids.
2. To study the design procedure of different components of storage vessels.

- **Outcomes:**

After completing this unit, student will be able to

1. Know the constructional features of different types of storage vessels.
2. Design various parts of storage vessels.

- **Unit Content:**

Introduction, Storage of fluids, Storage of Non-volatile liquids, Storage of volatile liquids, Storage of gases, Design of Rectangular tanks, Design of tanks, Nozzles and mountings, Large capacity storage tanks, Numerical examples.

- **Content Delivery Methods:**

Board, Chalk and Talk, Power point presentation

Section II

Unit 5– Heat Exchangers No of lectures – 6 Hrs

- **Prerequisite:** Knowledge of heat transfer
- **Objectives:**

1. To study different types of heat exchangers.
2. To study the design procedure of various parts of heat exchangers.

- **Outcomes:**

After completing this unit, student will be able to

1. Understand construction and working of various heat exchangers
2. Design different parts of heat exchanger

- **Unit Content:**

Introduction, Types of heat exchangers, Design of shell and tube heat exchangers, Numerical examples

- **Content Delivery Methods:** Board, Chalk and Talk, Power point presentation

Unit 6– Evaporators and Crystallizers No of lectures – 6 Hrs

- **Prerequisite:** Knowledge of evaporation and Crystallization
- **Objectives:**

1. To study different types of evaporators and crystallizers.
2. To study design considerations of various parts of evaporators and crystallizers.

- **Outcomes:**

After completing this unit, student will be able to

1. Know the construction and working of different types of evaporators and crystallizers.
2. Design various parts of evaporators and crystallizers.

- **Unit Content:**

Evaporators, Types of Evaporators, Entrainment separators, Materials of Construction, Design Considerations, Crystallizers, Numerical examples.

- **Content Delivery Methods:** Board, Chalk and Talk, Power point presentation

Unit 7– Supports No of lectures – 6 Hrs

- **Prerequisite:** Knowledge of different types of supports used process equipments and design considerations.
- **Objectives:**

1. To study various types of supports used for process equipments.
2. To design the supports using different design considerations.

- **Outcomes:**

After completing this unit, student will be able to

1. Know the applications of various types of supports used for process equipments.
2. Design the different parts of supports.

- **Unit Content:**

Introduction, Bracket or Lug supports, Leg supports, Skirt supports, Saddle supports, Numerical Examples.

- **Content Delivery Methods:** Board, Chalk and Talk, Power point presentation

Unit 8– Process Hazards and Safety Measures in Equipment Design No of lectures – 2 Hrs

- **Prerequisite:** Knowledge of different types of hazards in the process industries
- **Objectives:**

1. To study and analyze different types of process hazards.
2. To study different safety measures in equipment design.

- **Outcomes:**

After completing this unit, student will be able to

1. Know the various types of process hazards, their causes and effects.
2. Apply different safety measures in process industries.

- **Unit Content:**

Introduction, Hazards in process industries, Analysis of Hazards, Safety measures, Safety measures in equipment design, Pressure relief devices.

- **Content Delivery Methods:** Board, Chalk and Talk, Power point presentation

- Term Work:

1. Design of different parts of pressure vessel
2. Design of different parts of high pressure vessel
3. Design of different parts of storage vessel
4. Design of different parts of heat exchangers
5. Design of different parts of evaporators and crystallizers
6. Design of different types of supports

- **Text Books:**

1) Joshi's Process Equipment Design- V.V. Mahajani, S. B. Umarji, Macmillan Publishers India Ltd.
2) Process Equipment Design : By Browell and Young, John Wiley.

- **Reference Books:**

1) Theory and Design of Pressure Vessels", by Harvey, second edition, CBS publishers and distributors
2) Pressure Vessel Design Hand Book : H .Bedna
3) Chemical Engineering Handbook : Perry John, McGraw Hill
4) Chemical Equipment Design : B.C. Bhattacharya
5) Chemical Process Equipment Selection and Design : By Stanley M.Walas,Butterworth-Heinemann Series in Chemical Engineering

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I
ME415 (E) Free Elective- I-
Railway Transportation Systems

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

Course Introduction:

This course presents a comprehensive overview of passenger and freight railway transport systems, from design through to construction and operation. Moreover, it thoroughly covers freight railway systems transporting conventional loads, heavy loads and dangerous goods. For each system it provides a definition, a brief overview of its evolution and examples of good practice, the main design, construction and operational characteristics, the preconditions for its selection and the steps required to verify the feasibility of its implementation. This subject includes all means of transport whose rolling systems involve at least one iron component.

Course Prerequisite:

Students shall have introductory knowledge of Concept of force in physics and Concept of tensile, compressive &tangential stress.

Course Objectives: During this course, students are expected:

1. To make a student understand concepts of various types of railway transport systems.
2. To make a student understand the different aspects of railway engineering, their uses, capabilities and limitations.
3. To introduce track engineering and fundamental calculations for railway tracks.
4. To give students an introduction to rolling stock and their dynamics.
5. To introduce a student to concept of derailment railway systems.
6. To make a student aware about concepts of electric systems.

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

1. Summaries different components of a railway transportation system
2. Interpreting various stresses & deflections generated in track under various loads.
3. Analysis of forces on track due to various loads.
4. Design track under various loads.
5. Interpretation of behavior of railway track with rolling stock.
6. Evaluating derailment of railway vehicles.

Section I

Unit 1–Introduction to Railway Systems No of lectures – 06

- **Prerequisite:** Basic knowledge of transport systems.
- **Objectives:**
  1. To study services & basic design principles of railway systems.
  2. To study design and operational considerations of railway systems.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Explain design principles of railway systems
  2. Summaries different components of a railway system
- **Unit Content:** Introduction to railway systems, Components of railway systems: Railway infrastructure, Rolling stock and Railway operation, Fundamental functional principles, Running on a straight path, Running in curves, Distinctive features of railway systems, Classification of railway systems, Speed in railway engineering- Design and operational considerations, Classification based on functionality, Classification of railway systems based on track gauge, Classification of railway systems based on traffic.
- **Content Delivery Methods:** Board, Chalk and talk, animations.

Unit 2–Transport system No of lectures – 03

- **Prerequisite:** Basic knowledge of transport systems, knowledge of design of systems.
- **Objectives:**
  1. To make a student understand the different aspects of railway engineering, their uses, capabilities and limitations
  2. To study design and operational considerations of transport systems.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Explain design principles of transport systems
  2. Summaries different components of a transport system

  Unit Content: The capabilities of the railway system: Advantages and disadvantages of the railway, Comparison of the characteristics of railway systems, Comparison of the capabilities of different transportation systems, Historical overview of the railway and future perspectives.
- **Content Delivery Methods:** Board, Chalk and talk

Unit 3–Vertical loads on track No of lectures –06

- **Prerequisite:** Basic knowledge of Concept of force in physics and Concept of tensile, compressive & tangential stress.
- **Objectives:**
  1. To study design and operational considerations of track under vertical load.
  2. To introduce fundamental calculations for railway tracks under vertical load.
  3. To introduce the students to concept of transverse loads on track.
  4. To make a student calculate stresses under vertical load.

- **Outcomes:**
  After completing this unit, student will be able to
  1. Analyze the forces on track due to vertical load.
  2. Design track under transverse loads.
- **Unit Content:** Classification of loads, Vertical loads on track: Static vertical loads- Axle load, Wheel weight, Daily traffic load. Quasi-static vertical loads: Vertical wheel load due to crosswinds, Vertical wheel load due to residual centrifugal force. Dynamic vertical loads- Dynamic vertical wheel load, Total vertical wheel load, Design vertical wheel load, Design loads of bridges. (Numerical treatment expected)
- **Content Delivery Methods:** Board, Chalk and talk

Unit 4–Transverse loads on track No of lectures – 05

- **Prerequisite:**Basic knowledge of Concept of force in physics and Concept of tensile, compressive & tangential stress.
- **Objectives:**
  1. To study design and operational considerations of track under transverse load.
  2. Tointroduce fundamental calculations for railway tracks under transverse load.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Analysis of forces on track due to transverse loads.
  2. Design track under transverse loads.
- **Unit Content:**Transverse loads on track: Gravitational forces, Creep forces-Running on straight path, running in curves, Crosswind forces, Residual centrifugal force, Guidance forces, Forces due to vehicle oscillations, Total transversal force.(Numerical treatment expected)
- **Content Delivery Methods:** Board, Chalk and talk, animations.

Section II

Unit 5–Longitudinal force Analysis No of lectures –03

- **Prerequisite:**Basic knowledge of Concept of force in physics and Concept of tensile, compressive & tangential stress.
- **Objectives:**
  1. To study design and operational considerations of track under longitudinal load.
  2. Tointroduce fundamental calculations for railway tracks under longitudinal load.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Analysis of forces on track due to longitudinal load.
  2. Design track under longitudinal load.
- **Unit Content:**Longitudinal forces: Temperature forces, Rail creep forces, Braking forces: Acceleration forces, Traction forces: Adhesion forces, Fishplate forces. (Numerical treatment expected)
- **Content Delivery Methods:** Board, Chalk and talk

Unit 6–Behavior of rolling stock on track No of lectures – 07

- **Prerequisite:**Knowledge of dynamics from physics.
- **Objectives:**

1. To give students an introduction to rolling stock and their dynamics.
2. To make students aware about behavior rolling stock on track.

- **Outcomes:**
  After completing this unit, student will be able to
1. Interprets of behavior of railway track with rolling stock.
2. Summaries wheel rolling conditions and bogies inscription behavior in curves.
- **Unit Content:** Behavior of a single railway wheel set: Movement on straight path, Movement in curves, Behavior of a whole vehicle: Operational and technical characteristics of bogies- Object and purposes of bogies, Conventional bogies, Bogies with self-steering wheel sets, Bogies with independently rotating wheels, Bogies with creep-controlled wheel sets, Bogies with wheels with mixed behavior. Wheel rolling conditions and bogies inscription behavior in curves. Lateral behavior of a whole vehicle- Vehicles with conventional bogies, Vehicles with bogies with self-steering wheel sets, Vehicles with independently rotating wheels, Comparative assessment. Selection of bogie design characteristics based on operational aspects of networks: High-speed networks, Conventional speed networks, Mountainous networks, Metro networks, Tramway networks.(Numerical treatment expected)
- **Content Delivery Methods:** Board, Chalk and talk

Unit 7–Derailment of railway vehicles No of lectures – 04

- **Prerequisite:** Basic Concept of centrifugal force, overturning and behavior of vehicle during climbs.
- **Objectives:**
1. To give students an introduction to derailment of railway vehicles.
2. To analyze overturning and climb phenomenon due to derailment.
- **Outcomes:**
  After completing this unit, student will be able to
1. *E*valuating derailment of railway vehicles.
2. Analyze factors affecting on derailment
- **Unit Content:** Derailment of railway vehicles: Definition, Derailment through displacement of track, Derailment as a result of vehicle overturning, Derailment with wheel climb- Description of the phenomenon, Derailment criteria, Factors affecting derailment.
- **Content Delivery Methods:** Board, Chalk and talk, animations

Unit 8–Introduction to Electrical Railway Systems No of lectures – 06

- **Prerequisite:** Knowledge of basic electrical systems, working principals of AC and DC systems.
- **Objectives:**
1. To make a student aware about concepts of electric systems.
2. To introduce students various electric supply in railway lines.
- **Outcomes:**
  After completing this unit, student will be able to
1. Explain various electric systems in railway lines, track and train wheels.
2. Explain Single Phase and three phase at railway transportation.
- **Unit Content:** Traction Electrification Systems: DC Electrification, Single Phase Electrification at Railway Frequency, Single Phase Electrification at Mains Frequency, Three Phase Electrification at Railway Frequency, Types of Electric Power Supply in Railway Lines, Track and Train Wheel.
- **Content Delivery Methods:** Board, Chalk and talk

- **Term work:**
  1. **MinimumFour**case studies on:
     - Rail transportation systems.
     - Failure of railway tracks.
     - Loading conditions of various types of coaches and bogies.
     - Advanced electric systems in railways
     - Derailment of railway vehicles
  2. **Minimum Five assignments on the following**
     a) Assignment and tutorial on Vertical loads on track
     b) Assignment and tutorial on Transverse loads on track
     c) Assignment and tutorial on Longitudinal force Analysis
     d) Assignment and tutorial on Behavior of rolling stock on track
     e) Assignment and tutorial on Derailment of railway vehicles
     f) Assignment and tutorial on Electric Railway Systems
  3. **Compulsory:** Industrial visit/ field visit to any railway workshop/ railway part manufacturing factory/ railway station.
- **Text Books:**
  1. Railway Transportation Systems – Design, Construction and Operation, Christos N. Pyrgidis, 2019, CRC Press
  2. A Text Book of Railway Engineering, S.C. Saxena, S.P.Arora, Dhanpat Rai Publications (p) Ltd.-new Delhi, 2010.
  3. Electric Traction for Railway Trains: A Book for Students, Electrical & Mechanical Engineers, Superintendents of Motive Power & Others, E. P. Burch, McGraw- Hill Book Company.

- **Reference Books:**
  1. Handbook of Railway Vehicle Dynamics, Simon Iwnicki, Taylor & Francis Group, CRC Press, ISBN: 9780849333217, 0849333210
  2. Railway Track Engineering, J.S.Mundrey, Tata McGrow Hill Publication.
  3. Principles of Railway Engineering, S.C. Rangawala, Charotar Publication, 2015.
  4. Traction Rolling Stock- Three Phase Technology, A.K. Rawal, Indian Railway Institute of Electrical Engineering, Nasik Road.
  5. Traction Distribution- Power Supply Electric Traction, A.K. Rawal, Indian Railway Institute of Electrical Engineering, Nasik Road.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I.

ME416 Project Work –I

Teaching Scheme	**Examination Scheme**
Practical – 04 Hour/week, 02 Credit	**ICA- 50 Marks**

Course

Objectives:

1. Application of the knowledge gained to practical situations.
2. Develop the technical problem solving ability.

Course Outcomes:

After completing Project Work –I, students will be able to;

1. Analyze the Project Problem with schematic diagram
2. Write mathematical model of the Project Problem

Guidelines for Project content & Mark Distribution:	**Marks**
a. Work diary and weekly reporting	20
b. Synopsis	10
c. Progress report submission and presentation	20

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 on the progress completed till end of first semester along with the progress report.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I

ME417 Industrial Training

Teaching Scheme	**Examination Scheme**
Lectures – 1 Hour/week 1Credits	**ESE– OE-25 Marks**
Practical – Hour/week, - Credit	**ISE – Marks**
	ICA- 50 Marks

Course Introduction:

Industrial training is must for a fresher. Students know the theoretical knowledge but practical application of same in industry need to be understand. 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. This will help student to understand industrial culture, working, role of an engineering etc.

Course Prerequisite:

1. Student must be aware of different manufacturing processes.
2. Student must be aware of things to be observed in industry.
3. Student should know basics of different material handling systems, design, materials

Course Objectives: During this course, student is expected to

1. Be aware of Industrial culture & Organizational setup.
2. Be aware about technical report writing.

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

1. Understand the Industrial culture & Organizational setup.
2. Write technical report and give presentation.
3. Correlate theoretical knowledge with the actual in Industry
4. Responsibility and role of engineer in Industry

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 term work.

Semester-VIII (BE Part-II)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering)

ME421 Industrial Engineering

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week 3 Credits	**ESE– 70 Marks**
Practical – 2 Hour/week, 1 Credit	**ISE 30 Marks**
	ICA- 25 Marks

Course Introduction:

Industrial Engineering is concerned with the design, improvement and installation of integrated system of people, material, information, equipment and energy. Its draws upon specialized knowledge and skill in the mathematical, physical and social science together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such systems.
This course includes, Introduction of basic concepts of IE and its applications to improve productivity for manufacturing and service sector. To understand concept of method study, work measurement, Job evaluation and merit rating for improving overall productivity. To acquire knowledge about plant layout, facility location, safety and ergonomic consideration for improving productivity.

Course Prerequisite:

1. Knowledge of various manufacturing process.
2. Knowledge of industrial working environment through industrial training and Industrial visits.
3. Knowledge of Machine drawing, Machine Design.

Course Objectives: During this course, student is expected to

1. To acquire knowledge of work study and techniques for improving overall productivity and Performance.

Course Outcomes: At the end of this course, student will be able to
1. Analyze & measure productivity.
2. Perform method study and work measurement etc.
3. Develop improved method of working/process for manufacturing /service sector.

Section I

Unit 1– Introduction to Industrial Engineering — No of lectures – 4

- **Prerequisite:** Knowledge of manufacturing process, Industrial Visits, Industrial Training
- **Objectives:**
  1. To acquire knowledge about IE and its basic concepts of IE for improving productivity
- **Outcomes:**
  After completing this unit, student will be able to
  1. To impart knowledge of basic concepts of IE
  2. To analyze factors affecting productivity, and contribution of F W Taylor and Gilberth.
- **Unit Content:**
  Definitions and meaning of I.E., contribution by F.W. Taylor, Gilbreth, objectives of I.E. Productivity - Factors affecting productivity and ways to improve productivity.
  Work Study – Definitions, objectives, Importance of work study procedure, Relation of work study with – work Simplification, Human Relation
- **Content Delivery Methods:**

  Chalk and Talk

Unit 2– Method Study — No of lectures – 6

- **Prerequisite:** Basic concepts of I.E.
- **Objectives:**
  1. To acquire knowledge of Method Study tools and techniques for improving productivity.
  2. To understand Critical examination and selection and Implementation method.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Perform method study using different Charts and diagrams, Critical examination techniques.
  2. Develop improved method of working/process for manufacturing /service sector.
- **Unit Content:**
  Definition, objective, Scope of method study, Basic procedure symbols and recording of fact.s, Charting conventions, Charts – Operation process chart, Flow process chart, Multiple activity chart, Two handed process chart, Diagrams – Flow and string diagram, travel chart Templets and models, Micro motion study. Therbligs simo chart, Critical examination and selection, Implementation method.

- **Content Delivery Methods:**

  Chalk and Talk

Unit 3– Ergonomics and Industrial Safety No of lectures –6

- **Prerequisite:** Knowledge of Machine Design, Awareness about industrial safety.
- **Objectives:**
  1. To acquire knowledge about ergonomics and industrial safety for improving productivity

  Outcomes:
  After completing this unit, student will be able to

  1. To perform ergonomic consideration for display, control and material handling equipement etc
  2. To analyse safety factors at workpalce and prevention of accident.
- **Unit Content:**
  Definition, Man Machine system, Types of display, types of control, manual material handling, Anthropometry, Design of work place and working conditions, ILO Norms. Definition of accident, Cause of accident, Prevention of accident, safety measures factor acts, minimum wages act, Employers state Insurance act.

- **Content Delivery Methods:**
  Chalk and Talk

Section II

Unit 4– Work Measurements No of lectures – 06

- **Prerequisite:-** Basic concepts of IE, Method Study & Awareness about industrial work environment

- **Objectives:**

1. To acquire knowledge of work measurement tools and techniques for improving productivity.

- **Outcomes:**
  After completing this unit, student will be able to

  1. To acquire knowledge of work measurement tools and techniques for improving productivity.
  2. Perform work measurement by applying various techniques for enhancing productivity

- **Unit Content:**

  Definition, objective and techniques of work measurement, time study, stop watch method, performance rating, allowance, relaxation interference contingency, policy, calculation of standard time, work sampling its need and procedure, predetermined motion time study(PMTS).

- **Content Delivery Methods:**
  Chalk and Talk

Unit 5– Facility Locations and Plant Layout No of lectures –06

- **Prerequisite:** Knowledge of manufacturing processes, Awareness about industrial work environment

- **Objectives:**
  1. To understand concepts Facility location and Plant layout, and material handling equipment to improve overall productivity.
- **Outcomes:**
  After completing this unit, student will be able to

  1. Analyze & identify plant location and material handling equipment.
  2. Perform selection of plant layout and material handling equipment.

- **Unit Content:-**
  a) Factors affecting site selection:
  - Intangible factors for facility location, tangible factor for facility location, advantages and disadvantages of facility location in urban and rural areas.
  b) Plant Layout:
  - Characterization of an efficient layout objectives of plant layout, principles of plant layout, procedure in planning layout, types of plant, layout product/line layout, process/functional layout, fixed position/static layout, cellular/Group Technology layout, selection of material handling equipment .

- **Content Delivery Methods:**
  Chalk and Talk

Unit 6– Job Evolutions and Merit Rating No of lectures – 06

- **Prerequisite:** Basic concepts of IE, Method Study , Awareness about industrial work environment & Knowledge of scientific management

- **Objectives:**
  1. To acquire knowledge about job evaluation and merit rating for improving productivity.

- **Outcomes:**
  After completing this unit, student will be able to

  1. To understand the concept and procedure of Job evaluation and Merit rating.
  2. To analyze and select Job description, specification, methods of evaluation to improve productivity.
  3. To analyses and perform merit rating methods to improve productivity.

- **Unit Content:**
  Job evolution: objectives, advantages and procedure, job analysis, job description, job specification, methods of evolution. Merit rating: Objectives And Method of Merit rating.

- **Content Delivery Methods:**

  Chalk and Talk

- **Term Work:**
  Any Six assignment based on productivity, time study, method study, layout.

- **Text Books:**
  Books Recommended:
  1. Industrial engineering and Production management by Martand Telsang. (S. Chand)
  2. Engineering management by A. K. Gupta (S. Chand)
  3. Industrial Engineering and Management by O. P. Khanna.
  4. Work Study by O. P. Khanna. (Dhanpat Rai and Sons)

- **Reference Books:**

  1) Introduction to work study by ILO. (Universal Publication)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-II

ME422 Industrial and Quality Management

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week 3 Credits	**ESE–** 70 Marks
Practical – 2 Hour/week, 1 Credit	**ISE –** 30 Marks
	ISA- 25 Marks

Course Introduction:

This subject deals with introduction to general management principles and to functions of the management. The subject also includes the basic knowledge of different departments in an industrial organization.

The second section of this subject is related to quality management. The subject focuses on the basic concepts related to modern approach towards quality. It includes information of quality control tools and highlights the statistical control techniques used for process control in manufacturing industry.

Course Prerequisites:

1. Knowledge of industrial working environment through industrial training and Industrial visits.
2. Knowledge of metrology and measurements.
3. Knowledge of Communication, Applied Statistic

Course Objectives:

1. To give the students an overview of the general functions of Management applicable to industrial & other organizations

2. To give insight to the philosophy & techniques of quality management applicable to industry

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

1. Describe and explain various management functions.
2. Enlist general principles of management and apply them in practice.
3. Describe concepts related to total quality management
4. Enumerate different statistical quality control tools and apply them for quality management.

Section I

Unit 1– Introduction to Management, Planning: No of lectures – 05

Prerequisite:

1. Knowledge of industrial working environment through industrial training and Industrial visits.
2. Aware about Profession Ethics/Manners in Industry.

Objectives:

1. To acquire knowledge about basic concepts of management functions and system approach.
2. To understand importance of planning, decision making, Social responsibility and ethics, etc. in Management.

Outcomes:

After completing this unit, student will be able to

1. Use various planning and decision making techniques in industrial environment.
2. Describe social responsibility and able to follow ethical practices in industrial management

Unit Content:

Nature & purpose of Management. System approach to Management, Functions of Managers, Social responsibility & Ethics in Managing.

Planning: Meaning, Types of plans, steps in planning, planning process, decision making.

Content Delivery
Methods: Chalk and
Talk

Unit 2– Organising and Staffing No of lectures – 06

Prerequisite: Knowledge of basic functions of management.

Objectives:

1. To acquire knowledge about basic concepts related to organizing and staffing.

2. To understand importance of organization structure

Outcomes:

After completing this unit, student will be able

1. Apply the principles of organizing..
2. Describe and apply staffing and performance appraisal process.

Unit Content:

Organizing: Nature & purpose of organizing, Organization structure, Span & levels,

Departmentation, Authority delegation, decentralization.

Staffing: Definition, Human resource management. Selection, , Training & development, Performance appraisal.

Content Delivery Methods: Chalk and Talk

Unit 3– Leading and Controlling No of lectures – 06

Prerequisite:

1. Knowledge of basic concepts of management.
2. Knowledge of Planning, Organizing and Staffing.

Objectives:

1. To acquire knowledge about human factors in management and theories of motivation.
2. To understand importance communication and its process in organization.

Outcomes:

After completing this unit, student will be able to

1. Explain role of human factors in management and different of theories of motivation.
2. Describe leadership styles, and communication process in organization

Unit Content:

Leading: Human factors in managing, Motivation, Theories, 'Carrot & Stick', Maslow's theory,

Leadership: Concept, styles, communication: process. Types- oral, written & nonverbal communication.

Controlling: Process of controlling, control techniques.

Content Delivery Methods:

Chalk and Talk

Unit 4–Introduction to Basic Departments in Industrial Organization No of lectures –03

Prerequisite:

1. Knowledge of industrial working environment through industrial training and Industrial visits.
2. Knowledge of basic concepts of management.

Objectives:

1. To acquire knowledge of basic departments in Industrial Organization

Outcomes:

After completing this unit, student will be able to

1. Explain role, nature and functions of Basic Departments in Industrial Organization

Unit Content:

Production /Operations Management, Marketing Management, Financial Management: Role, Nature and Functions of each department.

Content Delivery Methods:
Chalk and Talk

Section II

Unit 5– Introduction to Quality No of lectures – 03

- **Prerequisite:** Basic knowledge of design and manufacturing processes.
  Basic knowledge of costing

Objectives:

1. To understand concept of quality and elements of quality.
2. To understand concepts of quality of design and quality of conformance.
3. To get knowledge of costs related to quality

Outcomes:

After completing this unit, student will be able to

1. describe various elements of quality
2. analyze all costs associated with quality.
3. Distinguish between quality of design and quality of conformance.

Unit Content:

Definition of Quality, Elements of quality, quality specifications. Factors affecting quality of design & quality of conformance, quality control, quality costs.

Content Delivery Methods: Chalk and Talk

Unit 6– Total Quality Management . No of lectures – 07

Prerequisite: Basic knowledge of quality, different meaning of quality. Working of an industry, basic mathematics.

Objectives:

1. To get the knowledge of different quality gurus and their contributions such as Involvement of employees, continuous improvement customer satisfaction etc.
2. To get knowledge of different tools of quality control

Outcomes:

After completing this unit, student will be able to

1. Describe contributions of different quality gurus
2. To explain role employee's involvement, customer satisfaction, continuous improvement etc, in quality management.
3. Apply different tools of quality control for solving the problems in industry.

Unit Content:

Quality Gurus, Customer satisfaction, continuous process improvement, employee involvement, supplier partnership, Tools of quality control: Check sheets, graphs, Pareto analysis, cause & effect diagram, Scatter diagram, control charts.

Content Delivery Methods:

Black board, chalk, talk and power point presentation.

Unit 7–Statistical Process Control **No.** of lectures – 05

Prerequisite: Basic knowledge of statistics, tools and techniques.

Objectives:

1. To impart knowledge of statistical tools such as control charts, sampling techniques
2. To get knowledge of statistical process control and sampling inspection in quality control

Outcomes:

After completing this unit, student will be able to

1. Use the statistical techniques of control charts and acceptance sampling for statistical process control and quality control in manufacturing processes.

Unit Content:

Introduction to SPC, Control charts for variable & attributes, interpretation & applications of X,R,P & C charts, Process capability. Acceptance sampling, Sampling plans- types single & double, Operating characteristic curve, Producer & consumer risks. (Numerical treatment)

Content Delivery Methods:

Black board, chalk, talk.

Unit 8– Introduction to Various Techniques and Tools No of lectures – 05

Prerequisite: Introductory knowledge of total quality management

Objectives:

1. To acquaint the students to various modern concepts and tools being used in quality manage

Outcomes:

After completing this unit, student will be able to

1. Describe various recent concepts and tools being used for quality management in industry.

Unit Content:
Introduction to Benchmarking, Quality Management Systems, Environmental Management System, Quality function deployment, Six Sigma, FMEA, Total Productive Maintenance, Quality Engineering, etc.

Content Delivery Methods: Black board, chalk, talk.

Term Work:
Minimum 8 assignments based on each topic out of which 2 case studies related to industry / Establishments.

Assignment should include seminar, visit report, survey, analysis & numerical problems, etc.

Text Books:

1. Essentials of Management – Koontz Weihrich By TMH
2. Principles of Management & Administration – D. Chandra Bose. PHI
3. Statistical Quality Control – M. Mahajan By DhanpatRai & Co.
4. Total Quality Management – Besterfield & Others PHI

Reference Books:

1) Principles of Management – Tripathy, Reddy by TMH

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-II

ME423 (A) Professional Elective VI
Non-Conventional Machining

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week 3 Credits	**ESE–**70 Marks
Practical – 2 Hour/week, 1 Credit	**ISE –**30 Marks
	ICA- 25 Marks
	OE- 25 Marks

Course Introduction:

There is a need for machine tools and processes which can accurately and easily machine the most difficult-to-machine materials and workpieces with intricate and accurate shapes. In order to meet these challenges, a number of newer material removal processes have now been developed to the level of commercial utilization. These newer methods are also called unconventional in the sense that conventional tools are not employed for metal cutting. This course aims at bringing the students up-to-date with the latest technological developments and research trends in the field of unconventional / nontraditional / modern machining processes. It includes study of various non-conventional machining processes like….

Course Prerequisite:

Student shall have knowledge of different machining processes such as turning, milling, drilling, grinding, etc. A sound background of different energy sources like thermal, electrical, mechanical, chemical, etc. is essential for successful completion of this course.

CourseObjectives: During this course, student is expected to

1. Study the various non-traditional machining processes
2. Predict the application of these machining methods in various fields
3. Use of advance coating technology in various fields

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

1. Elaborate the different non-conventional machining process for suitable materials
2. Select suitable machining process for suitable materials
3. Summarizes the merits and demerits of the non-traditional manufacturing process

Section I

Unit 1–Overview of Non-conventional Processes No of lectures – 03

- **Prerequisite:** Knowledge of Manufacturing Processes and Machine Tools and Processes

- **Objectives:**

1. To understand different non-conventional processes
2. To study need and classification of non-conventional processes

- **Outcomes:**

  After completing this unit, student will be able to

1. Explain different non-conventional processes
2. Classify the various non-conventional processes

- **Unit Content:**

  Non-conventional machining Process: Need, classification, Comparison with conventional machining processes, Brief overview of all techniques.

- **Content Delivery Methods:**

  Board, Chalk and talk, PowerPoint presentation

Unit 2–Mechanical Energy Based Processes No of lectures – 09

- **Prerequisite:** Knowledge of Machining processes and Mechanical energy sources

- **Objectives:**

1. To understand the non-conventional processes based on mechanical energy
2. To study working principle, process parameters for Abrasive Jet Machining, Water Jet Machining, Ultrasonic Machining

- **Outcomes:**

  After completing this unit, student will be able to

1. Outline the non-conventional processes based on mechanical energy source
2. Elaborate the Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machiningprocesses

- **Unit Content:**

  Abrasive Jet Machining – Water Jet Machining- Abrasive Water Jet machining- Ultrasonic Machining. (AJM, WJM, AWJM and USM): Working Principles, equipment used, Process parameters, MRR-Variation in techniques used, Applications.

- **Content Delivery Methods:**

  Board, Chalk and talk, PowerPoint presentation, Animations/Videos

Unit 3–Electrical Energy Based Processes No of lectures – 08

- **Prerequisite:** Knowledge of Machining processes and Electrical energy sources

- **Objectives:**

1. To understand the non-conventional processes based on electrical energy
2. To study working principle, process parameters and applications of Electric Discharge Machining (EDM) and Wire cut EDM

- **Outcomes:**

After completing this unit, student will be able to

1. Explain the non-conventional processes based on electrical energy source
2. Elaborate the Electric Discharge Machining (EDM) and Wire cut EDM processes

- **Unit Content:**

Electric Discharge Machining (EDM) and Wire cut EDM: working Principles, equipment, Process Parameters, MRR, electrode /Tool, Tool Wear, Dielectric Flushing, Applications

- **Content Delivery Methods:**

Board, Chalk and talk, PowerPoint presentation, Animations/Videos

Section II

Unit 4–Chemical and Electro-Chemical Energy Based Processes No of lectures – 08

- **Prerequisite:** Knowledge of Machining processes and chemical energy/chemical reactions

- **Objectives:**

1. To understand the non-conventional processes based on chemical energy
2. To study working principle, process parameters and applications of Chemical machining, Electro-Chemical machining, and Photochemical Machining

- **Outcomes:**

After completing this unit, student will be able to

1. Outline the non-conventional processes based on chemical and electro-chemical energy source
2. Elaborate the Chemical machining, Electro-Chemical machining, and Photochemical Machining processes

- **Unit Content:**

Chemical machining, Electro-Chemical machining, Electro-chemical Grinding and Photochemical Machining (CHM, ECM, ECG and PCM): Principles, equipment, Etchants, maskant-techniques of applying maskants,Process Parameters, MRR, Applications.

Content Delivery Methods:

Board, Chalk and talk, PowerPoint presentation, Animations/Videos

Unit 5–Thermal Energy Based Processes No of lectures – 08

- **Prerequisite:** Knowledge of Machining processes and thermal energy

- **Objectives:**

1. To understand the non-conventional processes based on thermal energy
2. To study working principle, process parameters and applications of Laser Beam machining (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM)

- **Outcomes:**

  After completing this unit, student will be able to

1. Explain the non-conventional processes based on thermal energy sources
2. Elaborate the Laser Beam machining (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM)

- **Unit Content:**

  Laser Beam machining (LBM), Plasma Arc machining (PAM),Ion Beam Machining (IBM) and Electron Beam Machining (EBM): Principles, Equipment, Types, Beam control techniques, Parameters, MRR, Applications.

  Content Delivery Methods:

  Board, Chalk and talk, PowerPoint presentation, Animations/Videos

Unit 6–Introduction to Coating Technology No of lectures – 04

- **Prerequisite:** Knowledge of Machining processes and about coating

- **Objectives:**

1. To understand the principle of coating technology
2. To study physical and chemical deposition and applications of coating

- **Outcomes:**

  After completing this unit, student will be able to

1. Explain the working principle of coating technology
2. Elaborate the coating methods like Metal Spraying, Metallic coating, Plasma flame spraying

- **Unit Content:**

  Principle of Coating Technology: Mechanism, Chemical and Physical vapour deposition, Application, Metal Spraying, Metallic coating, Plasma flame spraying

- **Content Delivery Methods:**

  Board, Chalk and talk, PowerPoint presentation, Animations/Videos

- **Term Work:**

  Total Eight Assignments:

  1) Minimum Six Assignments based on above six topics

  2) Two Case studies for effect of parameters on MRR of non-conventional machining processes (Refer Journal paper from Reputed Journals, Preferably SCIE)

- **Text Books:**

1. Advanced Machining Processes,V.K. Jain, Allied Publishers, 2009.
2. Non-Conventional Machining, P. K. Mishra, Narosa Publication
3. Manufacturing Science, A. Ghosh, A. K. Mallick, East West Publication
4. Modern Machines Process, P. C. Pandey, H. S. Shan, Tata McGraw Hill Publication
5. Nontraditional Manufacturing Processes, Gary F.Benedict, Taylor & Francis, 1987.
6. Advanced Methods of Machining, J.A. McGeough, Springer, 1988.
7. Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, Hassan El-Hofy, McGraw-Hill Prof Med/Tech, 2005.
8. Introduction to Micromachining,V.K. Jain,Alpha Science International Limited, 2010

- **Reference Books:**

1. Manufacturing Processes and Systems, P. F. Ostwald, J. Munoz, John Wiley Sons.
2. Materials and Processes in Manufacturing, E. P. DeGarmo, J. T. Black, R. A. Kohser, B. E. Klamecki, Wiley Publication
3. Advanced Machining Processes, H El-Hofy, McGraw Hill Publication
4. Introduction to Manufacturing Processes, J. Schey, McGraw-Hill
5. Micromachining Using Electrochemical Discharge Phenomenon, R. Wuthrich, William Andrew

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester- I
ME423 (B) Professional Elective -VI
Mechatronics (MTRN)

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week (3 Credits)	**ESE–**70 Marks
Practical – 2 Hour/week/batch (1 Credit)	**ISE –** 30 Marks
	ICA - 25 Marks
	OE – 25 Marks

Course Introduction

The course is an introductory course aimed to designing mechatronic systems, which require integration of the mechanical, electrical, electronic and computing engineering disciplines within a unified framework. Contents covered in this course include mechatronic systems, sensors and actuators, signal conditioning, machine learning techniques (genetic algorithms, neural networks, fuzzy logic and reinforcement learning), microcontrollers, PLC and interfaces.

The course is lab-centered and students will learn by working with real hardware such as 8085/8051 boards, Arduino and Raspberry Pi Boards and PLCs. Topics covered in the course include: assembly language programming, interfacing of software with hardware; digital logic, measurement and sensing, ladder programming. There are five specific labs on the topics of: sensor interfacing, DC motor control, stepper motor control, servo-motor control, and control using PLCs.

Course Prerequisites

Fundamentals of machines and mechanisms, matrix algebra, fundamental of electrical and electronics, C/C++ programming, Matlab/Scilab/Octave programming, preferably Free Elective – Industrial Robotics.

Course Objectives: During this course, student is expected to

5. Understand what makes up a mechatronic system.
6. Understand microprocessor/microcontroller architecture and assembly programming.
7. Understand the construction, programming and applications of PLCs.
8. Acquaint with the developments in mechatronics especially related to the field of AI.

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

6. Recall applications of sensors and actuators in mechatronic systems.
7. Program 8085 and 8051 in assembly language (and C/C++, Python) to demonstrate interfacing with sensors and actuators.
8. Program PLCs using ladder logic (both on simulators and actual hardware).
9. Build and program a mechatronic system which will accept data from input and sensors and control an output/actuator using any microprocessor/ microcontroller board (Arduino or Raspberry Pi can also be used)

Section I

Unit 1–Introduction to Mechatronics No of lectures – 4Hrs.

Objectives

5. Understand fundamental concepts of mechatronic systems.
6. Understand how mechatronic system have evolved over the years.

Outcomes

After completing this unit, student will be able to

5. Recall definition, scope and elements of mechatronic systems.
6. Explain the working of mechatronic systems such as CNCs, ABS etc.
7. Draw a conceptual block diagram of mechatronic systems.

Unit Content

Basic Definition, Key elements of Mechatronics, Historical Perspective, Examples of Mechatronics Systems: Car Engine Management, Automatic Camera, White goods and domestic appliances, various systems in a modern automobile (ABS, TCS, DAS), Modern HVACs, CNC machines and factory automation

Content Delivery Methods: Chalk and talk, PPTs,

Unit 2–Microprocessors and Microcontrollers No of lectures – 6 Hrs.

Prerequisite: Basic electrical and electronics, basic programming

Objectives

5. Understand the architecture of microprocessors and microcontrollers.
6. Understand how to program microprocessors/microcontroller using assembly and higher level programming languages.

Outcomes

After completing this unit, the student will be able to

5. Program 8085 and 8051 microcontrollers in assembly language.
6. Interface & program 8051 in C/C++ or any other language.

Unit Content

Introduction to 8085 microprocessor, 8085 architecture, microcontrollers, the 8051 microcontroller, architecture, introduction to Arduino and Raspberry PI development boards, interfacing sensors and actuators with 8051 microcontroller, realtime instrumentation.

Content Delivery Methods: Chalk and talk, PPTs. Demonstration using simulator and actual hardware.

Unit 3–Sensors and Actuators No of lectures – 6Hrs.

Prerequisite: Basic electrical and electronics, fundamentals of measurement systems,

Objectives

5. Understand classification, basic operation and applications of sensors and actuators.
6. Understand modern trends in sensor and actuator design.

Outcomes

After completing this unit, student will be able to

5. Select appropriate sensor and actuator for a given application.
6. Explain the basic principle of operation of sensors and actuators.

Unit Content

Sensors: Classification, Principle of Operation & Characteristics, Linear and rotational sensors, acceleration sensors, Force sensors, Torque Sensors, Flow Sensors, Temperature Sensors, Distance Sensors, Optical Sensors, Ultrasonic Sensors , Selection criteria. Applications: Sensors for Condition Monitoring, Micro sensors.

Actuators: Classification of Actuators, DC Motors, AC Motors, Stepper Motors, Switches, Solenoids, Piezoelectric Actuators, Micro motors.

Content Delivery Methods: Chalk and talk,demonstration using Matlab/Scilab/Octave

Unit 4– Interfacing No of lectures – 4 Hrs.

Prerequisite: Fundamentals of microprocessors, microcontrollers, basic electrical and electronic engineering

Objectives

5. Understand fundamentals of interfacing and signal conditioning.
6. Understand how to interface sensors and actuators.

Outcomes

After completing this unit, student will be able to

5. Interface sensors and actuators with microcontrollers.
6. Identify signal conditioning requirements for interfacing.

Unit Content

Interfacing, source and sink currents, pull up and pull down configuration, motor drivers, relays, optocouplers, ADC/DAC, OPAMPs, Signal Conditioning, Signal Processing, ComputerBased Instrumentation, Data Recording and Logging, DAQs.

(Simple calculations on ADC, OPAMPS)

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software and hardware.

Section II

Unit 5–Control using PLCs No of lectures – 6 Hrs.

Prerequisite: Fundamentals of electronics, microprocessors and microcontrollers, Boolean logic

Objectives

7. Understand how a PLC differs from an embedded controller.
8. Understand how to program a PLC using ladder logic.
9. Acquaint with the PLC and automation market scenario especially regards to applications.

Outcomes

After completing this unit, student will be able to

7. Use OpenPLC (or equivalent free or proprietary software) for ladder programming.
8. Demonstrate simple control tasks on actual PLCs.
9. Compare PLC specifications and make conclusions about their capabilities and applications.

Unit Content

PLC architecture, I/O Processing, Ladder Diagrams, Internal Relays, Jump and Call, Timers, Counters, Shift Registers and Data Handling, Programs for temperature control, sequencing etc., PLC Vs. PC based systems, top manufacturers.

Content Delivery Methods: Chalk and talk, PPTs,demonstration using software.

Unit 6 –Networking and Communications No of lectures – 4 Hrs.

Objectives

5. Understand fundamentals of networking and data communication.
6. Acquaint with terminology related totransmission standards and communication protocols.

Outcomes

After completing this unit, student will be able to

5. Define transmission and communication protocols and standards.
6. Explain scope and application of networking models and protocols and systems.

Unit Content

Terminology: Serial and Parallel communications, bit and baud rate, protocols, data flow, handshaking, signal transmission

TIA/EIA Serial Standards (RS 232, RS422, RS485), IEEE 488 General Purpose Interface bus. Computer Networks, OSI model, LAN, WAN, MAN, CAN bus, PROFI bus and SCADA.

Content Delivery Methods: Chalk and talk, PPT, videos, expert lecture.

Unit 7–Artificial Intelligence and Mechatronics No of lectures – 4 Hrs.

Objectives

- Understandwhat is meant by Artificial Intelligence.
- Understand what is Fuzzy Logic, ANNs and Gas and their applications.

Outcomes

After completing this unit, student will be able to

5. Explain in brief Fuzzy Logic, ANNs and Genetic Algorithms.
6. Execute sample Fuzzy Logic and ANN programs in Matlab and interpret the results.

Unit Content

Fundamentals of AI, Fuzzy logic, Fuzzy Process, Fuzzy Applications, Neural Networks and its applications, Genetic Algorithms and their applications.

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software, expert lecture.

Unit 8–Mechatronics Applications in Industry No of lectures – 4 Hrs.

Prerequisites: Previous units

Objectives

3. Understand mechatronics applications in industry
4. Acquaint with terminology related to automation and high technology.

Outcomes

After completing this unit, student will be able to

5. Explain terms such as automation, Industry 4.0, IOT.
6. Explain the application of mechatronics in industry and high technology.

Unit Content

MEMS based applications, Industrial Automation, machine diagnostics, IOT and mechatronic systems, Industry 4.0.

Content Delivery Methods: Chalk and talk, PPTs, videos, field visits.

Term Work

1) Survey assignment on mechatronic products.
2) Theory assignment on sensors, actuators.
3) One practical assignment on interfacing sensors with microcontrollers.
4) One practical assignment on dc motor control using microcontrollers.
5) One practical assignment of stepper motor control using microcontrollers.
6) One practical assignment which includes building small Mechatronics systems whichmicroprocessor/microcontroller receives input from sensors and controls actuators.
7) One practical assignment on interfacing sensors and actuators with PLC.
8) One theory assignment on communication systems.
9) One MatLab/Scilab assignment on AI.
10) One theory assignment on Mechatronics applications.

Text Books

11) W. Bolton, Mechatronics, Pearson Publishing
12) Shetty & Kolk, Mechatronics System Design,Cengage Learning.
13) Mazidi, 8051 Microcontroller, Prentice Hall.
14) Gaonkar Ramesh, The 8085 microprocessor, Penram International Publishing

Reference Books

6) Bishop et.al, Handbook of Mechatronics, CRC Press.
7) Fitzgerald, & Kingsley, Electric Machinery, McGraw Hill.
8) Banzi, Getting Started with Arduino, McGraw Hill.
9) W. Bolton, Programmable Logic Controllers, PearsonPublishing.
10) Petruzella Frank, Programmable Logic Controllers, McGraw Hill.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-II

ME423 (C) Professional Elective VI
Computational Fluid Dynamics

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week 3 Credits	**ESE–**70 Marks
Practical – 2 Hour/week, 1 Credit	**ISE –**30 Marks
	ICA- 25 Marks
	OE- 25 Marks

Course Introduction:

Computational Fluid Dynamics (CFD) is the simulation of fluids engineering systems using modeling (mathematical physical problem formulation) and numerical methods (discretization methods, solvers, numerical parameters, and grid generations, etc.). To solve fluid problem, we should know the physical properties of fluid by using Fluid Mechanics. Then we can use mathematical equations to describe these physical properties. This is Navier-Stokes Equation and it is the governing equation of CFD. As the Navier-Stokes Equation is analytical, human can understand it and solve them on a piece of paper. But if we want to solve this equation by computer, we have to translate it to the discretized form. The translators are numerical discretization methods, such as Finite Difference, Finite Element, Finite Volume methods. Consequently, we also need to divide our whole problem domain into many small parts because our discretization is based on them. Then, we can write programs to solve them. The typical languages are Fortran and C. Normally the programs are run on workstations or supercomputers. At the end, we can get our simulation results. We can compare and analyze the simulation results with experiments and the real problem. If the results are not sufficient to solve the problem, we have to repeat the process until find satisfied solution. This is the process of CFD.

Course objectives:

- To learn computational solution techniques for various types of partial differential equations
- To model fluid / heat transfer problems and apply fundamental conservation principles.
- To discretize the governing differential equations and domain by Finite Difference Method.
- To solve basic convection and diffusion equations and understands the role in fluid flow and heat transfer.
- To prepare the students for career in industry in CAE through use of software tools.
- To prepare the students for research leading to higher studies.

Course Outcomes:

After completion of the course the students will be able to:-

1. Analyze and model fluid flow and heat transfer problems.
2. Generate high quality grids and interpret the correctness of numerical results with physics.
3. Use a CFD tool effectively for practical problems and research.
4. Conceptualize the programming skills.

Section-I

Unit 1: Introduction to CFD **No. of Lectures: 06**

• **Prerequisite:**

Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

• **Objectives:**

1. To understand mathematical characteristics of partial differential equations.
2. To understand basic properties of computational methods – accuracy, stability, consistency
3. To learn computational solution techniques for time integration of ordinary differential equations

• **Outcomes: After completing this unit, students will be able to-**

1. Implement mathematical characteristics of partial differential equations.
2. To solve Euler and Navier-Stokes equations

• **Unit content:**

CFD – a research and design tool, CFD as third dimension of engineering supplementing theory and experiment, Steps in CFD solution procedure, strengths and weakness of CFD, Flow modelling using control volume - finite and infinitesimal control volumes, Basic governing equations in integral and differential forms – conservation of mass, momentum and energy (No derivations), Physical interpretation of governing equations, Navier-Stoke‘s model and Euler‘s model of equations.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 2: Basic Discretization Techniques **No. of Lectures: 07**

• **Prerequisite:**

Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

• **Objectives:**

1. To understand various method grid generation.
2. To discretize the domain and governing equations.
3. To use first order and second order equations for finite difference approximation

• **Outcomes: After completing this unit, students will be able to-**

1. Apply various methods of grid generation.
2. Apply first order and second order equations for finite difference approximation.

• **Unit content:**

Introduction to grid generation, Need to discretize the domain and governing equations, Finite difference approximation using Taylor series, for first order (Forward Difference Approximation, Backward Difference Approximation, Central difference Approximation) and second order,explicit and Implicit approaches applied to 1D transient conduction equation, Couette flow equation.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 3: Two Dimensional heat conduction **No. of Lectures: 07**

• **Prerequisite:**

Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

• **Objectives:**

1. To understand Explicit and Alternating Direction Implicit method (ADI Method) of solution.
2. To solve two dimensional steady and unsteady heat conduction equation with Dirichlet, Neumann, robbins and mixed boundary condition To select appropriate simulation or analysis software

• **Outcomes: After completing this unit, students will be able to-**

1. Implement Explicit and Alternating Direction Implicit method (ADI Method) of solution.
2. Carry out analysis of two dimensional steady and unsteady heat conduction problems

• **Unit content:**

Solution of two dimensional steady and unsteady heat conduction equation with Dirichlet, Neumann, robbins and mixed boundary condition – solution by Explicit and Alternating Direction Implicit method (ADI Method), Approach for irregular boundary for 2D heat conduction problems.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 4: Application of Numerical Methods to Convection – Diffusion System (No of Lect.07)

• Prerequisite:
Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

• Objectives:

1. To understand the concept and physical interpretation of Convection –Diffusion
2. To study and understand the concept of Central difference approach used for CFD analysis

• Outcomes: After completing this unit, students will be able to-

1. Carry out CFD analysis of 1 D transient convection-diffusion system
2. Implement concept of Central difference approach used for CFD analysis

• Unit content:
Concept and physical interpretation of Convection –Diffusion: 1D and 2D steady Convection Diffusion system – Central difference approach, Peclet Number, stability criteria, upwind difference approach, 1 D transient convection-diffusion system.

• Content Delivering Methods: Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 5: Incompressible Fluid Flow No. of Lectures: 06

• Prerequisite:
Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

• Objectives:

1. To solve Navier-Stoke‘s equation for incompressible flow using SIMPLE algorithms .
2. To demonstrate flow through pipe using CFD tool.

• Outcomes: After completing this unit, students will be able to-

1. Implement SIMPLE algorithms to solve Navier-Stoke‘s equation for incompressible flow.
2. Impement concept of finite Volume Method

• Unit content:
Solution of Navier-Stoke‘s equation for incompressible flow using SIMPLE algorithms and its variation (SIMPLER), Application to flow through pipe, Introduction to finite volume method.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 6: CFD as Practical Approach **No. of Lectures:07**

• **Prerequisite:**
Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

• **Objectives:**

1. To create model in CFD tool.
2. To apply material, boundary conditions and meshing.
3. To interpret CFD results.

• **Outcomes: After completing this unit, students will be able to-**

1. Apply CFD tool to solve fluid flow related problems

• **Unit content:** Introduction to any CFD tool, steps in pre-processing, geometry creation, mesh generation, selection of physics and material properties, specifying boundary condition, Physical Boundary condition Introduction to turbulence models. Reynolds Averaged Navier-Stokes equations (RANS), k-ϵ etc. Simple problems like flow inside a 2-D square lid driven cavity flow through the nozzle.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

List of Experiments

1. Program on 1D transient heat conduction
2. Program on 2D Transient Conduction equation / 2D Convection-Diffusion Equation
3. Numerical simulation and analysis of boundary layer over a flat plate are using any CFD software or computer programming.
4. Numerical simulation and analysis of flow through a pipe.
5. Numerical simulation and analysis of 2D square lid driven cavity using any CFD software. Effect of Reynolds number on the vorticity patterns.
6. CFD Analysis of external flow: Circular Cylinder or Aerofoil
7. CFD analysis of heat transfer in pin fin.

Text books and Reference Books:

1. John D Anderson: Computational Fluid Dynamics- The Basics with Applications, McGraw-Hill

2. J. Tu, G.-H. Yeoh and C. Liu: Computational Fluid Dynamics: A practical approach, Elsevier.

3. A. W. Date: Introduction to Computational Fluid Dynamics, Cambridge University Press, India

4. P. S. Ghoshdastidar: Computer Simulation of Fluid flow and heat transfer, Tata McGraw-Hill.
5. Bates, Computational Fluid Dynamics, Wiley India
6. C. Hirsch: Numerical Simulation of internal and external flows Vol. 1, John Wiley
7. Tannehill, Anderson, and Pletcher: Computational Fluid Mechanics and Heat transfer, CRC Press.
8. J. H. Ferziger and M. Peric: Computational Methods for Fluid Dynamics, 3rd Edition, Springer
9. Zikanov, Essential Computational Fluid Dynamics, Wiley India
10. Batchelor, An Introduction to fluid Dymanics, Cambridge Uni. Press, india

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-
ME423 (D) Professional Elective VI

Process Engineering (Professional Elective-VI)

Teaching Scheme	**Examination Scheme**
Lectures – 03Hours/week 3 Credits	**ESE–**80 Marks
Practical –02 Hour/week, 1Credit	**ISE –**30Marks
	ICA- 25 Marks
	OE- 25 Marks

Course Introduction:

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 Prerequisite: Knowledge of engineering and machine drawing, manufacturing process, Machine tools, tool engineering and metrology

Course Objectives: During this course, student is expected

Objectives

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

Outcomes: Learner will be able to…

1. Determine machine sequences to cater to the manufacturing requirements.
2. Analyze part prints.
3. Prepare process picture, process routing/process sheets.
4. Prepare process plan for a given component for job, batch and mass production
5. Prepare process plan for product within optimum time and cost

Section I

Unit 1– Introduction No of lectures – 06

- **Prerequisite:** Knowledge of Manufacturing processes
- **Objectives:**

1. To impart the knowledge of manufacturing system and categories
2. To impart the knowledge of product and process engineering departments

- **Outcomes:**

After completing this unit, student will be able to

1. Distinguish between different categories of manufacturing system
2. Distinguish between product and process engineering departments

- **Unit Content:**

a. Manufacturing system, Input & Output of manufacturing system, characteristics of manufacturing system.
b. Categories of manufacturing system.
c. Manufacturing Engineering.
d. organization chart
e. Position of product & process Engineering Department in organization.
f. Function of product & process Engineering.

- **Content Delivery Methods:** Chalk and Talk

Unit 2– Process planning fundamentals No of lectures – 10…….

- **Prerequisite:** Knowledge of Manufacturing processes and tool engineering.

- **Objectives:**

1. To familiarize with process planning
2. To acquaint with part print analysis

- **Outcomes:**

After completing this unit, student will be able to

1. Analyze process planning activities
2. Demonstrate the part print analysis

- **Unit Content:**

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

k. Basic process planning terminology- process, operation & cut.

- **Content Delivery Methods:**Chalk and Talk

Unit 3 Drawing interpretation No of lectures – …04….

- **Prerequisite:** Knowledge of engineering, machine drawing and metrology

- **Objectives:**

1. To familiarize with the basic concepts of assembly
2. To prepare and analyze tolerance for assembly

- **Outcomes:**

After completing this unit, student will be able to

1. Demonstrate the concepts in drawing the assembly
2. Analyze the tolerance for part and assembly

- **Unit Content:**

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

Content Delivery Methods: Chalk and Talk

Section-II

Unit 4– Feasibility study & selection of sequence of operation No of lectures 06

- **Prerequisite:** Knowledge of manufacturing processes, machine tools and tool engineering.

- **Objectives:**

1. To prepare the students study and analyze different aspects of feasibility
2. To prepare the students study and analyze the optimum selection of methods and operations

- **Outcomes:**

After completing this unit, student will be able to

1. Demonstrate the concepts of feasibility study
2. Identify the equipment, machinery and tooling used for product/process

- **Unit Content:**

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

- **Content Delivery Methods:** Chalk and Talk.

Unit 5– Selection of equipments & Selection of tooling No of lectures – 06

- **Prerequisite:** Knowledge of Machine tools
- **Objectives:**

1. To impart the knowledge of machine tools selection
2. To impart the knowledge of cutting tool and parameter selection

- **Outcomes:**

After completing this unit, student will be able to

1. Illustrate machine tools capabilities and types
2. Illustrate cutting tool parameters and capabilities

- **Unit Content:**

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

- **Content Delivery Methods:** Chalk and Talk+

Unit 6– Preparation of process sheet for machining of components for job, batch & mass production No of lectures – 08.

- **Prerequisite:** Knowledge of manufacturing and machine tools .

- **Objectives:**

1. To familiarize with process plan
2. To familiarize with process picture.

- **Outcomes:**After completing this unit, student will be able to

1. Develop process plan for different products
2. Develop process picture for different products

- **Unit Content:**

  a. Drawing interpretation.

  b. 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

  c. Process m/c selection & sequencing of process & operations.

  d. Tooling selection, setting correct cutting parameters, selecting proper work holding devices, process pictures, symbols, process pictures for operations.

  e. Selection of proper Inspection method required.

  f. Documenting process plan.

  g. Costing the process plan.

  h . Process bench marking.

  Content Delivery Methods: Chalk and Talk

- **Term Work:**
  - 1. Process plan for processing of component on job basis. (2 Exercises)
  - 2. Process plan for processing of a component on batch basis. (2 Exercises)
  - 3. Process plan for processing of a component on mass basis. (2 Exercises)
  - (These exercises shall include the components requiring processing on at least
  - 3 machines)
  - Process sheet shall include -
  - a. Sequence of operation including m/c selected, holding method, machining
  - data for each set up, time estimate.
  - b. Specification of gauges & inspection equipments.
  - c. ISO or any commercial Specification of each tool.
  - 4. Process pictures for various operations for a given component. (2 exercises)
  - 5. Industrial visit to study process planning of component & its report.

- **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, Solapur

B.E. (Mechanical Engineering) Semester-II
ME423 (E) Professional Elective – VI
Power Plant and Energy Engineering

Teaching Scheme	**Examination Scheme**
Lectures – 3Hours/week, 3 Credits	**ESE–** 70 Marks
Practical – 2 Hour/week, 1Credit	**ISE –**30Marks
	ICA- 25Marks
	OE-25 Marks

Course Introduction:

Availability of power is the one key area where most of the Indian industry is facing problems. In India, even today, short fall of power generation is about 30 percent. Fuel supply and distribution is also an area where country is still developing smooth lines of supply. Since power and energy is required by every sector of economy, the growth in this sector is must if Indian economy grows in any sector. Many of the job opportunity in private as well as public sector are therefore waiting for students in this field. Hence, this course attempts to provide them basic knowledge of the technologies available at plant level and would also acquaint them with the latest technological advances taking place in this sector.

Course Prerequisite:
Basic Mechanical Engineering, Engineering Physics, Thermal Power Engineering- Boilers, thermal cycle, Thermodynamic devices

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Course Objectives: During this course, student is expected to-
1. To study of Power Station performance evaluation & economic analysis.
2. To Study of various non-conventional energy sources & principles of energy Conservation & audit.

Course Outcomes: At the end of this course, student will be able to-
1. get basic knowledge for effective use of available energy sources by suitable planning of power generation in thermal, hydro, gas & atomic power plant.
2. create awareness and knowledge for economical cost analysis of electrical energy.

Section I

Unit 1– Introduction of Energy Sources — No of lectures – 04

- **Prerequisite:** Basic Mechanical Engineering

- **Objectives:**
  1. To explain various Energy Sources.
  2. To describe the basic of renewable Energy Sources.
  3. To explain common organizations of power sector.

4. **Outcomes:**
   After completing this unit, student will be able to-
   1.Describe energy conversion in power plants.
   2.Identify elements and their functions of hydro, geothermal, tidal, wave, ocean thermal and nuclear power plants.
   3.Describe role of various organizations of power sector
5. **Unit Content:**
   Forms & characteristics of renewable energy sources, Organization of Power Sector in India, Impact of energy sources (coal, oil, natural gas, solar, wind, biomass, hydro, geothermal, tidal, wave, ocean thermal and nuclear) on environment, Role of private sector in energy management.

6. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation.

Unit 2– Loads on Power Plant — No of lectures – 05

1. **Prerequisite:** Basic Mechanical Engineering

2. **Objectives:**
1. To explain various loads on power plant.
2. Significance of different load curves and load factors on power plant.
3. To explain variable load on power plant.

3. **Outcomes:**
   After completing this unit, student will be able to
   1. explain load curves and load factors.
   2. explain design, operation & working of power plant
   3. solve various numerical on load calculations.
4. **Unit Content:**
   Introduction, Different load curves and load factors, Effect of variable load on power plant, design & operation, comparison of the various power plants. (Numerical treatment)

5. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 3– Peak Load & Base Load Power Plants No of lectures – 05

1. **Prerequisite:** Basic mechanical Engineering

2. **Objectives:**
   1. To explain peak load & base load plant.
   2. To study various requirement of peak load plant.
   3. To study the Pumped storage plants.

3. **Outcomes:**
   After completing this unit, student will be able to
   1. study & solve various numericals on base load & peak load plant
   2. study the load sharing between base load & peak load power stations.
4. **Unit Content:**
   Introduction & classification, Requirement of peak load plant, Types, Pumped storage plants, Compressed air storage plants, Load sharing between base load & peak load power stations. (Numerical treatment)

5. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 4– Economic Analysis of Power Plants No of lectures – 06

1. **Prerequisite:** Engineering economics.

2. **Objectives:**
   1. To study & explain economics of power plant.
   2. To explain cost of electric energy.
   3. To study tariff & explain various methods of tariff.

3. **Outcomes:**
   After completing this unit, student will be able to
   1.explain calculation of fixed & operating cost.
   2.explain Methods of determining depreciation.
   3.study selection of site for various Power station.
4. **Unit Content:**
   Introduction, Cost of electric energy, Fixed and operating cost, Methods of determining depreciation, Selection of site for Power station(thermal, hydro, nuclear), Selection of generation equipment, Tariff methods. (Numerical treatment)

5. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Section II

Unit 5– Solar Energy No of lectures – 05

1. **Prerequisite:** Basic mechanical Engineering

2. **Objectives:**
   1. To explain solar radiations to earth's atmosphere.
   2. To study various solar radiation measuring instrument.
   3. To study & explain Liquid flat plate collector.

3. **Outcomes:**
   After completing this unit, student will be able to
   1. Explain various solar radiation measuring instrument.
   2. Discuss various types of concentrators.
   3. Explain effect of various parameters on performance of power plant.

4. **Unit Content:**
   a) Solar radiation outside the earth's atmosphere & at the earth's surface, Solar radiation measurement – Pyranometer & Pyrheliometer, solar radiation geometry. LAT & SCT, Solar concentrators-Method and classification, Types of concentrators.
   b) Liquid flat plate collector – General, Performance analysis, Effects of various parameters. (Numerical treatment)

5. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 6– Wind Energy No of lectures – 06

1. **Prerequisite:** Basic Mechanical Engineering

2. **Objectives:**
   1. To study the Classification of WEC systems.
   2. To explain construction and working of Horizontal & Vertical axis machines.
   3. To study & explain Application of wind energy.

3. **Outcomes:**
   After completing this unit, student will be able to
   1. Explain Basic components of 'WECS'.
   2. Explain construction and working of Horizontal & Vertical axis machines.
   3. solve various numerical on wind energy.

4. **Unit Content:**
   Introduction, Power of wind, Basic components of 'WECS', Classification of WEC systems., Horizontal axis machines, Vertical axis machines, Advantages & Disadvantages of WECS, Application of wind energy. (Numerical treatment)

5. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 7– Other Non- Conventional Energy Sources No of lectures – 05

1. **Prerequisite:** Basic mechanical Engineering

2. **Objectives:**
   1. To study other non – conventional energy sources.
   2. To study & explain various types of wave machines.
   3. To explain types of Ocean thermal energy.

3. **Outcomes:**
   After completing this unit, student will be able to
   1.Explain components of tidal power plant and its types.
   2.Explain types of Ocean thermal energy.
   3. Explain energy conversion devices.

4. **Unit Content:**
   Geothermal energy – Introduction, Types of geothermal resources, Methods of Harnessing. Tidal energy components of tidal power plant, single basin system, Double basin system, Advantages &Disadvantages of tidal energy. Ocean thermal energy – Introduction, open & closed systems. Wave Energy – wave energy, energy conversion devices- High pressure accumulator wave machines, Dolphin type wave machine, Dam Atoll wave machine.

5. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

Unit 8– Energy Audit & Energy Conservation No of lectures – 05

1. **Prerequisite:** Engineering Physics, Basic mechanical Engineering, Applied Thermodynamics

2. **Objectives:**
   1.To study & explain objective of energy audit & energy flow diagram.
   2. To study energy audit instrument
   3.To study energy conservation in various industries.

3.Outcomes:
After completing this unit, student will be able to
1. Explain duties & responsibilities of energy auditors.
2. Explain energy conservation act 2001 & its feature.
3. Explain energy conservation in various industries.

Unit Content:

Energy Audit - Definition & objective of Energy audit, Energy flow diagram, Energy Audit Instruments; Duties and responsibilities of energy auditors, Duties and responsibilities of energy managers.

Energy Conservation- Introduction, energy conservation act 2001 & its feature, energy conservation in industries – Chemical industry, Cement industry & Sugar industry. Energy conservation in house hold & commercial sectors.

4. **Content Delivery Methods:** Board, Chalk and talk, Power point Presentation

- **Term Work:**

Group - I: Any two Experiment from Expt. No. 1 to 5

1. Solar radiation & its measurement
2. Test on solar water heater
3. Efficiency measurement of standalone solar P-V system
4. Study of components of windmill
5. Identifying & measuring the parameters of a solar PV module in the field

Group - II: Minimum Six Assignments based on following topics –

1. Study of solar collectors
2. Study of solar thermal applications- solar water heating, space heating, power
3. Study of solar pond / solar photovoltaic
4. Study of Biogas plants
5. Study of instruments of a power plant water purity, PH meter, Gas analysis, Measurement of smoke & dust.
6. Study of various pollution control devices
7. Study of various Energy storage devices.

Group - III

1. The report based on any Industrial Visit to renewable energy appliances or power generation transmission station.

- **Text Books:**

1. Generation of electrical energy – B.R.Gupta, S.Chand & co. ltd.
2. A course in Power Plant Engineering – Arora Domkundwar ,Dhanpat Rai & co.
3. Solar Energy – S.P.Sukhatme, Tata McGraw hill co.
4. Solar Energy – G.D.Rai, Khanna Publisher.
5. Energy Technology – S.Rao & Dr.B.B.Purulekar, Khanna publishers.
6. Power Plant Engineering – P.K.Nag, Tata McGraw hill publishing co.
7. Power Plant Engineering – R. K. Rajput

- **Reference Books:**

1. Power Plant Technology – M. M. El Wakil.
2. Berau of Energy efficiency Manual
3. Non-conventional Energy Sources- G.D.Rai, Khanna Publisher.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur B.E.

(Mechanical Engineering) Semester- II

ME424 (A) Free Elective-II

Software Engineering & Cyber Security

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ESE–** 70 Marks
Practical – 1 Hour/week, 1 Credit	**ISE –** 30 Marks
	ISA- 25 Marks
	OE- 25 Marks

Course Introduction:

Software engineering is an engineering approach for software development. We can alternatively view it as a systematic collection of past experience. The experience is arranged in the form of methodologies and guidelines. A small program can be written without using software engineering principles. But if one wants to develop a large software product, then software engineering principles are indispensable to achieve a good quality software cost effectively. These definitions can be elaborated with the help of a building construction analogy.

Despite the threat of viruses and malware almost since the dawn of computing, awareness of the security and sanctity of data with computer systems didn't gain traction until the explosive growth of the internet, whereby the exposure of so many machines on the web provided a veritable playground for hackers to test their skills – bringing down websites, stealing data, or committing fraud. It's something we now call cybercrime. Combating this is a multi-disciplinary affair that spans hardware and software through to policy and people – all of it aimed at both preventing cybercrime occurring in the first place, or minimizing its impact when it does. This is the practice of cyber security. There is no silver bullet, however; cyber security is a constantly evolving, constantly active process just like the threats it aims to prevent.

Course Objectives:

The Course should enable the student

1. To be acquainted with the software Project development life cycle models.
2. To design and develop correct and robust software products.
3. To analyze business requirements pertaining to software development.
4. To be acquainted with Cyber security norms.

Course Outcomes:

At the end of the course students will be able to

1. Select a proper software life cycle model for design and development.
2. Prepare a prototype model
3. Focus on the fundamentals of developing a Software Project.
4. Get Software Requirement Specification from client, analyze, design and estimate the cost of development of a Software Project

SECTION-I

Unit 1: Introduction to Software Engineering (5Hrs.)

• **Prerequisite:**

• **Objectives:**

1. To understand Software Development Life Cycle and life cycle models
2. To understand Software Requirement Analysis and Specification

• **Outcomes: After completing this unit, students will be able to-**

1. Describe Software Development Life Cycle and life cycle models
2. Describe Software Requirement Analysis and Specification

• **Unit content:** Software Development Life Cycle, Life cycle models: Water fall model, Spiral model, Prototype model, Agile process model. Software Requirement Analysis and Specification: Value of Good SRS, Requirement Process, Requirements specification.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 2: Design and Planning a Software Project (10 Hrs.)

• **Prerequisite:**

• **Objectives:**

1. To understand the design concepts like coupling, cohesion etc.
2. To understand function and object oriented design

• **Outcomes: After completing this unit, students will be able to-**

1. Implement the design concepts like coupling, cohesion etc.
2. Apply concepts like function and object oriented design

• **Unit content:** Design Concepts: Coupling, Cohesion, Open Closed Principle, Function-Oriented Design, Object Oriented Design, Detailed Design, Verification, Metrics and Planning.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 3: Agile Project Management and Testing (5Hrs.)

• **Prerequisite:**

• **Objectives:**

1. To understand the Adaptive Project Management Life cycle.
2. To understand testing methods

• **Outcomes: After completing this unit, students will be able to-**

1. Apply the Adaptive Project Management Life cycle.
2. Implement various testing methods.

• **Unit content:** Introduction to APM, Implementation, Iterative Project Management Life Cycle, Adaptive Project Management Life Cycle, Adaptive & Integrating the APM toolkit. Testing Concepts, Testing Process , Black-Box Testing, White-Box Testing, Object Oriented Software testing methods, Functional testing, Unit testing, System testing, User satisfaction testing.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

SECTION-II

Unit 4: Introduction to Computer Security (8 Hrs)

• **Prerequisite:**

• **Objectives:**

1. To understand the Secure System Planning and administration.
2. To understand Security policy requirements, accountability, assurance and documentation requirements

• **Outcomes: After completing this unit, students will be able to-**

1. Describe the Secure System Planning and administration.
2. Describe Security policy requirements, accountability, assurance and documentation requirements

• **Unit content:** Definition, Threats to security, Government requirements, Information Protection and Access Controls, Computer security efforts, Standards, Computer Security mandates and legislation, Privacy considerations, International security activity. Secure System Planning and administration, Introduction to the orange book, Security policy requirements, accountability, assurance and documentation requirements, Network Security, The Red book and Government network evaluations.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 5: Information security policies and procedures: (4Hrs)

• **Prerequisite:**

• **Objectives:**

1. To understand corporate policies
2. To understand process of developing policies

• **Outcomes: After completing this unit, students will be able to-**

1. Use corporate policies
2. Implement process of developing policies

• **Unit content:** Corporate policies- Tier 1, Tier 2 and Tier3 policies -process management-planning and preparation-developing policies-asset classification policy-developing standards.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Unit 6: Information security: (8Hrs)

• **Prerequisite:**

• **Objectives:**

1. To understand Role of information security professionals
2. To understand Information handling Tools of information security

• **Outcomes: After completing this unit, students will be able to-**

1. Describe role of information security professionals
2. Apply Information handling Tools of information security

• **Unit content:** fundamentals-Employee responsibilities- information classification-Information handling Tools of information security- Information processing-secure program administration. Organizational and Human Security: Adoption of Information Security Management Standards, Human Factors in Security- Role of information security professionals.

• **Content Delivering Methods:** Board, Chalk & talk, Computational facility, Power Point Presentation, Animations.

Text Books

1. Pankaj Jalote's Software Engineering, A Precise Approach(Wiley Precise Textbook,WILEY INDIA)
2. An Integrated Approach to Software Engineering- 3rdedition: Pankaj Jalote (Narosa Publishers)
3.Debby Russell and Sr. G.T Gangemi, "Computer Security Basics (Paperback)", 2ndEdition,O' Reilly Media, 2006.

References Books:

1. Effective Project Management Traditional,Agile,Extreme ,Robert K. Wysocki WILEY INDIA,6th edition
2. Ian Sommerville,software engineering, pearson education Asia, 6th edition
3. Software Engineering Fundamentals –Ali Behforooz and Frederick j. Hudson (Oxford University Press) . Thomas R. Peltier, “Information Security policies and procedures: A Practitioner’sReference”, 2nd Edition Prentice Hall, 2004.
4. Kenneth J. Knapp, “Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions”, IGI Global, 2009.
5. Thomas R Peltier, Justin Peltier and John blackley, ”Information Security Fundamentals”, 2nd Edition, Prentice Hall, 1996
6. Jonathan Rosenoer, “Cyber law: the Law of the Internet”, Springer-verlag, 1997
7. James Graham, “ Cyber Security Essentials” Averbach Publication T & F Group.

Term Work:

In Tutorial Session, Students of Different Batches should be assigned Different Case Studies to Design & Implement products.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-II.

ME424 (B)Agro Machine Engineering

Teaching Scheme	**Examination Scheme**
Lectures– 3Hours/week 3 Credits	**ESE–70 Marks**
Practical – 2 Hour/week 1 Credit	**ISE –30Marks**
	ICA- 25 Marks

Course Introduction:
India is an agricultural country. Almost 70% people doing farming. Agriculture sector is a back bone of Indian economy. So for the development of country, advancement in farming is essential. For that purpose new technology must be introduced in farming to reduce the wastage and increase the productivity with quality. This course is the combination of agricultural & technical knowledge.

Course Prerequisite:
Before study this subject students must well familiar with the agricultural field. They must know different agricultural foods, plants, old equipment's. Also they must know different difficulties faced by farmers during farming.they Also know the knowledge of machine design, strength of materials.

CourseObjectives: During this course, student is expected to
1. To explore various agro machinery related operations such as ploughing,harrowing, threshing.
2. To learn the working mechanisms of different agro machines.
3. To make the student to know about design aspects of different agromachines.

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

1. Distinguish between various agro operations such as ploughing, harrowing, threshing etc.
2. Select and design mechanism for various agro machines

Section I

Unit 1–Introduction No of lectures – 4

- **Prerequisite:** student must familiar with agriculture.
- **Objectives:**

1. To study the present status and Scope of agriculture
2. To learn properties of soil & its reaction with tool

- **Outcomes:**
  After completing this unit, student will be able to

1. They understand present status & scope
2. They can select proper material for tool

- **Unit Content:**
  Present Status and Scope, bottle necks of farm mechanization and mechanization policy. Dynamic soil properties affecting soil tool interaction. Atterberg, soil and metal friction

- **Content Delivery Methods:**

  Chalk-board & LCD

Unit 2–Primary Tillage Equipments No of lectures – 6

- **Prerequisite:** student must know need of mechanization in farming**.**

- **Objectives:**

1. To make the students to know about design aspects of different agro machines.
2. To identify different agricultural equipment.

- **Outcomes:**
  After completing this unit, student will be able to
1. Calculate different forces acting on tillage tool different
2. Differential between various farming tools.

- **Unit Content:**
  Force analysis of tillage tools and their measurement. Mould board plough - animal and power operated, types and construction, working principles. Accessories of M.B. plough forces acting on mould board bottom. Disc ploughs, types and construction, soil reaction and draft of disk ploughs, and special tillage implements such as rotavators sub-soiler, paddy puddler.

- **Content Delivery Methods:**

  Chalk-board & LCD

Unit 3–Secondary Tillage Equipment No of lectures – 5.

- **Prerequisite:** students must familiar with primary tillage equipments.

- **Objectives:**

1. To make the students to select proper harrow for particular application.
2. To calculate the different forces acting on disc harrow.

- **Outcomes:**

  After completing this unit, student will be able to
1. Select proper Disc harrow for particular application.
2. Calculate different forces acting on disc harrow.

- **Unit Content:**
  Disc harrow types and construction. Selection of disk harrow. Forces acting on disk harrows and there analysis

- **Content Delivery Methods:**

  Chalk-board & LCD

Unit 4–Hitching Implements No of lectures – 5

- **Prerequisite:** students must familiar with primary &secondary tillage equipments.
- **Objectives:**

1. To make aware about different types of hitching implements.
2. To make aware about different types of yokes & harness.

- **Outcomes:**
  After completing this unit, student will be able to

1. Differentiate between hitching implements.
2. Differentiate between yokes &harness.

- **Unit Content:**
  Virtual and real hitching for single point, single axis and double hitch implements. Yokes and harness for draught animals and mechanics of hitching
- **Content Delivery Methods:**

  Chalk-board & LCD

Section II

Unit 5–Sowing, Planting and Fertilizer Application Equipment No of lectures – 6

- **Prerequisite:** students must familiar with hitching implements**.**

- **Objectives:**

1. To make the students to know about seeding, planting& fertilizer equipment.
2. To make the students to know about furrow openers, covering devices, field adjustments.

- **Outcomes:**
  After completing this unit, student will be able to

1. Explain different types of seeding, planting& fertilizer equipments.
2. Explain different types of furrow openers, covering devices, field adjustments

- **Unit Content:**
  Construction and working principles of seeding, planting and fertilizer application equipment seed and fertilizer metering devices, furrow openers and covering devices calibration, field adjustment and operations

- **Content Delivery Methods:**
  Chalk-board & LCD

Unit 6–Inter-culture Equipment No of lectures – 4

- **Prerequisite:** students must familiar with seeding, planting and fertilizer application equipments.

- **Objectives:**

1. To make the students to know about different types of Cultivators, sweeps & shovels.
2. To make the students to know about different types of rotary hoes, nodders&weeders.

- **Outcomes:**
  After completing this unit, student will be able to

1. Explain different types of Cultivators, sweeps & shovels
2. Explain different types ofrotary hoes, nodders&weeders

- **Unit Content:**
  Cultivators, sweeps and shovels, types and uses, rotary hoes, nodders, classification of weeders according to power sources.
- **Content Delivery Methods:**

  Chalk-board & LCD

Unit 7–Plant Protection Equipment No of lectures – 5

- **Prerequisite:** Students must familiar with Inter-culture Equipments.

- **Objectives:**

1. To make the students to know about plant protection equipment's.
2. To make the students to know aboutselection of equipment for spraying and dustingequipments.

- **Outcomes:**
  After completing this unit, student will be able to

1. Explain different types of plant protection equipments
2. Explain different types ofselection of equipment for spraying and dustingequipments

- **Unit Content:**
  Plant protection equipments, types construction and working principle. Selection of equipment for spraying and dusting, characteristics of equipment

- **Content Delivery Methods:**

  Chalk-board & LCD

Unit 8–Harvesting, Threshing and Specialized Crop Equipment No of lectures – 5

- **Prerequisite:** students must familiar with Plant Protection Equipment.

- **Objectives:**

1. To make the students to know about working principles of reapers, mowers
2. To make the students to know about working principles ofcombine harvesters and power threshers

- **Outcomes:**
  After completing this unit, student will be able to

1. Explain different types & working principal of reapers, mowers
2. Explain different types &working principal of combine harvesters and power threshers

- **Unit Content:**
  Classification, construction and working principles of reapers, mowers, combine harvesters and power threshers

- **Content Delivery Methods:**

  Chalk-board & LCD

- **Term Work:**

  Any six assignments on

  1. Different farm operations and familiarization with farm machines and equipment.
  2. Different animal and tractor drawn mould board ploughs and their evaluation.
  3. Different type of disc ploughs and their evaluation.
  4. Blade, drag and power harrows.
  5. Different type of harrows.
  6. Different type of sub-soiling equipment
  7. Paddy and potato planters, sugarcane planters.
  8. Equipment for maize, cotton, sugarcane, root crops and horticultural crops

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- **Text Books:**

  1. Jain S.C. and Grace Philip, “Farm Machinery: An approach”, Standard Publisher and distributor, Delhi
  2. Srivastava, A.K. Carroll E. Georing and Roger P.Rohrbach "Engineering Principles of Agricultural Machinery", ASAE Publication, 1993

- **Reference Books:**

  1) Roy Bainer, Kepner R.A. and Berger, E.L. "Principles of Farm Machinery", John Wiley and Sons, 3rd Ed., 1978.
  2) Smith. H.P. and Pearson, "Farm Machinery and Equipment", Tata McGraw Hill Pub. Co. Ltd.,1964.
  3) Lal, Radhey and Dutta, A.C. "Agricultural Engineering through solved examples".

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Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester- II

ME424 (C) Free Elective-II

Plastic Engineering

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ESE–** 70 Marks
Practical – 1 Hour/week, 1 Credit	**ISE** – 30 Marks
	ISA- 25 Marks
	OE- 25 Marks

Course Introduction: During this course, student is exposed to following knowledge-

1. Study of extraction, manufacturing of plastic and classification.
2. Also study of various properties of plastic materials, comparative study of the plastics on the basis of parameters like structure, cost and processing time etc.
3. Study and Comparison of the different processes on the basis of parameters like cost and processing time etc.
4. Design of plastic part and molds, correct selection & design leads to compact & less cost of systems. Design & development, for an optimum process of a given job / component in a given situation.

Course Prerequisite: For this course, student is expected to have-

Knowledge of Engineering Chemistry and Polymers.
Knowledge of Basic Manufacturing Process.
Basic knowledge of welding processes
Basic Design Knowledge

Course Objectives: During this course, student is expected to

1. To understand the mechanism of polymerization, techniques of polymerization
2. To provide the depth knowledge about different kinds of plastic materials based on their Structure and properties.
3. To make the students familiar about processing of plastics and use it for different applications.
4. To provide the knowledge of part design as well mould design for different molding processes.

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

1. Select the plastic materials for particular end user application
2. Predict the structure and properties of different kind of plastic material
3. Know the processing of different plastic material based on the end user requirement.
4. Part design as well mould design for different moulding processes.

Section I

Unit 1– Introduction to Plastics — No of lectures – 4

- **Prerequisite:** Knowledge of Engineering Chemistry and Polymers.
- **Objectives:**
  1. To study characteristics and classification of Plastics.
  2. To study different methods of testing for plastics.
  3. To study the principles of various Polymerization methods.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Understand the characteristics and classification of Plastics
  2. Select the suitable testing methods for particular type of plastic.
  3. Apply the principle on various Polymerization methods.
- **Unit Content:**
  Definition and Classification of Plastic Materials, Properties of plastics, applications, Testing methods for plastics, additives in plastics, Monomers & Polymers, Polymerization - Types of Polymerization.
- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

Unit 2– Processing of Plastics — No of lectures – 6

- **Prerequisite:** Knowledge of Basic Manufacturing Process.
- **Objectives:**
  1. To study characteristics and classification of Plastics Manufacturing Process.
  2. To study various methods of Plastics Manufacturing Process.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Understand the characteristics & classification of Plastics Manufacturing Process.
  2. Select the suitable methods of Manufacturing Process for particular type of plastic component.

- **Unit Content:**

  Injection molding, Extrusion molding, sheet forming processes, calendaring, Blow molding, Processing of thermosetting plastics, compression molding, Transfer molding, rotational molding.
- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

Unit 3– Welding of Plastics No of lectures – 4

- **Prerequisite:** Basic knowledge of welding processes.
- **Objectives:**
  1. To study characteristics and classification of Plastics Joining Process.
  2. To study various methods of Plastics Joining Process.
- **Outcomes:**

  After completing this unit, student will be able to
  1. Understand the characteristics and classification of Plastics Joining Process.
  2. Select the suitable methods of Joining Process for particular plastic component.
- **Unit Content:**

  Hot gas welding, hot tool welding, High frequency induction welding, laser welding, infrared welding, ultrasonic welding, friction welding
- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

Unit 4– Design of Plastic Parts No of lectures – 6

- **Prerequisite:** Basic Design Knowledge.
- **Objectives:**
  1. To study characteristics of basic elements for proper *plastic* part *design*.
  2. To study design procedure of all basic elements for proper *plastic* part *design*.
- **Outcomes:**

  After completing this unit, student will be able to
  1. Understand the characteristics of basic elements for proper *plastic* part *design*.
  2. Integrate the design of all basic elements for proper *plastic* part *design*.
- **Unit Content:**

  Tolerances of molded plastics parts, allowances in plastics, Design corners, undercuts, curing time, ribs, minimum wall thickness, design of inserts, cores mold materials.
- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

Section II

Unit 5– Design of compression and transfer molds No of lectures – 6

- **Prerequisite:** Knowledge of compression and transfer moulding process.
- **Objectives:**

  After completing this unit, student will be able to

1. To study types and main parts of compression and transfer moulds.
2. To carry out design of compression mould.

- **Outcomes:**
  After completing this unit, student will be able to
1. Explain types and main parts of compression and transfer moulds.
2. Design compression mould for thermoset plastic part.

- **Unit Content:**

a) Design and main parts of compression mould, standard insert mould body, design of loading chamber, design of punch, ejectors, stripper guided pin.
b) Technology of transfer mould, types, main parts, automation in transfer mould.

- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

Unit 6– Injection Mould Design No of lectures – 6

- **Prerequisite:** Knowledge of Injection moulding process.
- **Objectives:**
  After completing this unit, student will be able to
1. To study types and main parts of Injection mould.
2. To study Feed system, Temperature control system and Ejection System for Injection moulding.
3. To carry out design of injection mould.
- **Outcomes:**
  After completing this unit, student will be able to
1. Explain types and main parts of Injection mould.
2. Explain Feed system, Temperature control system and Ejection System for Injection moulding.
3. Design Injection mould for a thermoplastic part.
- **Unit Content:**
  Injection mould design, Single, multi cavity, semi-automatic and automatic moulds. Types of injection mould, detailed structure and working. Feed system, Temperature control system, Ejection System, application.
- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

Unit 7– Cooling of plastic injection mould No of lectures – 5

- **Prerequisite:** of coolants used for mould cooling and concept of curing time.
- **Objectives:**
  After completing this unit, student will be able to
1. To study the heat quantity dissipated with cooling, cooling time required and amount of coolant required to cool the injection mould.
2. To understand summary of dimension and construction of correct cooling system.

- **Outcomes:**
  After completing this unit, student will be able to

1. Calculate the heat quantity dissipated with cooling, cooling time required and amount of coolant required to cool the injection mould.
2. Explain summary of dimension and construction of correct cooling system.

- **Unit Content:**
  Determining the heat quantity dissipated with cooling, heat dissipation with natural cooling, mean temperature, thermal resistance of mold body, summery of dimension and construction of correct cooling system.
- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

Unit 8– Introduction of advanced Plastics No of lectures – 3

- **Prerequisite:** Knowledge of thermoplastic and thermosetting plastic materials and their basic applications.
- **Objectives:**
  After completing this unit, student will be able to

1. To study the concept of composite plastics, polymer degradation and biodegradable plastics.
2. To study advanced application of plastics in various fields.

- **Outcomes:**
  After completing this unit, student will be able to

1. Explain the concept of composite plastics, polymer degradation and biodegradable plastics.
2. Explain advanced application of plastics in various fields

- **Unit Content:**
  Introduction to composite plastics, Introduction of polymer degradation and biodegradable plastics, advanced application like Agriculture, Packaging, Building, Transport, Electrical, Electronics, Medical and Furniture
- **Content Delivery Methods:** Board, animations, videos, Chalk and talk

- **Term Work:**

1. Introduction to plastic material and processes 2 Turns
2. Injection mould design for simple component 2 Turns
3. Design of Blow Mould 2 Turns
4. Design of Compression mould 2 Turns
5. Case study for mould manufacturing 2 Turns
6. Visit to Plastic industry (Thermo sets & Thermo Plasts)

- **Text Books:**

3) Prof(Dr.)Sanjay K Nayak, Fundamentals of Plastics Mould Design, Tata McGraw Hill Education Private Limited, New Delhi

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- **Reference Books:**

1. J. A. Brydson, “Plastics Materials”, Butter worth Heinemann Oxford,1999
2. Schwartz & good man “Plastics materials and processing”
3. Irwin Rubin “Hand book of Plastic Materials and technology”
4. Fred W. Billmeyer, JR., “Text Book of Polymer Science”, John Wiley & Sons, Singapore, 1994

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-VIII
ME424 (D) Free Elective-II
Economics for Engineers

Teaching Scheme	**Examination Scheme**
Lectures – 03 Hours/week	**ESE** -70 Marks
Tutorial – 02 Hour/week	**ISE** - 30 Marks
	ICA - 25 Marks
	OE - 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 must have the knowledge of fundamental concepts of economics to take correct decisions for any firm. With this purpose, the course covers various concepts of demand, supply, pricing, cost estimation, time value of money, elementary economic analysis and project life cycle management.

Course Prerequisites:

6. Knowledge of elementary mathematics
7. Basic knowledge of various core subjects like design engineering, manufacturing processes, industrial engineering etc.

Course Objectives: During this course, a 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, reports and compare various alternatives on economic basis.

Course Outcomes: 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 apply value analysis & value engineering procedure.

Section I

Unit 1 Fundamentals of Engineering Economics No of lectures- 10

- **Objectives:**
  1. To understand importance of economics in Engineering.
  2. To apply the concepts of demand and supply, analyze the factors affecting them.

- **Outcomes:**
  After completing this unit, student will be able to

  1. Explain the importance of economics in Engineering.
  2. Apply the concepts of demand and supply, analyze the factors affecting them.

  - **Unit Content:** Definition of Economics, Definition and scope of Engineering Economics, major topics in Engineering Economics, 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

  - **Content Delivery Methods**: 1. Chalk and Board **2**. Demonstrations

Unit 2 Costs, Cost Estimation and Break Even Analysis No of lectures – 06

- **Objectives:**
  1. To determine various types of costs and total cost.
  2**.** To apply the concept of break even analysis.
- **Outcomes:**
  After completing this unit, student will be able to

  1. Determine various types of costs and total cost.
  2**.** Apply the concept of break even analysis.

  Unit Content: Concept of Cost, difference between cost and price, types of costs, implicit and explicit costs, 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

- **Content Delivery Methods:** 1**.** Chalk and Board

Unit 3 Time Value of Money No of lectures – 4

- **Objectives:**
  1. To calculate worth using different techniques in time value of money.
- **Outcomes:**
  After completing this unit, student will be able to

  1. Calculate worth using different techniques in time value of money.
- **Unit Content:** Time Value of Money, inflation, its reasons & effects, interest formulae and their application, present worth method, future worth method, annual equivalent method, rate of return method, net present value, applications of these to determine worth.
- **Content Delivery Methods:** 1**.** Chalk and Board

Section II

Unit 4 Process Engineering and Elementary Economic Analysis No of lectures – 08

- **Objectives:**
  1. To take correct decisions regarding make or buy.
  2. To take correct decisions regarding process or design modifications based on elementary economic analysis.
- **Outcomes:**
  After completing this unit, student will be able to
  1. Take correct decisions regarding make or buy.
  2. Take correct decisions regarding process or design modifications based on elementary economic analysis.
- **Unit Content:** Process Engineering, block diagram and steps in it, Elementary Economic Analysis, Material selection for a product, raw material substitution, design selection and modification, process planning and modification, engineering and economic approach, Make or Buy decisions, applications
- **Content Delivery Methods:** 1. Chalk and Board
  2. Demonstrations

Unit 5 Maintenance Practices and Replacement No of lectures – 06

- **Objectives:**
  1. To carry out better maintenance using effective maintenance practices.
  2. To take appropriate decisions regarding replacement of assets.
- **Outcomes:**
  After completing this unit, student will be able to

  1. Carry out better maintenance using effective maintenance practices.
  2. Take appropriate decisions regarding replacement of assets.
- **Unit Content:** Maintenance and its importance, types of maintenance practices, preventive and breakdown maintenance, routine and predictive maintenance, opportunistic maintenance, condition based monitoring and modern techniques, cost of maintenance, types and causes of failure, strategies to prevent them, lives of an asset, economic life, useful life, physical life, ownership life, need of replacement of an asset, defender and challenger, replacement decision
- **Content Delivery Methods:** 1. Chalk and Board

Unit 6 Project Management Life Cycle and Value Engineering No of lectures – 06

- **Objectives:**
    1. To analyze phases in project life cycle and to prepare project appraisals.
    2. To apply value analysis and value engineering procedure for various products.
- **Outcomes:**
  After completing this unit, student will be able to
    1. Analyze phases in project life cycle and to prepare project appraisals.
    2. Apply value analysis and value engineering procedure for various products.
- **Unit Content:** Project, definitions, features of a project, types of projects, project management life cycle, project appraisal, technical appraisal, financial appraisal, economic appraisal, social appraisal, market appraisal, ecological appraisal, Value, types of values, performance of a product, functions of a product, value analysis, value engineering, aims of value engineering, value engineering procedure
- **Content Delivery Methods:** 1. Chalk and Board 2. Demonstrations

- **Term Work:**
  1. Six Assignments based on above units to be completed. Assignments must include numerical problems wherever applicable.
  2. Presentation of minimum four case studies in a group of two students based on various units.

- **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: Martand Telsang, S. Chand & Company Pvt. Ltd., Delhi.
- **Reference Books:**

  1. Principles of Engineering Economic Analysis: John White, Kenneth Case, David Pratt, Wiley India Pvt. Ltd., New Delhi.

  2. Managerial Economics: Varshney and Maheshwari, Sultan Chand & Sons, New Delhi.
  3. Financial Management: M. Y. Khan, P. K. Jain, McGraw Hill Publication, New Delhi.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-II

ME424(E) Free Elective II Project Management

TeachingScheme	**Examination Scheme**
Lectures– 3 Hours/week 3 Credits	**ESE–70 Marks**
Practical – 2 Hour/week, 1 Credit	**ISE –30 Marks**
	ICA- 25 Marks
	OE- 25 Marks

Course Introduction:

Project management is important because it ensures what is being delivered, is right, and will deliver real value against the business opportunity.Project management theory, terms and concepts are introduced in this course. Students will discover theproject life cycle and learn how to build a successful project from pre-implementation to completion. Thiscourse will introduce project management topics such as resources, costs, time constraints and projectscopes.

Course Prerequisite:

Student shall have knowledge of basic principles of processes related to mechanical engineering like thermal, production and design.A sound background of the subjects like operations research is essential for successful completion of this course.

CourseObjectives: During this course, student is expected to

4. Understandthebasics of project management
5. Study the modules like project planning, selection, project network, execution and controlling
6. Learn about the Project management information system
7. Study the application of project management software and its benefits

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

1. Describe a project life cycle, and can skillfully map each stage in the cycle
2. Identify the resources needed for project selection and planning
3. Analyze the risk in project management
4. Evaluate the project execution and performance
5. Explain the use of project management software

Section I

Unit 1–Basics of Project Management No of lectures – 06

- **Prerequisite:** Knowledge about project and life cycle

- **Objectives:**

1. To understand the basics of project management
2. To project life cycle and project management principles

- **Outcomes:**

After completing this unit, student will be able to

1. Explain the significance of project management
2. Analyze the impact of delays in project completions

- **Unit Content:**

Introduction, Need for Project Management, The Project Life Cycle, Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

- **Content Delivery Methods:**

Board, Chalk and talk, PowerPoint presentation

Unit 2–Project Selection and Project Planning No of lectures – 07

- **Prerequisite:** Knowledge about basic principles used in project planning and selection.

- **Objectives:**

1. To understand the project selection and planning process
2. To study role of project leader and work breakdown structure

- **Outcomes:**

After completing this unit, student will be able to

1. Outline the project identification and project planning process
2. Explain the role of project leader and teamwork
3. Elaborate the work breakdown structure

- **Unit Content:**

Project Selection: Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point

Project Planning: Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles and Responsibilities of Project Leader,Team Work, Project Planning Process, Work Breakdown Structure (WBS)

Content Delivery Methods:

Board, Chalk and talk, PowerPoint presentation

Unit 3–Resource Consideration and Project Network No of lectures – 07

- **Prerequisite:** Knowledge of CPM and PERT
- **Objectives:**

1. To understand the resource allocation and project cost
2. To study the time estimation, critical path, CPM and PERT models

- **Outcomes:**
  After completing this unit, student will be able to

1. Explain the resource allocation and estimate of project cost
2. Elaborate the critical path and CPM and PERT model for a project

- **Unit Content:**

  Resources Considerations: Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, CostForecasts
  Project Network: Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System

- **Content Delivery Methods:**

  Board, Chalk and talk, PowerPoint presentation

Section II

Unit 4–PMIS and Project Risk Management No of lectures – 07

- **Prerequisite:** Knowledge about information system used in project management
- **Objectives:**

1. To understand the project management information system
2. To study the risk management

- **Outcomes:**
  After completing this unit, student will be able to

1. Explain theplanning and design of Project Management Information System
2. Outline the steps in risk management

- **Unit Content:**
  Project Management Information System (PMIS): Introduction, Project Management Information System (PMIS), Planning of PMIS, Design of PMIS

Project Risk management: Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks.

Content Delivery Methods:

Board, Chalk and talk, PowerPoint presentation

Unit 5–Project Performance Measurement and Evaluation No of lectures – 04

- **Prerequisite:** Knowledge of basics of measurement and controlling.
- **Objectives:**

1. To understand the project performance and measurement
2. To study the benefits and challenges in performance measurement and evaluation

- **Outcomes:**

After completing this unit, student will be able to

1. Explain the project performance evaluation
2. Elaborate the challenges in performance evaluation

- **Unit Content:**

Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects

Content Delivery Methods:

Board, Chalk and talk, PowerPoint presentation

Unit 6–Project Execution, Control and Project Close out and Termination No of lectures – 06

- **Prerequisite:** Knowledge of operations research .
- **Objectives:**

1. To understand the project execution and control
2. To study steps in closing the project

- **Outcomes:**

After completing this unit, student will be able to

1. Explain the project control process
2. Elaborate the steps in closing the project

- **Unit Content:**

Project Execution and Control: Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control

Project Close-out, Termination and Follow-up: Introduction, Project Close-out, Steps for Closing the Project, Project Termination, Project Follow-up

- **Content Delivery Methods:**

Board, Chalk and talk, PowerPoint presentation

Unit 7–Introduction to Project Management Software No of lectures – 03

- **Prerequisite:** Knowledge of any basic software

- **Objectives:**

1. To understand the advantages of using Project Management Software
2. To study the features available in most of the Project Management Software

- **Outcomes:**

After completing this unit, student will be able to

1. Explain the benefits of usingProject Management Software
2. Elaborate the features available in most of the Project Management Software

- **Unit Content:**

Project Management software, Advantages of Using Project Management Software, Common Features Available in Most of the Project Management Software, Illustration

- **Content Delivery Methods:**

Board, Chalk and talk, PowerPoint presentation, Animations/Videos

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- **Term Work:**

Total Seven Assignments:
1) Minimum Six Assignments based on above six topics
2) One Case study for Project management in any field

- **Text Books:**

1. Project Management and Control,Narendra Singh; Himalaya Publishing House
2. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, Wiley India, 7th Ed.
3. Projects- Planning, Analysis, Selection, Financing, Implementation and Review, Prasanna Chandra, TMGH
4. Project Management - By S. Choudhary
5. Project Management - By Vasant Desai
6. Text Book of Project Management - By P Gopalakrishnan, V. E. Ramamoorthy
7. Project Appraisal - By P. K. Mattoo

- **Reference Books:**

1. Project Management, Dennis Lock, Gower Publishing England, 9th Ed.
2. Project Management, Gido Clements & Cengage Learning.
3. Project Management, Gopalan, Wiley India
4. Preparation, Appraisal, Budgeting, Implementing and Review, Prasanna Chandra TMGH
5. PMP - Project Management Professional - “Study Guide” - By Kimi Heldman

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-II
ME424 (F) Marketing Management (FREE Elective-II)

Teaching Scheme	**Examination Scheme**
Lectures – 03Hours/week 3 Credits	**ESE–70 Marks**
Practical –02 Hour/week, 1Credit	**ISE –30Marks**
	ICA- 25 Marks
	OE-25 Marks

Course Introduction: Marketing is no longer a company department charged with a limited number of tasks. It is a companywide undertaking. It drives the company's vision, mission and strategic planning. Marketing succeeds only when all the departments work together to achieve goals. The student will be able to understand these concepts.

Course Prerequisite: Industrial visits and in- plant training

Course Objectives: During this course, student is expected
To understand the meaning of marketing, marketing concept and marketing management
To understand how marketing concept and marketing mix are integrated in practice
To understand marketing process and strategy; and the relevance of marketing in a developing economy

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

Outcomes: Learner will be able …
1. To familiarize with marketing, and its concepts.
2. To acquaint with new marketing trends and the marketing environment.
3. To study the components of the marketing mix; identify how the firms marketing strategy, marketing mix evolve and adapt to match consumer behavior and perceptions of the product.

Section I

Unit 1– Basics of Marketing No of lectures – 10

Introduction, Nature & scope of marketing, the core concepts of marketing, marketing in 21st century, marketing environment: Micro and Macro marketing environment, Marketing Planning and Marketing Planning process, Differentiation between Sales and Marketing. Introduction to Services marketing

- **Content Delivery Methods:**
  Chalk and Talk

Unit 2– Market segmentation & Consumer Behavior No of lectures – 10…….

A. Market segmentation-Meaning and concept, benefits of segmentation, Bases for market segmentation consumer goods market segmentation; industrial goods market segmentation, Market targeting, Selection of segments, Product positioning.

B. Consumer Behavior-Meaning and definition of Consumer behavior, importance, Different buying roles, Consumer buying decision process, factors influencing consumer behavior

- **Content Delivery Methods:**

Chalk and Talk

Section-II

Unit 3 Marketing Mix No of lectures – …10….

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

B. Branding and packaging, decisions – 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.

Content Delivery Methods:

Chalk and Talk

Unit 4– Place & Promotion mix No of lectures 10

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

- **Content Delivery Methods:**

Chalk and Talk.

- **Term Work:**

Identify different types of services available in your Area / locality and describe those services and submit a report.

Select any product along with its competitor and study Segmentation, Targeting, and Differentiation and Positioning. Submit a report.

Online exercise: visit any website of FMCG organization, study its marketing mix with respect to product or price and submit a report.

a. 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.

b. Select any organization and study its supply chain management.

Note: Relevant audio, video CD's and case studies should be discussed. Emphasis should be given to field assignments.

- **Text Books**
  - Marketing Management-Ramswamy V. S., Namakumari S., Macmil lion Pub lishers India Ltd.
  - Marketing Management-Raj an Saxena, Tata McGrawHill.
  - Marketing Management: Text and Cases-Tapan Panda, Excel Books. Marketing-Etzel, Walker B., Stanton W., Pandit A., Tata McGrawHill.
  - Marketing Management- Karunakarn K-Himalaya Publication, New Delhi.
- **Reference Books:**
  - Marketing Management-a south asian perspective: Kotler Phillip, Keller Kevin Lane, Koshy Abrahamand Jha Mithileshwar, Pearson.
  - Marketing Management: A South Asian Perspective-Kotler P., Keller K.,Koshy A., Jha M., Pearson PrenticeHall.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-II
ME424 (G) Free Elective-II
Railway Transportation Management

Teaching Scheme	**Examination Scheme**
Lectures– 03 Hours/week, 03 Credits	**ESE–**70 Marks
Practical – 02 Hour/week, 01 Credit	**ISE –**30 Marks
	ICA- 25 Marks
	Oral Exam- 25 Marks

Course Introduction:

This course seeks to provide an introduction to management of passenger in interurban railway transport, its design principles &Qualityparameters. Rolling stock& its assessment procedures are also covered in this course. Further the course explains in detail the freight railway transport, its Organization and management along with traffic composition and classification of railway networks/corridors, Economic profitability. The second part of this course covers railway safety and incidents in various parts of railway systems like railway tunnels, road overpasses, embankments, cuttings, railway stations, open tracks, RLC's along with the detailed explanation of effecton the natural environment due to railway system. Energy Consumption and Ecosystem in Railway are also covered in this course.

Course Prerequisite:

Students shall have introductory knowledge of railway systems. Basic knowledge of freight railway transport, rolling stock, railway track.

Course Objectives: During this course, students are expected:

1. To study the requirements and challenges of organization and management of railway transport systems.
2. To study the economics and profitability of railway systems
3. To learn the concepts related to good grounding in railway safety
4. To learn the needs to be done to minimize accidents
5. To study Environmental Impact Assessment (EIA) of railways.
6. To study the energy consumptions in various railway systems and their effects on ecosystem.

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

1. Explain organizational and management aspects of the railways
2. Select the proper rolling stock
3. Explain the organization and management of freight railway transport
4. Recognize effect of railways on environment and mitigation measures are required
5. Implement safety regulations in railway systems & select preventive measures required to

reduce accidents.

6.Explain greenhouse gases emitted by the means of transport.

Section I

Unit 1–Organization and management of passenger interurban railway transport No of lectures – 04

Prerequisite: Types of transport systems, knowledge of design of systems.

Objectives:

a. To study services & basic design principles of transport systems.
b. To study quality parameters in railway transport for interurban passengers.

Outcomes:

After completing this unit, student will be able to

c. Explain design principles of transport systems
d. Apply quality parameters in railway transport for interurban passengers.

Unit Content: Services and basic designprinciples, Service level of interurban passenger railway transport: Qualityparameters, Scheduling of passenger trainservices

Content Delivery Methods: Board, Chalk and talk, animations

Unit 2–The railway as a transport system No of lectures – 05

Prerequisite: Basic knowledge of rolling stock

Objectives:

e. To study selection criteria of rolling stock.
f. To study requirementof rolling stock for the performance of scheduled services.

Outcomes:

After completing this unit, student will be able to

g. Select proper rolling stock.
h. Calculate requirementof rolling stock for the performance of scheduled services.

Unit Content: Selection and purchase of rolling stock&Procedures for: assessment of the existing situation, determination of the target year, assessment of the situation in the target year, determination of the transport volume target, determination of the service frequency target(numerical treatment), new train timetable scheme, checks on corridor track capacity and transport volume, calculating Required rolling stock for the performance of scheduled services, determining practically required rolling stock, defining required rolling stock (descriptive treatment).

Content Delivery Methods: Board, Chalk and talk, animations

Unit 3–Organization and management of freightrailway transport No of lectures –05

Prerequisite: Basic knowledge aboutfreight railway transport.

Objectives:

i. To study quality parameters in Service level of freight railway transport.
j. To study transportation of dangerous goods.
k. To study scheduling of different types of transportation methods.

Outcomes:

After completing this unit, student will be able to

- Decide quality parameters in Service level of freight railway transport.
- Explain special measures required for transportation of dangerous goods.
- Define scheduling of different types of transportation methods.

Unit Content: Services and cargo movement, Service level of freight railway transport: Quality parameters, Scheduling of freight train services, combined transport, Mass transport, Transportation of dangerous goods- Differentiation from the rest of freight transport services, Creation of safe transport conditions, Special measures to protect the environment (Descriptive treatment only).

Content Delivery Methods: Board, Chalk and talk, animations

Unit 4–Impact of traffic composition on the economic profitability of a railway system No of lectures – 06

Prerequisite: Basic knowledge of Railway corridor Mathematical simulation.

Objectives:

- To study various types of railway networks/corridors.
- To study the impact of traffic composition on the economic profitability of a railway system

Outcomes:

After completing this unit, students will be able to

- Explain the various types of railway networks/corridors.
- Determine impact of traffic composition on the economic profitability of a railway system
- Select the operating framework for an existing railway corridor.

- **Unit Content:** Traffic composition and classification of railway networks/corridors, Economic profitability, The problem of mixed traffic operation, Investigation of the impact of traffic composition on the economic profitability of a railway system, Data published by the railway networks, Mathematical simulation, Selection of the operational framework for a new railway corridor, Selection of the operating framework for an existing railway corridor (Numerical treatment expected).

Content Delivery Methods: Board, Chalk and talk, animations

Section II

Unit 5–Introduction to Railway safety and Incidents No of lectures –04

Prerequisite: Basic knowledge about safety regulations.

Objectives:

- To study various types of railway incidents.
- To study Significance of safety in railway systems and differences in road safety.

Outcomes:

After completing this unit, student will be able to

- Explain various types of railway incidents.
- Differentiate safety in railway systems and in road safety.

Unit Content: Types of railway incidents and definition of railway safety, Significance of safety in railway systems and differences in road safety, Classification of railway incidents, Causes of railway incidents(Descriptive treatment only).

Content Delivery Methods: Board, Chalk and talk, animations

Unit 6– Railway Safety No of lectures – 04

Prerequisite: Knowledge of different civil engineering structures used in railways

Objectives:

- To study safety measures in civil engineering structures.
- To study Correlation between the cost of interventions and the safety level improvement.

Outcomes:

After completing this unit, student will be able to

- Explain safety measures in civil engineering structures.
- Calculate Correlation between the cost of interventions and the safety level improvement.

Unit Content: Safety in civil engineering structures (railway tunnels, road overpasses, embankments, cuttings, railway stations, open track), Safety at RLCs,Correlation between the cost of interventions and the safety level improvement(Descriptive treatment only).

Content Delivery Methods: Board, Chalk and talk

Unit 7–Railway and the natural environment No of lectures – 06

Prerequisite: Basic Causes of pollution, working of railway systems,

Objectives:

- To study natural environment of the railways.
- To study causes of pollutions produced due to railways.

Outcomes:

After completing this unit, student will be able to

Explain natural environment of the railways.

Determine the causes of pollutions produced due to railways.

Unit Content: Natural environment of the railway, Air pollution, Soil and water pollution, Visual annoyance, Acoustic annoyance(Descriptive treatment only).

Content Delivery Methods: Board, Chalk and talk, animations

Unit 8–Energy Consumption and Ecosystem in Railway No of lectures – 06

Prerequisite: Knowledge of Energy calculations, Vibration measurement & Ecosystem.

Objectives:

- To study the energy consumptions.
- To study the impacts of various means of transport to the natural environment.

Outcomes:

After completing this unit, student will be able to

- Calculate energy consumptions.
- Determine the base load requirement.
- Do the Comparative assessment of the impacts of various means of transport to the natural environment

Unit Content: Energy consumption, Integration of the track into the landscape, Ecosystem disturbance, Disturbance of local resident activities, Ground-borne noise and vibrations, Impacts on land use, Comparative assessment of the impacts of various means of transport to the natural environment, Freight transport(Numerical treatment expected).

Content Delivery Methods: Board, Chalk and talk, animations

Term work:

Minimum four case studies on:

a. Rail transportation of hazardous materials.
b. Optimum exploitation scenario for an interurbanrailway corridor by the help of mathematical models.
c. Safety in civil engineering structures.
d. Bio toilets in Railway.
e. Accidental analysis.
f. Green energy initiatives in railways.
g. Solar energy generation in Indian railways.

Minimum five assignments on the following

h. Selection of rolling stock.
i. Impact of traffic composition on the economic profitability of railway system.
j. Ecosystem in railway.
k. Economic profitability of a railway system.
l. Freight railway transport.
m. Railway safety.
n. Energy consumption analysis.

Compulsory: Industrial visit/ field visit to any railway maintenance workshop/ railway part manufacturing factory/ railway station.

- **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, Dhanpat Rai Publications (p) Ltd.-new Delhi, 2010.
- **Reference Books:**
  1. Technology in Rail Transport Management,Prabha Shastri Ranade,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 November 2017).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.E. (Mechanical Engineering) Semester-I.

ME425 Project Work -II

Teaching Scheme	**Examination Scheme**
Practical – 04 Hour/week, 02 Credit	**Oral Exam –100 Marks**
	ICA- 100 Marks

Course Objectives:

1. Manufacturing/modeling the project work.
2. Analyzing/comparing/evaluating the result of the project work.

Course Outcomes:

After completing Project Work –I, students will be able to;

1. Present the work in the Journal/conference/workshop
2. Apply for patent/IPR

Guidelines for Project contents & mark distribution:

a) Work diary and weekly reporting:		20
b) Project Report	:	40
c) Presentation	:	40

Project Report:

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 it in 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 and one copy should remain with each student of the project group. (Sample Format for Project Work Diary):

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: