**Title of the Course: Finite Element Analysis**
**Course Code:UPRD0701**

| L | T | P | Credit |
|---|---|---|---|
| 03 | - | - | 03 |

**Course Pre-Requisite:**
Knowledge of Engineering Materials, strength of materials and theories of failure, Fundamentals of Programming Language

**Course Description:**
A finite element Analysis is a numerical procedure for solving physical problems governed by a differential equation or an energy theorem. The FEM provides an approximate solution. The method uses continuous piecewise smooth functions for approximate the unknown quantity.

**Course Learning Objectives:**
1. To learn basic principles of finite element analysis procedure.
2. To learn the theory and characteristics of finite elements that represent engineering structures.
3. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analysis.
4. It provides some experience with a commercial FEM code and some practical modeling exercises.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understand the concepts behind formulation methods in FEM. | III | Understanding |
| CO2 | Identify the application and characteristics of FEA elements such as Bars Springs, Truss. | II | Applying |
| CO3 | Derive and use of 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses. | III | Analyzing |
| CO4 | Able to apply suitable boundary conditions to a global equation for heat transfer and fluid flow problems. | I | Applying |
| CO5 | Use commercial FEA software, to solve problems related to engineering. | II | Evaluating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | | | |
| CO2 | 1 | 2 | | 1 | | | | | | | | | | |
| CO3 | | | 3 | 1 | 2 | | | | | | | | 3 | |
| CO4 | | | 3 | 3 | 2 | | | | | | | | 2 | |
| CO5 | | | 2 | | 3 | | | | | | | | 3 | |
| CO6 | | | | | | | | | | | | | | |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:--- Introduction to Finite Element Method: 10 Hrs.**

General description of the finite element method, General FEM Procedure, comparison with other methods, Engineering applications, Discretization process, Types of elements: 1D, 2D and 3D, Node numbering, Location of nodes. Strain displacement relations, Stress strain relations, Plain stress and Plain strain conditions, temperature effects.

**Introduction to different approaches used in FEA** Potential energy Method, Raleigh Ritz method, Weighted residual Method

**Unit 2:--- One-Dimensional Elements 06 Hrs.**

Types of 1D elements, Formulation of elemental stiffness matrix and load vector for spring and bar elements, Properties of stiffness matrix, Assembly of global stiffness matrix and load vector, Boundary conditions, elimination method and penalty approach, displacement, Stress and strain calculations in springs and bar elements, Shape functions and its properties, Variation of Shape Functions, Higher order interpolation functions for 1D quadratic and cubic elements in natural coordinates.

**Unit 3:--- Two Dimensional Finite Element Formulations 06 Hrs.**

Introduction, 2D Elements, Formulation of elemental stiffness matrix and load vector for Plane stress/strain Such as Constant Strain Triangles (CST), Calculation of stress, strain, four nodded quadrilateral element,

**Unit 4:- Analysis of 2D Truss Element 06 Hrs.**

Local and global coordinate system, coordinate transformation, Natural coordinate system, Element Stiffness matrix of Truss, Calculations of displacement stress and strain.

**Unit 5:- Steady State Heat Transfer Analysis 06 Hrs.**

Basic equations of heat transfer: conduction, convection, radiation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions, 1 D Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins.

**Unit 6:- Computer implementation for the Finite Element Method 06 Hrs.**

Features of commercial software's, Pre-processor, solver and Postprocessor. Meshing techniques, and Quality checks of elements. Sources of errors, Mesh revision methods.

**CAD DATA Exchange**: File Structure and format of IGES, STEP and DXF.

**Textbooks:**


1) Rao, S. S., Finite element method in engineering, 5th Edition, Pergaman Int. Library of Science, 2010.
2) Chandrupatla T. R., Finite Elements in engineering**,** 2nd Edition, PHI, 2013.
3) Finite Element Methods: Basic Concepts and applications/ Alavala/PHI Publications.
4) Logan, D. L., A first course in the finite element method,6th Edition, Cengage Learning, 2016.


**Reference**


1) Fagan M. J., ―Finite Element Analysis, Theory and Practice, Pearson Education Limited
2) Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., ―Practical Finite Element

Analysis, Finite to Infinite, Pune
3) Cook R. D., et al. “Concepts and Application of Finite Elements Analysis”- 4th Edition, Wiley & Sons, 2003.
4) Seshu. P. “Textbook of Finite Element Analysis” Prentice Hall of India, 2003.
5) J.N. Reddy, “Finite Element Method” Tata McGraw Hill, 2003.

**Unitwise Measurable outcomes:**

1. Understand the concepts of the FEA
2. Use 1 D element and solve simple Problems.
3. Derive stiffness matrix for 2D Elements and determine stresses in 2 D Problems.
4. Understand Truss and fluid flow analysis
5. Formulate equations and Solve different 1D Heat transfer problems.
6. Study different FEA packages, meshing techniques.

**Title of the Course: Production and Operations Management**
**Course Code: UPRD 0702**

| L | T | P | Credit |
|---|---|---|---|
| 3 | 1 | - | 4 |

**Course Pre-Requisite:**
Knowledge of Management Functional Application Framework. Planning Competency is essential requirement.

**Course Description:**
To study the concepts of production and operations management and their applications to the corporate world.

**Course Learning Objectives:**
1. To explain different types of manufacturing systems and theory characteristics with applications
2. To discuss significance of pre-production functions such as forecasting, product design and capacity planning for managing production and operations of an organization
3. To explain functions of production planning and production control.
4. To illustrate the principles of modern production management techniques like tpm, jit, tps, lean, six sigma to achieve excellence at firm level.
5. To discuss various approaches for inventory management, supply chain management and logistics management to achieve excellence at value chain level.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Compare types of manufacturing processes by taking into account basic characteristics of processes for production and operations management applications. | II | Understanding |
| CO2 | Select appropriate forecasting technique and numerically compute sales forecast based on past performance of the organization. | III | Applying |
| CO3 | Demonstrate ability to apply production planning control functions to a manufacturing system through application of a case study. | II | Understanding |
| CO4 | Select an appropriate modern production management method based on organizational objectives. | III | Applying |
| CO5 | Apply the inventory management principles to determine economic order quantity by taking into account cost of ordering and cost of holding involved with inventory. | III | Applying |
| CO6 | To appraise the supply chain and logistic systems by distinguishing facts and inferences through the existing case studies. | V | Evaluating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | | 2 |
| CO2 | 2 | 2 | | | | | | | | | | | | 2 |
| CO3 | 3 | 2 | 2 | 2 | | | | | | | | | 2 | 3 |
| CO4 | 3 | 2 | 2 | | 2 | | | | | | | 2 | | 3 |
| CO5 | 3 | 2 | 2 | 2 | | | | | | | 2 | 2 | | 3 |
| CO6 | 3 | 2 | | 1 | | | | | | 2 | 2 | | 2 | 3 |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively..

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:--- 08 Hrs.**

**The production Management**

Definition, objectives, scope, functions, relative position in organization, classifications of manufacturing systems and characteristics.

**Product design and development**

Requirements of good design, stages in design, manufacturing, functional, Marketing and economical aspects, '3S'- Simplifications, Standardization and Specialization, product life cycle

**Demand Forecasting**

Need, long term and short term Forecast, classification of forecasting methods, judgmental techniques, quantitative techniques, forecast errors

**Capacity Planning**

Measures of capacity, estimating Future capacity needs, factors influencing effective capacity, aggregate planning.

**Unit 2:--- Production planning and control 08 Hrs.**

Meaning, objectives, functions, organization, relationship of PPC with other departments for planning and execution, comparison between production planning and production control

**Production Planning**

Routing, scheduling, machine loading, job cards, route sheets, scheduling- need, objective, factors affecting machine loading techniques, drum-buffer rope concept, theory of constraints.

**Production control**

Outline of production control Dispatching- Rules, systems, functions Progressing- Functions, feedback, corrective actions.

**Unit 3:--- Inventory Management 04 Hrs.**

Meaning, types, objectives, benefits, costs associated with inventory, selective control of inventory, inventory control systems. stores Management- objectives, functions, procedure.

**Unit 4:- Advanced manufacturing technologies and systems 08Hrs.**

Introduction, challenges facing the organization, growth of technologies, advanced manufacturing philosophies and techniques 5S, Poka Yoke, SMED, Kaizen. Concept and philosophy of Toyota production system, Just in Time manufacturing, Kanban System, Lean Manufacturing. Business Process Reengineering- Need, steps, framework, process.

**Unit 5:- Supply chain management 06 Hrs.**

Drivers and obstacles, objectives, strategy, tactical and operational decisions in supply chain, flow in supply chain, IT used for SCM.
Logistics management
Definition, need, scope, function, role of infrastructure in transportation, different logistics approaches. .

**Unit 6:- Total Productive maintenance** **06 Hrs.**

Types of maintenance, objectives and scope of TPM, Five pillars of TPM implementation, overall equipment effectiveness, Benefits of TPM implementation. Human consideration in productive management Motivational factors, behavior aspects, safety work working condition, shop supervisor role.

**Textbooks:**


1) Narasimhan, Mcleavey, Billingten, Production Planning & Inventory Control, Prentice Hall of India, Edition 1997.
2) Chary S.N., Theory and Problems in Production and Operation Management, Tata McGraw Hill, Edition 1995.
3) Roberta S. Russell, Bernard W. Taylor III, Operations Management, Wiley India, Edition 2007.
4) Joseph S. Martinich, Production and operation management, Wiley India, Edition 2008.
5) R. B. Khanna, (2007), Production & Operations Management, PHI
6) Industrial Engineering and Production Management, Martand Telsang


**Reference**


1) Martin K. Starr, (2007), Production & Operations Management, India Edition, Cengage Learning
2) Dr. K.C. Arora, (2009), Production & Operations Management, University Science Press (Laxmi Publications Pvt. Ltd.)
3) Mahadevan B, Operations Management Theory & Practice, Pearson Education.
4) Chase R B, Aquilano N J , Jacobs F R and Agarwal N, Production & Operations Management Manufacturing and Services, Tata McGraw Hill
5) Adam,E.E and Ebert, Production & operations Management, Prentice Hall of India, New Delhi.
6) Gaither and Frazier, Operations Management, Thomson South-Western


**Unitwise Measurable outcomes:**

**After the completion of respective unit, the student should be able to**

1. Explain different types of manufacturing systems and pre-production functions like forecasting, product design and capacity
2. Explain functions of production planning and production control.
3. Apply Inventory management principles in practice.
4. Illustrate various advanced manufacturing technologies and systems
5. Decide supply chain and logistics management strategies
6. Implement Total productive maintenance principle to achieve equipment effectiveness

**Title of the Course: Process Engineering and Technology**
**Course Code: UPRD0703**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Fundamental knowledge of machine tools, conventional and CNC machining, quality, jigs, fixtures, cutting tools

**Course Description:**
Course comprises of introduction to process planning, selection of equipment, cutting tools for component machining, preparing process sheets, process pictures, estimation of component machining time and production rate.

**Course Learning Objectives:**
1. To analyze the part drawing from the view point of process designing for the required lot size.
2. To select the originating and other processes be carried out on the component to ensure the geometrical and dimensional requirements.
3. To select proper machines/equipment, cutting tools and inspection equipment required for processing the component.
4. To design the process sequence and the operation contents along with selecting the optimum cutting parameters and document it.
5. To estimate the cycle time for processing a component.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Interpret a component drawing for the purpose of planning its total process sequence. | II | Understanding |
| CO2 | Select the originating and machining processes to be carried out in order to satisfy the dimensional and geometrical requirements of the component. | I | Remembering |
| CO3 | Demonstrate the ability of selecting the machine tool, cutting tools and inspection equipment necessary for processing the component in a given lot size. | II | Understanding |
| CO4 | Document the complete process sheet for a component for the required lot size. | VI | Creating |
| CO5 | Explain process of industrial component with help of process pictures | V | Evaluating |
| CO6 | Estimate the cycle times and production rates for different operations in the formulated process plan. | VI | Creating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | | | | | | | | | | | 1 | |
| CO2 | 1 | 1 | 2 | | 3 | | | | | | | | 1 | |
| CO3 | | | 1 | | 3 | | | | | | | | | 2 |
| CO4 | | | | 3 | | | | | | | | | 2 | |
| CO5 | | | | 2 | | | | | | | | | 1 | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO6** | | | | 2 | | | | | | | | | | 2 |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively..

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:--- Introduction to Process Engineering**: 05 **Hrs.**

Introduction to manufacturing systems ,Continuous and discrete parts manufacturing, Processing strategies, Position of product and process engineering department in the organization, functions of product and process engineers, process planning function and activities-drawing interpretation, process planning, input and output of process planning, material evaluation and process selection, selection of machines and tooling, setting process parameters, work-holding devices, selecting quality assurance methods, costing and documentation

**Unit 2:--- Part Print Interpretation & Study of Machining Accuracies** 08 **Hrs.**

Identifying originating process, major and minor operations, identifying useful supplementary information, material specification and treatments, interchangeability and standardization, tool references, dimensional and geometrical tolerances, surface finish, critical processing factors

Study of Machining Accuracies:

Factors affecting accuracies, sources of errors, systematic and random errors, workpiece variation work piece control theories, product tolerances, process tolerances, and tolerance stack -types and effects.

**Unit 3:--- Technical Feasibility Study & Process Selection** 07 **Hrs.**

Raw material, basic originating process, accuracy level, processes required, machine tools and accessories required Manufacturing feasibility study with illustrations.

Process Selection: Factors in process selection, process selection method, process and operation sequencing –guidelines; Operations classification, Effect of product design on processing, Combining and eliminating operations, concept of breakeven analysis ,economic aspects of processing, make or buy decision, Introduction to computer aided process planning, Steps for process planning, Generative and Retrieval type.

**Unit 4:- Selection of Equipment & Tooling** 07 **Hrs.**

Various sources of information, technical, economical and managerial considerations, selection criteria for GPMs, SPMs and CNCs for processing in job, batch and mass mode, Introduction to process capability.

Selection Tooling:

Classification of cutting tools ,Introduction to cutting tools and tool holders catalogue Selection of standard cutting tools for various machining operations, Study of special tools, Various work holding devices, Selection of gauges. Selection of machining parameters like cutting speed, feed, depth of cut

**Unit 5:- Process Planning** 07**Hrs.**

Preparation of process sheet for machining of a component for job, batch and mass production using conventional and CNC machines, Selection of quality assurance method and tools, in-process gauging, process picture

**Unit 6:- Time Estimation** 06 **Hrs.**

alculation of standard time and production rates for various operations by consideration of various allowances. (Numerical exercises expected ) Takt-time concept.

**Textbooks:**


1) Process Engineering for Manufacturing – Eary & Johnson (Prentice Hall) Process Planning: The Design/Manufacturing Interface, –Petert Scallan, (2003),(Buttreworth Heinmann, Elsevier) ISBN: 0-7506-51-29-6
2) A Text Book of Production Engg, –P.C. Sharma, (Millennium Edition, 2000) (S. Chand & Co.)


**Reference**


1) Principles of Machine Tools- Sen, Bhattacharya
2) Automation, Production Systems, and C.I.M. – Groover, M.P. 3/e, (PHI)
3) Workshop Technology Vol. III – Chapman (ELBS)
4) Manufacturing Technology: Principles for Optimisation – Daniel
5) Mechanical Estimating and Costing – TTTI Chennai (TMH)
6) Standard manuals of ISO, QS, TS etc.
7) Manufacturers' catalogues for cutting tools and inspection equipments
8) Product Design-Kevin Otto and Kristin Wood (Pearson)
9) All About Machine Tools-Heinrich Gerling (New Age International)
10) Westerman Tables (Metals) (New Age International)


**Unitwise Measurable outcomes:**

1. At the end of the unit, student will be able to differentiate Process and Product engineering function
2. At the end of the unit, student will be able to interpret component from manufacturing and accuracy point of view
3. At the end of the unit, student will be able to understand manufacturing feasibility and also select proper manufacturing process
4. At the end of the unit, student will be able to select appropriate manufacturing equipment, tooling and machining parameters
5. At the end of the unit, student will be able to develop process sheet ,process picture as per component manufacturing sequence
6. At the end of the unit, student will be able to find out correct processing time and production rate.

**Title of the Course: Refrigeration & Air Conditioning**
**Course Code:UPRD0721**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Knowledge of Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

**Course Description:**
Refrigeration and Air conditioning is one of the important subjects today across the globe. Due to global warming, the earth temperature is going up. So, to get human comfort and to get industrial processes carried out at controlled temperatures, we need to study this subject

**Course Learning Objectives:**
1. Familiarize students with the terminologies associated with refrigeration & air conditioning.
2. To cover the basic principles of psychrometry and applied psychometrics.
3. Familiarise students with system analysis.
4. Familiarise students with load calculations and elementary duct design
5. Familiarise students with refrigerants; vapour compression refrigeration and multi-stage vapour compression systems.
6. Understand the components of vapour compression systems and other types of cooling systems

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Explain fundamentals in Refrigeration & Air conditioning. | II | Understanding |
| CO2 | Solve various refrigeration and air conditioning problems, using P-h chart and Psychrometric Chart. | III | Applying |
| CO3 | Identify various components of vapour compression system depending on Tonnage of Refrigeration. | III | Applying |
| CO4 | Test for calculating performance indicators using refrigeration and air conditioning test rigs | IV | Analyzing |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | 2 | |
| CO2 | 2 | | | | | | | | | | | | 2 | |
| CO3 | | 3 | | | | | | | | | | | 2 | 2 |
| CO4 | | | 3 | 2 | | | | | | | | | 2 | 2 |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:---** 03 **Hrs.**

**Introduction:** Recapitulation of Thermodynamics, Thermodynamics process pertaining to refrigeration and air conditioning. First and Second law applied to refrigerating machines, Carnot principles, Unit of refrigeration, COP EER

**Unit 2:---** 06 **Hrs.**

**Air Refrigeration:** Air refrigeration cycle. Reverse Carnot cycle, Bell-Coleman cycle Numerical on above.

**Air Refrigeration Systems:** Thermodynamic processes, priority criteria and suitability of air refrigeration system. Types of Air refrigeration system, Simple, Boot Strap, Regeneration, Reduced Ambient. Evaporative System. Comparison of these cycles based on DART rating. Numerical on above.

**Unit 3:---** 08 **Hrs.**

**Vapor Compression Cycle:** Necessity of modification of Carnot Cycle, Thermodynamic processes in VCC. Simple vapor compression system, Various conditions of vapor refrigerant in the system, Improvement in simple system. Flash Chamber, Flash Intercooler. Numerical on above syllabus. Compound vapor Compression System: Need of compound compression, Two stage compression, and various arrangements for improvement in C O P with mathematical analysis. Numericals Three Stage Compressions: Various arrangements for improvement in C O P. Numericals. Multiple Evaporator System. Requirement for multiple Evaporator, Various arrangements for improvement in C O P with mathematical analysis. Numericals.

**Unit 4:-** 08**Hrs.**

**Introduction to Cryogenics:**Cascade Refrigeration, Thermodynamically analysis of Cascade systems Various arrangements.

Methods of Producing and maintaining low temperature such as simple Linde, Claude, Kapitea, Heylandt cycle, Philips, Stirling machine, Thermodynamic analysis of above cycle to find yield and exegetic efficiency.

**Unit 5:-** 06 **Hrs.**

**Refrigerants.** Desirable properties of refrigerant, R-12, R-22, R-717, R-134, Butane recent substitute for refrigerants

**Unit 6:-** 08 **Hrs.**

**Introduction to Psychrometry:** Need of Air Conditioning, principle of psychrometry, psychometric properties such as DBT, WBT relative humidity, specific humidity, dew point temperature, enthalpy, Thermodynamic wet bulb temperature.

**Applied Psychrometry:** Representation of various psychometric processes on psychometric chart and their analysis, Adiabatic mixing of streams, By pass factor, sensible heat factor, RSHF, ESHF, GSHF, ADP, Ventilation and infiltration Use of psychometric charts.

**Textbooks:**

1) Refrigeration and Air Conditioning, Arora C. P., Tata McGraw Hill
2) Principles of Refrigeration, Dossat R. J., Prentice Hall

3) Refrigeration and Air Conditioning,Domkundwar,Dhanpat Rai
4) Refrigeration and Air Conditioning, Ballany P.L., Khanna Publications

**Reference**

1) Air Conditioning System design Handbook, Carrier Corporation, U S A

**Unitwise Measurable outcomes:**

1. The student will be able to explain Thermodynamic laws and basics.
2. The student will be able to draw The Carnot cycle and explain and also solve simple numericals on it. Also the student will be able to explain various air refrigeration systems.
3. The student will be able to explain the vapour compression cycle and terms regarding that. The student will be able to solve some basic numerical on it,
4. The student will be able to explain Cascade, Linde and Claude system.
5. The student will be able to Explain necessity of refrigerants, their designation and properties. The student will be able to tell names of some refrigerants.
6. The student will be able to explain the Psychrometric chart and display its application

**Title of the Course: Automotive Technology**
**(Automotive Electronics)**
**Course Code:UPRD0722**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Fundamental knowledge of theory of machines, machine design and manufacturing processes.

**Course Description:**
The course comprises of introduction to various automobile components like transmission system, braking system , steering and suspension system, Brakes, Wheels and Tyres, electrical and electronic system and recent trends in automobile technology

**Course Learning Objectives:**
1. To study various vehicle layouts and automobile components
2. To learn various transmissions systems
3. To analyze steering and suspension systems
4. To study different types of braking systems,wheels and tyres
5. To learn electrical and electronic systems in automobile
6. To get acquainted with recent trends in automobiles

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| **CO1** | To explain various vehicle layouts and automobile components | II | Understanding |
| **CO2** | To identify different types of transmissions systems | III | Applying |
| **CO3** | To analyze steering and suspension systems | IV | Analyzing |
| **CO4** | To interpret different types of braking systems, wheels and tires. | V | Evaluating |
| **CO5** | To explain electrical and electronic systems in automobile | II | Understanding |
| **CO6** | To analyze recent trends in automobiles | IV | Analyzing |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | 1 | | | | | | | | 1 | | 1 |
| CO2 | 1 | 1 | | 1 | | | | | | | | 1 | 1 | |
| CO3 | 1 | 1 | | | | | | | | | | 1 | 1 | |
| CO4 | | 1 | | | | | | | | | | 1 | 1 | |
| CO5 | 1 | | | | 2 | | | | | | | 1 | | |
| CO6 | | | | 1 | 2 | | | | | | | 1 | 1 | |

**Assessments :**
**Teacher Assessment: :**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:--- Introduction** 6 **Hrs.**

Automobile history and development, Classification, vehicle layouts- engine location and drive arrangement, specifications of vehicles, Type of vehicle bodies, body parts and its advanced materials, Chassis types, constructional details, details of chassis material, Vehicle life development cycle overview.

**Unit 2:---Transmission System** 6 **Hrs.**

Clutch – Function and requirements, Classification, Construction and working of Single-plate, Multi-plate, Diaphragm spring and centrifugal clutches, Fluid flywheel.

Gear Box – Necessity, classification, construction of manual gear boxes like Sliding mesh, constant mesh, Synchromesh, Epicyclic gear train, Automatic transmission, Overdrive. Propeller shaft, Differential and final drive.

**Unit 3:---Steering and Suspension Systems** 8 **Hrs.**

Live and dead axles, live axle arrangement.

Steering systems, function, principle of steering, Ackerman and Davis, steering geometry, center point steering, cornering force, slip angle, scrub radius, steering characteristic, Types of steering gearbox, power steering, collapsible steering.

Suspension system- Functions, Types of suspension linkages, types of spring - leaf, coil, air springs, telescopic shock absorber, hydro gas suspension, rubber suspension, self-levelling suspension (active suspension) Advances in suspension system, Air suspension

**Unit 4:---Brakes, Wheels and Tyres** 7 **Hrs.**

Brakes: Need, principle, types, Mechanical, hydraulic and pneumatic brakes, disc and drum types, air brakes, servo and power brakes, Anti-lock braking system, their relative merits, details of components, brake adjustments, defects and causes.

Wheels and Tyres: Wheel construction, alloy wheel, Types, tyre construction, tread design, Tyre specifications, factors affecting tyre performance, tyre wear and its causes, wheel balancing.

**Unit 5:---Electrical and Electronic Systems** 6 **Hrs.**

Automotive batteries - lead acid batteries, Advances in batteries ,battery charging system, alternators, principle and operation of cutout and regulators, starter motor, Bendix drive, solenoid drive, magneto coil and solid stage ignition systems, lighting and electrical accessories, automobile air conditioning, panel board instruments. Electronic Controlled Management (ECM) Systems, Automobile wiring. Sensors used in automobile.

**Unit 6:- Recent Trends in Automobiles** 6 **Hrs.**

Automotive emission controls, emission norms, Principle of operation construction- working & application of different types of sensors, Safety in Automobiles, Testing and certification of vehicles. Aerodynamics and ergonomics in automobile designs. Hybrid system- Series, parallel and series parallel, Fuel Cell.

**Reference :**


1) Kirpal Singh, "Automobile Engineering‖ ,Vol. II,Standard Publishres Distributors,(2009), ,ISBN8180141241
2) Narang G. B. S., "Automobile Engineering", S. Chand and Company Ltd, Fifth Edition, Delhi, 1995. Motor Vehicle: Newton & Steeds
3) Automobile Mechanics: N. K. Giri
4) Automobile Engineering; R. K. Rajput
5) Automobile Engineering: K.K.Ramalingam
6) Automobile Electrical Equipment; P. L. Kohali


**Textbooks:**


1) W. H. Crouse, "Automotive mechanics", Tata McGraw Hill Publishing Company Ltd, New Delhi, Ninth Edition, Delhi, 1993. ,ISBN0070634351
2) Newton, Steeds and Garrett. "Motor Vehicle", The English Language Book Society, Ninth Edition, 1972.

3) Heitner Joseph, "Automotive Mechanics" CBS Publishers and Distribution, Second Edition, Delhi, 1987.
4) Automobile Mechanics: N. K. Giri
5) Automobile Engineering; R. K. Rajput
6) Automobile Engineering: K.K.Ramalingam
7) Automobile Electrical Equipment; P. L. Kohali
8) P. L. Ballaney, "Internal Combustion Engines", Khanna Publishers, Third Edition, New Delhi, 1991.

**Unitwise Measurable outcomes:**

After completion of each unit the student shall be able to

1. Understand various vehicle layouts and automobile components
2. Learn various transmissions systems
3. Analyze steering and suspension systems
4. Select different types of braking systems, wheels and tyres
5. Learn electrical and electronic systems in automobile
6. Get acquainted with recent trends in automobiles

**Title of the Course: Computer Integrated Manufacturing System**
**Course Code: UPRD0723**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Knowledge of basic manufacturing processes

**Course Description:**
It is the study of manufacturing planning, integration and implementation of automation. It contains Computer Aided Manufacturing (CAM), studies of Concurrent Engineering, Group Technology, Computer Aided Process Planning and Flexible Manufacturing Systems and Networking concepts.

**Course Learning Objectives:**

1. To understand the basic concepts of computer aided manufacturing, design and engineering and concept of group technology
2. To understand the subsystems in CIMS, such as computer aided process planning, flexible manufacturing, production management, quality control and material handling, and their integration
3. To understand the role of database management and communication systems in integration
4. To understand different data acquisition techniques.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Explain the link between Automation and CIM | II | Understanding |
| CO2 | Make use of computer in Manufacturing and design process | III | Applying |
| CO3 | Develop part family classification code using the concept of group technology. | III | Applying |
| CO4 | Apply knowledge of computer aided process planning and flexible manufacturing in manufacturing processes. | III | Applying |
| CO5 | Classify different production support machines. | II | Analyzing |
| CO6 | Select appropriate networking topology for given application | V | Evaluating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | | 1 |
| CO2 | | 1 | | | 3 | | | | | | | | 2 | |
| CO3 | | 1 | 3 | | | | | | | | | | | |
| CO4 | | 1 | 2 | | | | | | | | | | 2 | |
| CO5 | | 1 | | | | | | | | | | | | 1 |
| CO6 | | | | 1 | 2 | | | | | | | | 1 | |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:- Basic Concept of CIMS:-** **6 Hrs.**

Scope, islands of automation, architecture of CIM, information flow in CIM, elements of CIM, benefits, limitations, obstacles in implementation Planning for CIMS, need for planning, Phases of CIM implementation, incremental implementation and one time implementation, CIM benchmarking, Economic and social justification of CIM.

**Unit 2:-** **6 Hrs.**

Product Design and CAD, application of computers in design, CAM – manufacturing planning and control, scope of CAD / CAM and CIM, Concurrent engineering, Design for manufacturing and assembly ,Case studies on Concurrent engineering, Design for manufacturing and assembly.

**Unit 3:** **8 Hrs.**

**a) Group Technology:** Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA, classification and coding system- OPITZ, Relevance of GT in CIM, GT and CAD, benefits and limitations of GT.

**b) Computer Aided Process Planning and Control:** need, retrieval and generative type CAPP, role of CAPP in CIM.

**c) Computer Aided Production Planning and Control:** Computer integrated production management system, Role of computers in aggregate planning, master production schedule, shop floor control, materials requirement planning, and capacity planning, manufacturing resource planning and enterprise resource planning

**Unit 4: Flexible Manufacturing Systems, Transfer lines, Assembly Lines in CIMS:** **6 Hrs.**

Concept, flexible & rigid manufacturing, manufacturing cell and FMS structure, types, components of FMS, Distributed Numerical Control (DNC), Building Blocks of FMS, Flexible Assembly System, Transfer Lines, concept, applications, benefits, Automates assembly lines, Design for assembly.

**Unit 5: Production Support Machines and Systems in CIM: Robots, types, joint configurations,** **6 Hrs.**

Industrial robots for load/unload, automated material handling, automatic guided vehicles, Types, Vehicle guidance, Management and safety, automated storage and retrieval system.

**Unit 6:** **8 Hrs.**

**a) Data Acquisition and Database Management Systems:** (a) Data acquisition system, type of data, automatic data identification methods, bar code technology, machine vision.(b) Data and database management system, database design requirements, types of DBMS models- hierarchical, network and relational models and their applications

**b) Communication in CIMS:** Role of communication in CIMS, requirements of shop floor communication, types and components of communication systems in CIM, Networking concepts, network topology, access methods, ISO-OSI reference model for protocols, MAP/TOP, TCP/IP.

**Reference :**

1) Performance Modeling of Automated Manufacturing Systems, 2/e - Viswanadham, N & Narahari, Y. (EEE) (PHI)

2) CIM Handbook - Teicholtz& Orr (McGraw Hill) Computer Integrated Manufacturing, 2/e - James A. Rehg, H. W. Kraebber, (Pearson Education)

**Textbooks:**

1) Automation, Production systems and Computer Integrated Manufacturing, 3/e - M.P. Groover (PHI or Pearson Education)
2) Computer Integrated Design and Manufacturing - Bedworth, Henderson & Wolfe,(McGraw Hill)
3) Principles of Computer Integrated Manufacturing - S. Kant Vajpayee, (PHI)
4) CAD / CAM Principles and Applications - P.N. Rao (Tata McGraw Hill)
5) CAD/CAM/CIM, 3/e – Radhakrishnan, Subramanayam & Raju (New Age International)
6) MAP/TOP Networking : Foundation of CIM – Vincent Jones (McGraw Hill)

**Unitwise Measurable outcomes:**

1. The student shall be able to understand basic concepts of CIMS
2. The student shall be able to learn the applications of CAD and CAM
3. The student shall be able to understand importance of GT and CAPP
4. The student shall be able to understand the concept of FMS
5. The student shall be able to understand role of Production Support Machines
6. The student shall be able to understand the concept of DBMS

**Title of the Course: Industrial Automation and Robotics**
**Course Code:UPRD0724**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Basic knowledge of manufacturing , Basics of Hydraulics and Pneumatics, Basics of Programming

**Course Description:**
This course is an introduction to fixed and flexible automation equipment. An emphasis is placed upon flexible equipment components such as the industrial robot. Robot topics includes fundamentals of robots, robot control system, end effectors and sensors, robot programming and kinematics.

**Course Learning Objectives:**

1. To be familiar with the automation and brief history of robot and applications.
2. To give the student familiarities with the kinematics of robots.
3. To give knowledge about robot end effectors and their design.
4. To learn about Robot Programming methods & Languages of robot.
5. To give knowledge about various Sensors and their applications in robots.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| **CO1** | Distinguish the types of automation | IV | Analyzing |
| **CO2** | Identify various transfer mechanisms and assembly automation configurations | III | Applying |
| **CO3** | Explain fundamentals of industrial robots and their control systems | II | Understanding |
| **CO4** | Select appropriate sensor for given application | III | Applying |
| **CO5** | Solve various automation and robotic problems using appropriate programming language | VI | Creating |
| **CO6** | Apply artificial intelligence in solving social and economical problems | III | Applying |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | | 2 | | | | | | | 1 | | 1 |
| CO2 | | | | | 1 | | | | | | | 1 | | |
| CO3 | | | | | 2 | | | | | | | 1 | | |
| CO4 | | | | | 2 | | | | | | | 1 | | 1 |
| CO5 | | 1 | 2 | | 2 | | | | | | | 1 | 2 | 1 |
| CO6 | | | | | 2 | 2 | | | | | | 1 | | |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1: Introduction:** 6 **Hrs.**

Automated manufacturing systems, fixed /programmable /flexible automation, need; Basic elements of automated systems- power, program and control; Advanced automation functions, Levels of automation; Industrial control systems in process and discrete manufacturing industries, Continuous and discrete control; Low cost automation, Economic and social aspects of automation.

**Unit 2:** 6 **Hrs.**

**a)Transfer Lines:** Fundamentals, Configurations, Transfer mechanisms, storage buffers, control, applications; Analysis of transfer lines without and with storage buffers.

**b)Assembly Automation:** Types and configurations, Parts delivery at workstations-Various vibratory and non-vibratory devices for feeding and orientation, Calculations of feeding rates, Cycle time for single station assembly machines and partially automated systems; Product design for automated assembly.

**Unit 3: Fundamentals of Industrial Robots and Control System:** 6 **Hrs.**

Specifications and Characteristics, Basic components, configurations, Criteria for selection, various industrial applications.

Drives, Robot Motions, Actuators, Power transmission systems; Robot controllers, Dynamic properties of robots- stability, control resolution, spatial resolution, accuracy, repeatability, compliance

**Unit 4:Robotic End Effectors and Sensors:** 8 **Hrs.**

Transducers and sensors- sensors in robotics and their classification, Touch (Tactile) sensors, proximity and range sensors, force and torque sensing, End Effectors- Types, grippers, Various process tools as end effectors; Robot-End effectors interface, Active and passive compliance, Gripper selection and design.

**Unit 5:** 8 **Hrs.**

**Robot Programming:** Lead through method, Robot program as a path in space, Methods of defining positions in space, Motion interpolation, branching; Textual robot programming languages,

**Introduction to E-Yantra Firebird V-** Buzzer beep, line follower and motion programming.

**Unit 6:- Robot Kinematics** 6 **Hrs.**

Introduction, forward, reverse & homogeneous transformations, manipulator path control, introduction to robot dynamics configuration of a robot controller.

**Artificial Intelligence**:- Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics.

**Reference :**


1) Keramas, James G. (1998), Robot Technology Fundamentals, (CENGAGE) ISBN:981-240-621-2 7.
2) Noff, Shimon Y. "Handbook of Robotics", (John Wiley & Sons)
3) Niku, Saeed B. (2002), "Introduction to Robotics, Analysis, Systems & Applications", (Prentice Hall of India)
4) Koren, Yoram "Robotics for Engineers", (McGraw Hill)
5) Schilling, Robert J.(2004), "Fundamentals of Robotics, Analysis & Control", (Prentice Hall of India), ISBN: 81-203-1047-0
6) Dan W. Patterson(1990),Introduction to Artificial Intelligence and Expert Systems, ISBN: 0134771001, 9780134771007

**Textbooks:**


1) Groover, M.P., (2004), "Automation, Production Systems & Computer Integrated Manufacturing" 2/e, (Pearson Edu.) ISBN: 81-7808-511-9
2) Morris, S.Brian (1994), Automated Manufacturing Systems", (McGraw Hill) ISBN: 0-07-113999-0
3) Pessen, David W.(1990), "Industrial Automation, Circuit Design & Components", (John Wiley & Sons, Singapore)
4) Groover, M.P.; Weiss, M.; Nagel, R.N. & Odrey, N.G. "Industrial Robotics, Technology, Programming & Applications", (McGraw Hill Intl. Ed.) ISBN:0-07-024989-X
5) Fu, K.S.; Gonzalez, R.C. & Lee, C.S.G. "Robotics-Control, Sensing, Vision and Intelligence", (McGraw Hill Intl. Ed.) ISBN:0-07-100421-1


**Unitwise Measurable outcomes:**

1. The student shall be able to understand different types of automation
2. The student shall be able to understand the concept of transfer line
3. The student shall be able to understand basics of robotics
4. The student shall be able to understand robotic control system
5. The student shall be able to select appropriate end effectors
6. The student shall be able to write a robot program using suitable programming language

**Title of the Course: Industrial Product Development**
**Course Code: UPRD0725**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Fundamental knowledge of CAD, CAM Design and Manufacturing Engineering

**Course Description:**
Design and development of industrial products is the key for manufacturing companies to achieve the long-term success and survive in intensively competitive global market.

**Course Learning Objectives:**
1. Explain the Industrial product development and processes.
2. Explain the technical and business aspects of the Industrial product development process and explore / analyze market needs and appreciate their direct relationship with new products
3. Develop concepts and Select appropriate concept out of available set of concepts.
4. Analyze product teardown process and establish benchmarking of product
5. Apply the guidelines of Design for manufacturing, Assembly and environment in the process of developing new product.
6. Explain the concepts of Intellectual Property Rights (IPR)

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| **CO1** | Explain the product design and development processes. | II | Understanding |
| **CO 2** | Explain the technical and business aspects of the product development process and explore / analyze market needs and appreciate their direct relationship with new products | II | Understanding |
| **CO 3** | Develop concepts and Select appropriate concept out of available set of concepts. | III | Applying |
| **CO 4** | Analyze product teardown process and establish benchmarking of product | IV | Analyzing |
| **CO 5** | Apply the guidelines of Design for manufacturing, Assembly and environment in the process of developing new product. | III | Applying |
| **CO 6** | Analyze the various phases of the design cycle sequentially and envision the concept of "Scratch to Market" w. r. t a product | IV | Analyzing |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | | | | | | | | | | | | |
| **CO2** | 2 | 2 | | | | | | | | | | | 1 | |
| **CO3** | | 2 | 3 | | | | | | | | | | 3 | |
| **CO4** | 1 | | | 2 | | | | | | | | | 2 | |
| **CO5** | 1 | | 2 | | | | 1 | | | | | | 1 | |
| **CO6** | 2 | | | | | | | | | | | | | |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit-1 Introduction to Industrial Product Design & Development:** 6 Hrs

Definition Of Industrial Product Design and Development, Design By Evolution And Innovation, Factors In Product Development, Morphology Of industrial Product Design (Seven Phases), Standardization, Simplification and Specialization In Product Development, Modern Approaches-Concurrent Design and Quality Function Deployment (QFD), Product Development, Product Development versus Product Design, Types Of Design And Redesign, Modern Product Development Process, Introduction To Prototyping, Rapid Prototyping Methods

**Unit- 2 Industrial Product Development - Technical and Business Concerns:** 6 Hrs

Technology Forecasting and Technology S-Curve (Technology Stage), Mission Statement and Technical Questioning, Economic Analysis of Product, Customer Needs and Satisfaction, Customer Population and Market Segmentation, Customer Needs-Types and Models, Gathering Customer Needs Information, Analysis of Gathered Information.

**Unit- 3 Industrial Product Development from Concept to Product Function:** 8 Hrs

Generating concepts, information gathering, and brainstorming, morphological analysis, concept selection-design evaluation, estimation of technical feasibility, concept selection process, Pugh's concept, selection charts, numerical concept scoring, process of concept embodiment, system modeling, FMEA, functional modeling and decomposition, establishing system functionality, augmentation and aggregation.

**Unit-4 Industrial Product Development in the Context of Reverse Engineering:** 6 Hrs

Product Teardown Process, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used In Benchmarking - Indented Assembly Cost Analysis, Function -Form Diagrams, Trend Analysis, Setting Product Specifications, Introduction to Product Portfolio and Architecture.

**Unit-5 Design for Manufacture, Assembly and Environment:** 8 Hrs

Introduction to concepts of design for manufacture, design for assembly, need and importance of design for environment, global, local and regional issues,
Aesthetics : Aesthetic Considerations, Visual Effects of Form and Color in Product Design.
Ergonomics : Ergonomics and product design and automated systems, Anthropomorphic data and its applications in ergonomic design, Limitations of Anthropomorphic data, General approach to the Man-Machine Relationship - Workstation Design and environment (Working position and posture).

**Unit-6 Intellectual Property Rights, Patents. :** 6 Hrs

Objectives of intellectual property law, Concepts of Trademarks, copyrights, patents and its procedures, Industrial design rights, Infringement, misappropriation, and enforcement.

**Reference :**


1) New Product Development, Tim Jones, Butterworth, Heinemann, Oxford, (1997).
2) Assembly Automation and Product Design,Geoffrey Boothroyd, Marcel Dekker, CRC,Press.
3) Industrial Product Design,C W Flureshem.
4) Industrial Design for Engineers,Mayall W.H, London, Hiffee books Ltd.
5) Introduction to Ergonomics,R.C. Bridger, Tata McGraw Hill Publication.


**Textbooks:**


1) Product Design and Development,Karl T. Ulrich, Steven G. Eppinger; Irwin Tata,McGraw Hill, 3rd Edition.
2) Product Design and Manufacturing, A.C. Chitale and R.C. Gupta, Prentice Hall of India, 3rd Edition.
3) Product Design,Otto and Wood, Pearson education.“Human Factor Engineering”, L P Singh , Galgotia Publication Pvt.Ltd, 1st Edition.


**Unitwise Measurable outcomes:**

1. The different processes in industrial product development
2. The business concepts, customer needs, Economical aspects etc.
3. The design Processes, assembly of product and Functioning of final product.
4. The process of reverse engineering, Benchmark of product, Product portfolio etc.
5. The design for manufacture , assembly, Environment, Aesthetics, Ergonomics etc.
6. The Intellectual Property rights like Patent, Trademark, Copyrights.

**Title of the Course: Machine Tool Design**
**Course Code: UPRD0726**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Basic knowledge of Different machine tools and machining processes

**Course Description:**
Course offers detailed understanding on design of machine tools. Detailed analysis on design of Gear box and mechanical stepless regulations. Design of structural elements, guide ways, power screws, spindle and bearings.

**Course Learning Objectives:**
1. To understand core concepts of Machine Tool Design
2. To understand the selection of different machine tools
3. To understand the basic approach for designing machine tool components and implement the appropriate method.
4. To compute the power requirements of various machine tools.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | **Apply** the concepts of machine tool design. | III | Applying |
| CO2 | **Select** the correct design approach & design the important Components of Machine tools. | III | Applying |
| CO3 | **Determine** the forces acting and the subsequent power requirements of machine tools. | V | Evaluating |
| CO4 | Specifically **Design** the critical components comprising a manufacturing system & emphasize on the quality of the system. | VI | Creating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | 1 | | | | | | | | | | 1 | 1 |
| CO2 | | 2 | 2 | 3 | | | | | | | | | 2 | 1 |
| CO3 | 3 | | 1 | | | | | | | | | | | |
| CO4 | 1 | | 3 | 1 | | | | | | | | | | 2 |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc.
**MSE:** Assessment is based on 50% of course content (Normally first three modules)
**ESE:** Assessment is based on 100% course content with60-70% weightage for course content (Normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1: Introduction to Machine & Machine Tool- Principle of Machine Tool Design** 6 Hrs.

General requirements of machine tool design - design process machine tool layout, Working and auxiliary motions in machine tools, methodology for machine tools design considering quality, quantity of production and economic aspects. Machine tool drives- Electric drives, Hydraulic transmission.

**Unit 2: Analysis of forces and Design consideration** **6 Hrs**

**Analysis of forces:** Forces affecting machine tool elements, determination of motive power for different Operating conditions, use of handbooks.

**Design considerations and selection of standard components:** Drive systems with pulleys, belts, ropes and chains; selection of oil seals, gaskets and electric motors from standard catalogues.

**Unit 3: Kinematics of Machine Tools** **7Hrs.**

Classification of various driving systems, basic considerations in the design of drives, aim of speed & feed regulation, stepped regulation of speeds, design of gear box, laws of stepped regulations, selection of range ratio, G.P. ratio, break up of speed steps, structural diagram, Ray diagram & speed chart, design of feed box, machine tool drives using multiple speed motors, general recommendations for developing gearing diagram, determining the number of teeth on gears. Stepless regulation of speed and feed rates.

**Unit 4: Design of Machine Tool Structures** **7Hrs.**

Functions-Requirements-Design criteria Material used – static and dynamic stiffness – Profile and basic design procedure for machine tool structures. Design of beds, columns, housing, bases, tables, cross-rails, arms saddle, carriages. Causes of vibrations in machine tools and methods of elimination.

**Unit 5:** **7Hrs.**

**A)Design of Guide Ways, Power Screws**

Function and types of guide ways – Design of slide ways - aerostatic slide ways - antifriction guide ways, combination guide ways - protecting devices, design of power screws.

**B)**Ergonomic and aesthetic considerations applied to the design of control members, Ergonomic considerations applied to the location of Displays and control members

**Unit 6: Design of Spindle and Spindle Bearings** 7 **Hrs.**

Functions of spindle unit and requirements, materials for spindle, Effect of Machine tool compliance and machining accuracy, Design of spindles. Selection of Machine Tool Bearing, Journal, rolling and hydrostatic bearings, basic principles, assembly, mounting and maintenance, procedure for selection of bearings from manufacturer's catalogue based on load and life considerations.

**Reference :**


1) Design of Machine Elements, V. B. Bhandari, Tata McGraw-Hill Publishing Company Ltd.
2) Elements of Machine Design, N. C. Pandya and C. S. Shaha, Charotkar Publishing House
3) Design Data Handbook, K. Mahadevan and Balveera Reddy, C.B.S Publishers & Distributors.
4) Engineering Design, a Materials and Processing Approach, G. Dieter, Tata McGraw-Hill
5) Publishing Company Ltd.
6) Catalogues of Bearing Manufacturers, example, S.K.F, NACHI, TIMKEN, NRB etc


**Textbooks:**


1) Machine tool design by N.K.Mehta ( TMH ).
2) Principles of machine tools by Gopal Chandra Sen and Amitabh Bhattacharya (New Central Book Agency).

3) Machine Tool Design Handbook, C.M.T.I, Bangalore, (TMH).
4) Design Data Handbook, PSG College of Tech., Coimbatore.
5) Design of Machine Tool, Dr. S. K. Basu (Oxford IBH)
6) Design of Machine Elements, Dobrovalsky.

**Unitwise Measurable outcomes:**

1. Principles and requirements of machine tool design
2. Analysis of forces, Design consideration and selection of standard components
3. Kinematics of Machine Tools, Gear box design.
4. Design of Machine Tool Structures like beds, columns, houses etc.
5. Design of Guide Ways, Power Screws ,Ergonomic and aesthetic considerations
6. Design of Spindle and Spindle Bearings

**Title of the Course: Finite Element Analysis Lab**
**Course Code: UPRD0731**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Strength of Material, CAD Software

**Course Description:**
Design and Finite element Analysis of 1D,2D and 3D Objects

**Course Learning Objectives:**
1. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analysis.
2. It provides some experience with a commercial FEM code and some practical modelling exercises.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understand the concepts behind formulation methods in FEM. | II | Understand |
| CO2 | Identify the application and characteristics of FEA elements such as Bars Springs, Truss. | II | Apply |
| CO3 | Derive and use of 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses. | III | Analyze |
| CO4 | Able to apply suitable boundary conditions to a global equation for heat transfer and fluid flow problems. | I | Apply |
| CO5 | Use commercial FEA software, to solve problems related to engineering. | I | Perform |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | | 2 | |
| CO2 | 1 | 2 | | 1 | | | | | | | | | 2 | |
| CO3 | | | 3 | 1 | 2 | | | | | | | 3 | 1 | |
| CO4 | | | 3 | 3 | 2 | | | | | | | 2 | 1 | |
| CO5 | | | 2 | | 3 | | | | | | | 3 | 3 | |

**Assessments :**
**Teacher Assessment:**
One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE (POE) | 25 |

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE: Assessment is based on oral examination

**Course Contents:**

**Experiment No. 1:** **4 Hrs**

Introduction of FEA Software, Analysis of spring element using any FEA software and Validate results with analytical method

**Experiment No. 2:** **4 Hrs**

Introduction of FEA Software, Analysis of spring element using any FEA software and Validate results with analytical method

**Experiment No. 3:** **4 Hrs**

Analysis of 2D truss using FEA software and Validate results with analytical method

**Experiment No. 4:** **4 Hrs**

Static stress concentration factor calculation for a plate with centre hole subjected to axial loading in tension using FEA software.

**Experiment No. 5:** **4 Hrs**

Static stress analysis of steel bracket using 2d elements. Determine deflection and stress using any FEA software.

**Experiment No. 6:** **2 Hrs**

Thermal analysis of Composite wall or Fin by using 1D or 2D Elements

**Experiment No. 7:** **2 Hrs**

Stress and deflection analysis of any machine component consisting of 3-D elements using FEA software.

**Reference**


1) Fagan M. J., ―Finite Element Analysis, Theory and Practice‖ , Pearson Education Limited
2) Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., ―Practical Finite Element Analysis, Finite to Infinite, Pune
3) Cook R. D., et al. "Concepts and Application of Finite Elements Analysis"- 4th Edition, Wiley & Sons, 2003.
4) Seshu. P. "Textbook of Finite Element Analysis" Prentice Hall of India, 2003.
5) J.N. Reddy, "Finite Element Method" Tata McGraw Hill, 2003.


**Textbooks:**


1) Rao, S. S., Finite element method in engineering, 5th Edition, Pergaman Int. Library of Science, 2010.
2) Chandrupatla T. R., Finite Elements in engineering**,** 2nd Edition, PHI, 2013.
3) Finite Element Methods: Basic Concepts and applications/ Alavala/PHI Publications.
4) Logan, D. L., A first course in the finite element method,6th Edition, Cengage Learning, 2016.

**Title of the Course: Process Engineering and Technology-Lab**
**Course Code: UPRD0732**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Fundamental knowledge of machine tools, conventional and CNC machining, quality, jigs, fixtures, cutting tool

**Course Description:**
Course comprises of Preparing Part print interpretation, process sheets, process pictures and estimation of component machining time and production rate.

**Course Learning Objectives:**
1. To interpret industrial component drawing from manufacturing point of view.
2. To make aware students about format of process sheet and process pictures
3. To understand process sequence and prepare process sheet of component to be machined
4. To understand process sequence and prepare process picture of component to be machined
5. To prepare time estimation for processing a component
6. To understand process sheets and process pictures of industrial component and observe it

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Interpret component drawing from manufacturing and accuracy point of view | II | Understanding |
| CO2 | Understand process sheet and process pictures in order to use them from component machining documentation point of view. | II | Understanding |
| CO3 | Formulate process design using process sheet of component machined on conventional and CNC machine tools by understanding its process sequence | VI | Creating |
| CO4 | Formulate process picture of component machined on conventional and CNC machine tools by understanding its process sequence | VI | Creating |
| CO5 | Estimate time for component processing on conventional and CNC machine tools and find out production rate | VI | Creating |
| CO6 | Explain manufacturing process of industrial component using its process plan | V | Evaluating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | | | | | | | | | | | 1 | |
| CO2 | 1 | 1 | 2 | | 3 | | | | | | | | 1 | |
| CO3 | | | 1 | | 3 | | | | | | | | | 2 |
| CO4 | | | | 3 | | | | | | | | | 2 | 3 |
| CO5 | | | | 2 | | | | | | | | | | 2 |
| CO6 | | | | 2 | | | | | | | | | | 2 |

**Assessments :**

**Teacher Assessment:**

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE | 25 |

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

**Course Contents:**

**Experiment No. 1:** **4 Hrs**

Part print interpretation of one industrial component drawing

**Aim and Objectives:** To interpret industrial component drawing from manufacturing point of view.

**Outcomes:** Interpret component from manufacturing and accuracy point of view **Theoretical Background:** Fundamental knowledge of machine tools, quality, conventional and CNC machining

**Experiment No. 2:** **4 Hrs**

Study of formats of Process sheets, Process pictures

**Aim and Objectives:** To make aware students about format of process sheet and process pictures

**Outcomes:** Understand process sheet and process pictures in order to use them from component machining documentation point of view.

**Theoretical Background:** Fundamental knowledge of machining , quality, conventional and CNC machining

**Experiment No. 3:** **4 Hrs**

Process sheet of one component (made from casting, forging, bar stock, etc.) to be machined on conventional/ CNC machine tools or both for batch/mass production

**Aim and Objectives:** To understand process sequence and prepare process sheet of component to be machined

**Outcomes:** Develop process sheet using process sheet of component machined on conventional and CNC machine tools by understanding its process sequence

**Theoretical Background:** Basic knowledge of machining, cutting tools, gauges, work holding devices, quality.

**Experiment No. 4:** **4 Hrs**

Process picture of one component machined (made from casting, forging, bar stock, etc.) on conventional/ CNC machine tools or both for batch/mass production

**Aim and Objectives:** To understand process sequence and prepare process picture of component to be machined

**Outcomes:** Formulate process picture of component machined on conventional and CNC machine tools by understanding its process sequence

**Theoretical Background:** Basic knowledge of machining, cutting tools, gauges, work holding devices, quality.

**Experiment No. 5:** **4 Hrs**

Time estimation of component processing on conventional/ CNC machine tools or both for batch/mass production

**Aim and Objectives:** To prepare time estimation for processing a component on conventional and CNC machine tools

**Outcomes:** Estimate time for component processing on conventional and CNC machine tools and find out production rate

**Theoretical Background:** Basic knowledge of machining, cutting tools, gauges, work holding devices, quality.

**Experiment No. 6:** **4 Hrs**

Industrial visit to study component manufacturing process plan and visit report.

**Aim and Objectives:** To understand process sheets and process pictures of industrial component and observe it's machining.

**Outcomes:** Understand process design of industrial component by studying its process sheets and process pictures

**Theoretical Background:** Basic knowledge of machining, cutting tools, gauges, work holding devices, quality

**Reference**


1) Principles of Machine Tools- Sen, Bhattacharya
2) Automation, Production Systems, and C.I.M. – Groover, M.P. 3/e, (PHI)
3) Workshop Technology Vol. III – Chapman (ELBS)
4) Manufacturing Technology: Principles for Optimisation – Daniel
5) Mechanical Estimating and Costing – TTTI Chennai (TMH)
6) Standard manuals of ISO, QS, TS etc.
7) Manufacturers' catalogues for cutting tools and inspection equipments
8) Product Design-Kevin Otto and Kristin Wood (Pearson)
9) All About Machine Tools-Heinrich Gerling (New Age International)
10) Westerman Tables (Metals) (New Age International)


**Textbooks:**


1) Process Engineering for Manufacturing – Eary & Johnson (Prentice Hall)
2) Process Planning: The Design/Manufacturing Interface, –Petert Scallan, (2003), (Buttreworth Heinmann, Elsevier) ISBN: 0-7506-51-29-6
3) A Text Book of Production Engg, –P.C. Sharma, (Millennium Edition, 2000) (S. Chand & Co.)


**Unitwise Measurable outcomes:**

1. Interpret component from manufacturing and accuracy point of view
2. Understand process sheet and process pictures in order to use them from component machining documentation point of view.
3. Formulate process design using process sheet of component machined on conventional and CNC machine tools by understanding its process sequence
4. Formulate process picture of component machined on conventional and CNC machine tools by understanding its process sequence
5. Estimate component processing time on conventional and CNC machine tools and find out production rate.
6. Explain manufacturing process of industrial component with help of its process plan

**Title of the Course: Refrigeration & Air Conditioning Lab**
**Course Code: UPRD0733**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Knowledge Of Thermodynamics ,Fluid Mechanics, Heat and Mass Transfer

**Course Description:**
Refrigeration and Air conditioning is one of the important subject today across the globe. Due to global warming, the earth temperature is going up. So, to get human comfort and to get industrial processes carried out at controlled temperatures, we need to study this subject.

**Course Learning Objectives:**
1. Familiarize students with the terminologies associated with refrigeration & air conditioning.
2. To cover the basic principles of psychrometry and applied psychometrics.
3. Familiarise students with system analysis.
4. Familiarise students with load calculations and elementary duct design
5. Familiarise students with refrigerants; vapor compression refrigeration and multi-stage vapor compression systems.
6. Understand the components of vapor compression systems and other types of cooling systems.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Explain fundamentals in Refrigeration & Air conditioning. | II | Understanding |
| CO2 | Solve various refrigeration and air conditioning problems, using P-h chart and Psychrometric Chart. | III | Applying |
| CO3 | Identify various components of vapour compression system depending on Tonnage of Refrigeration. | III | Applying |
| CO4 | Test for calculating performance indicators using refrigeration and air conditioning test rigs | IV | Analyzing |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | 2 | |
| CO2 | 2 | | | | | | | | | | | | 2 | |
| CO3 | | 3 | | | | | | | | | | | 2 | 2 |
| CO4 | | | 3 | 2 | | | | | | | | | 2 | 2 |

**Assessments :**
**Teacher Assessment:**
In Semester Evaluation (ISE) is based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc. It is having 100% course content.

| Assessment | Marks |
|---|---|
| ISE | 50 |

**Course Contents:**
**Experiment No. 1: To study working of domestic refrigerator along with wiring diagram 2 Hrs**
**Aim and Objectives:**To study working of domestic refrigerator along with wiring diagram.
**Outcomes:** The student will be able to explain different parts and working of refrigerator and also

about its wiring.

**Theoretical Background:**Every household has a refrigerator. So it is worth to study and troubleshoot if necessary the domestic refrigerator.

**Experimentation:**The students will be explained the working of the refrigerator available in the laboratory.

**Results and Discussions:-**The students have queries which will be clarified.

**Conclusion:-**The student displays his/her knowledge.

**Experiment No.2:Study of RAC tools and their applications in refrigeration workshop and Lab.** **2 Hrs**

**Aim and Objectives:**Study of RAC tools and their applications in refrigeration workshop and Lab.

**Outcomes:** The student will be able to recognize various tools and explain their application

**Theoretical Background:**Every refrigeration industry needs these tools. So beforehand, every student must know these tools.

**Experimentation:**The studentswill be shown the various tools and their application in HVAC industry.

**Results and Discussions:**The students have queries which will be clarified.

**Conclusion:**The student will be able to recognize every tool and its application.

**Experiment No. 3:Study of different types of compressors.** **2 Hrs**

**Aim and Objectives:**Study of different types of compressors

**Outcomes:**The student will be able to know different types of compressors and their applications in HVAC industry.

**Theoretical Background:** It is necessary for every student to know the construction and working of various compressors and their applications.

**Experimentation:**The student will be taken to nearby industry to show different types of compressors

**Results and Discussions:**The students have queries which will be clarified.

**Conclusion:**The student will be able to know different types of compressors and their applications in HVAC industry

**Experiment No. 4:To study the procedure of leak detection, evacuation and charging of refrigerant.** **2 Hrs**

**Aim and Objectives**:To study the procedure of leak detection, evacuation and charging of refrigerant.

**Outcomes:**The student will be able to know various leak detection techniques and procedure of charging the system.

**Theoretical Background:**Every student must know how to charge the system and check the leaks.

**Experimentation:**The student will be taken to nearby industry to show the process of charging and leak detection.

**Results and Discussions:**The student will be able to know various leak detection techniques and procedure of charging the system.

**Conclusion:**The student will be able to know charging and leak detection techniques.used in HVAC industry

**Experiment No.5:To study different types of refrigeration controls.** **2 Hrs**

**Aim and Objectives:** To study different types of refrigeration controls.

**Outcomes:**The student will be able to explain different types of refrigeration controls.

**Theoretical Background:**The HVAC field requires various control such as overload cutout, HP- LP cutout, etc. Therefore, every student must know the principle, construction and working of these controls.

**Experimentation:**The students will be shown different controls on the test rigs available as well as through the industrial visit.

**Results and Discussions:**The student will be able to explain different types of refrigeration controls.

**Conclusion:**The student will be able to know various refrigeration controls.

**Experiment No.6: Trial on window air conditioner.** **2 Hrs**

**Aim and Objectives:** Trial on window air conditioner.

**Outcomes:**The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters.

**Theoretical Background:**Every student must know different parts of window air conditioner and different performance parameters.

**Experimentation:**The test rig is started and reading are taken at appropriate points and the performance parameters are calculated.

**Results and Discussions:**The student will be able to measure different parameters and calculate the performance.

**Conclusion:**The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters

**Experiment No.7:Trial on refrigeration test rig.** **2 Hrs**

**Aim and Objectives:** Trial on refrigeration test rig.

**Outcomes:** The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters.

**Theoretical Background:** Every student must know different parts of refrigeration test rig and different performance parameters.

**Experimentation:**The test rig is started and reading are taken at appropriate points and the performance parameters are calculated.

**Results and Discussions:**The student will be able to measure different parameters and calculate the performance.

**Conclusion:**The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters.

**Experiment No.8:Trial on Air-Conditioning test rig.** **2 Hrs**

**Aim and Objectives:** Trial on Air-Conditioning test rig.

**Outcomes:** The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters.

**Theoretical Background:** Every student must know different parts of air conditioning test rig and different performance parameters.

**Experimentation:**The test rig is started and reading are taken at appropriate points and the performance parameters are calculated.

**Results and Discussions:**The student will be able to measure different parameters and calculate the performance.

**Conclusion:**The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters.

**Experiment No.9: Report on different international protocols to regulate global warming.** **2 Hrs**

**Aim and Objectives:** Report on different international protocols to regulate global warming.

**Outcomes:** The student will be able to explain different protocols related to the HVAC field.

**Theoretical Background:** The measuresare being taken across the globe to curb on the Ozone layer depletion and global warming. Therefore, it is necessary for the students to know the various protocols.

**Experimentation:**The student will be asked to study different protocols and write a report.

**Results and Discussions:**The student will be able to explain different protocols related to the HVAC field.

**Conclusion:**The student will be able to

**Experiment No.10:Report on visit to refrigeration establishments.** **2 Hrs**

**Aim and Objectives:** Report on visit to refrigeration establishments.

**Outcomes:** The student will recognize different components and explain them.
**Theoretical Background:** It is necessary for an engineer to study physical components of the system so as to correlate whatever they study in academics and physically how that is applied in the market.
**Experimentation:**The students will be taken on a visit to different refrigeration and Air conditioning applications and explained to them the total system.
**Results and Discussions:**The student will recognize different components and explain them.
**Conclusion:**The student will recognize different components and explain them.

**Reference**

1. Air Conditioning System design Handbook, Carrier Corporation, U S A

**Textbooks:**

1) Refrigeration and Air Conditioning, Arora C. P., Tata McGraw Hill
2) Principles of Refrigeration, Dossat R. J., Prentice Hall
3) Refrigeration and Air Conditioning,Domkundwar,Dhanpat Rai
4) Refrigeration and Air Conditioning, Ballany P.L., Khanna Publications

**Unitwise Measurable outcomes:**

1. The student will be able to explain different parts and working of refrigerator and also about its wiring.
2. The student will be able to recognize various tools and explain their application
3. The student will be able to know different types of compressors and their applications in HVAC industry.
4. The student will be able to know various leak detection techniques and procedure of charging the system.
5. The student will be able to explain different types of refrigeration controls
6. The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters
7. The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters.
8. The student will be able to measure different parameters on the test rig and calculate the necessary performance parameters.
9. The student will be able to explain different protocols related to the HVAC field.
10. The student will recognize different components and explain them.

**Title of the Course: Automotive Technology ( Automotive Electronics) Lab**
**Lab Course Code: UPRD0734**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Fundamental knowledge of theory of machines, machine design and manufacturing processes

**Course Description:**
The course comprises of introduction to various automobile components like transmission system, braking system , steering and suspension system, Brakes, Wheels and Tyres, electrical and electronic system and recent trends in automobile technology

**Course Learning Objectives:**
1. To learn various transmissions systems
2. To analyze steering and suspension systems
3. To study different types of braking systems, wheels and tyres
4. To learn electrical and electronic systems in automobile
5. To get acquainted with recent trends in automobiles

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Explain various vehicle layouts and automobile components | II | Understanding |
| CO2 | Identify different types of transmissions systems | III | Applying |
| CO3 | Analyze steering and suspension systems | IV | Analyzing |
| CO4 | Interpret different types of braking systems, wheels and tires. | V | Evaluating |
| CO5 | Explain electrical and electronic systems in automobile | II | Understanding |
| CO6 | Analyze recent trends in automobiles | IV | Analyzing |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | 1 | | | | | | | | 1 | | 1 |
| CO2 | 1 | 1 | | 1 | | | | | | | | 1 | 1 | |
| CO3 | 1 | 1 | | | | | | | | | | 1 | 1 | |
| CO4 | | 1 | | | | | | | | | | 1 | 1 | |
| CO5 | 1 | | | | 2 | | | | | | | 1 | | |
| CO6 | | | | 1 | 2 | | | | | | | 1 | 1 | |

**Assessments :**
**Teacher Assessment:**
In Semester Evaluation (ISE) is based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc. It is having 100% course content

| Assessment | Marks |
|---|---|
| ISE | 50 |

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**Course Contents:**

**Experiment No. 1:** **4 Hrs**

Study and demonstration of four wheeler chassis layout. Two-wheel & four-wheel drive layouts

**Experiment No. 2:** **2 Hrs**

Study and Demonstration of working of single plate automobile clutch.

**Experiment No. 3:** **2 Hrs**

Study and demonstration of synchromesh gearbox.

**Experiment No. 4:** **2 Hrs**

Study and demonstration of final drive and differential.

**Experiment No. 5:** **4 Hrs**

Study and demonstration of front wheel steering geometry and steering mechanism.

**Experiment No. 6:** **4 Hrs**

Study and demonstration of suspension system of a four-wheeler.

**Experiment 7:** **2 Hrs**

Study and demonstration of electrical charging system of automobiles.

**Experiment 8:** **2 Hrs**

Study and demonstration of electrical starting system of automobiles.

**Experiment 9:** **2 Hrs**

Study and demonstration of electric horn, fuel gauge and wiper circuit of automobiles

**Reference**


1) W. H. Crouse, "Automotive mechanics", Tata McGraw Hill Publishing Company Ltd, New Delhi, Ninth Edition, Delhi, 1993. ,ISBN0070634351
2) Newton, Steeds and Garrett. "Motor Vehicle", The English Language Book Society, Ninth Edition, 1972.
3) Heitner Joseph, "Automotive Mechanics" CBS Publishers and Distribution, Second Edition, Delhi, 1987.
4) P. L. Ballaney, "Internal Combustion Engines", Khanna Publishers, Third Edition, New Delhi, 1991.


**Textbooks:**


1) Kirpal Singh, "Automobile Engineering‖ ,Vol. II,Standard Publishres Distributors,(2009), ,ISBN8180141241
2) Narang G. B. S., "Automobile Engineering", S. Chand and Company Ltd, Fifth Edition, Delhi, 1995. Motor Vehicle: Newton & Steeds
3) Automobile Mechanics: N. K. Giri
4) Automobile Engineering; R. K. Rajput
5) Automobile Engineering: K.K.Ramalingam
6) Automobile Electrical Equipment; P. L. Kohali


**Unitwise Measurable outcomes:**

1. Understand various vehicle layouts and automobile components
2. Learn various transmissions systems

3. Analyze steering and suspension systems
4. Select different types of braking systems,wheels and tyres
5. Learn electrical and electronic systems in automobile
6. Get acquainted with recent trends in automobile

**Title of the Course: Computer Integrated Manufacturing System Lab**
**Course Code: UPRD0735**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Knowledge of basic manufacturing processes

**Course Description:**
It is the study of manufacturing planning, integration and implementation of automation. It contains Computer Aided Manufacturing (CAM), studies of Concurrent Engineering, Group Technology, Computer Aided Process Planning and Flexible Manufacturing Systems and Networking concepts.

**Course Learning Objectives:**
1. To understand the basic concepts of computer aided manufacturing, design and engineering and concept of group technology
2. To understand the subsystems in CIMS, such as computer aided process planning, flexible manufacturing, production management, quality control and material handling, and their integration
3. To understand the role of database management and communication systems in integration
4. To understand different data acquisition techniques.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Explain the link between Automation and CIM | II | Understanding |
| CO2 | Make use of computer in Manufacturing and design process | III | Applying |
| CO3 | Develop part family classification code using the concept of group technology. | III | Applying |
| CO4 | Apply knowledge of computer aided process planning and flexible manufacturing in manufacturing processes. | III | Applying |
| CO5 | Classify different production support machines. | II | Understanding |
| CO6 | Select appropriate networking topology for given application | V | Evaluating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | | 1 |
| CO2 | | 1 | | | 3 | | | | | | | | 2 | |
| CO3 | | 1 | 3 | | | | | | | | | | | |
| CO4 | | 1 | 2 | | | | | | | | | | 2 | |
| CO5 | | 1 | | | | | | | | | | | | 1 |
| CO6 | | | | 1 | 2 | | | | | | | | 1 | |

**Assessments :**
**Teacher Assessment:**
In Semester Evaluation (ISE) is based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc. It is having 100% course content.

| Assessment | Marks |
|---|---|
| ISE | 50 |

**Course Contents:**

**Assignment No. 1** **4 Hrs**

Exercise on classification and coding of components using GT Techniques, related to a) Design Attributes, b) Manufacturing attributes.

**Assignment No. 2** **4 Hrs**

Assignment on CAD and CAM

**Assignment No. 3** **4 Hrs**

Exercise on MRP-I

**Assignment No. 4** **4 Hrs**

Exercise on Database management system through any suitable software

**Assignment No. 5** **4 Hrs**

Case study on Capacity Planning

**Assignment No. 6** **4 Hrs**

Study of co-ordinate measuring machine involving study of dimensions and geometrical features of components, accessories of CMM and programming aspects, through an industrial visit and its report.

**Reference**


1) Performance Modeling of Automated Manufacturing Systems, 2/e - Viswanadham, N & Narahari, Y. (EEE) (PHI)
2) CIM Handbook - Teicholtz& Orr (McGraw Hill)
3) Computer Integrated Manufacturing, 2/e - James A. Rehg, H. W. Kraebber, (Pearson Education)


**Textbooks:**


1) Automation, Production systems and Computer Integrated Manufacturing, 3/e - M.P. Groover (PHI or Pearson Education)
2) Computer Integrated Design and Manufacturing - Bedworth, Henderson & Wolfe,(McGraw Hill)
3) Principles of Computer Integrated Manufacturing - S. Kant Vajpayee, (PHI)
4) CAD / CAM Principles and Applications - P.N. Rao (Tata McGraw Hill)
5) CAD/CAM/CIM, 3/e – Radhakrishnan, Subramanayam & Raju (New Age International)
6) MAP/TOP Networking : Foundation of CIM – Vincent Jones (McGraw Hill)


**Unitwise Measurable outcomes:**

1. The student shall be able to understand basic concepts of CIMS
2. The student shall be able to learn the applications of CAD and CAM
3. The student shall be able to understand importance of GT and CAPP
4. The student shall be able to understand the concept of FMS
5. The student shall be able to understand role of Production Support Machines
6. The student shall be able to understand the concept of DBMS

**Title of the Course: Industrial Automation and Robotics Lab**
**Course Code: UPRD0736**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Basic knowledge of manufacturing , Hydraulics and Pneumatics and Programming

**Course Description:**
This course is an introduction to fixed and flexible automation equipment. An emphasis is placed upon flexible equipment components such as the industrial robot. Robot topics includes fundamentals of robots, robot control system, end effectors and sensors, robot programming and kinematics

**Course Learning Objectives:**
1. To be familiar with the automation and brief history of robot and applications.
2. To give the student familiarities with the kinematics of robots.
3. To give knowledge about robot end effectors and their design.
4. To learn about Robot Programming methods & Languages of robot.
5. To give knowledge about various Sensors and their applications in robots.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Distinguish the types of automation | IV | Analyzing |
| CO2 | Identify various transfer mechanisms and assembly automation configurations | III | Applying |
| CO3 | Explain fundamentals of industrial robots and their control systems | II | Understanding |
| CO4 | Select appropriate sensor for given application | III | Applying |
| CO5 | Solve various automation and robotic problems using appropriate programming language | VI | Creating |
| CO6 | Apply artificial intelligence in solving social and economical problems | III | Applying |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | | 2 | | | | | | | 1 | | 1 |
| CO2 | | | | | 1 | | | | | | | 1 | | |
| CO3 | | | | | 2 | | | | | | | 1 | | |
| CO4 | | | | | 2 | | | | | | | 1 | | 1 |
| CO5 | | 1 | 2 | | 2 | | | | | | | 1 | 2 | 1 |
| CO6 | | | | | 2 | 2 | | | | | | 1 | | |

**Assessments :**
**Teacher Assessment:**
In Semester Evaluation (ISE) is based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc. It is having 100% course content.

| Assessment | Marks |
|---|---|
| ISE | 50 |

**Course Contents:**

**Assignment No. 1** **4 Hrs**
Introduction to E-Yantra robotic kit

**Assignment No. 2** **4 Hrs**
Programming for buzzer beep

**Assignment No. 3** **4 Hrs**
Programming for Motion Control

**Assignment No. 4** **4 Hrs**
Programming for Motion control with PWM

**Assignment No. 5** **4 Hrs**
Programming for LCD Display

**Assignment No. 6** **4 Hrs**
Programming for Line follower

**Reference**


1) Keramas, James G. (1998), "Robot Technology Fundamentals",(CENGAGE) ISBN:981-240-621-2 7. Noff, Shimon Y. "Handbook of Robotics", (John Wiley & Sons)
2) Niku, Saeed B. (2002), "Introduction to Robotics, Analysis, Systems & Applications", (Prentice Hall of India)
3) Koren, Yoram "Robotics for Engineers", (McGraw Hill)
4) Schilling, Robert J.(2004), "Fundamentals of Robotics, Analysis & Control", (Prentice Hall of India), ISBN: 81-203-1047-0
5) Dan W. Patterson(1990),Introduction to Artificial Intelligence and Expert Systems


**Textbooks:**


1) Groover, M.P., (2004), "Automation, Production Systems & Computer Integrated Manufacturing" 2/e, (Pearson Edu.) ISBN: 81-7808-511-9
2) Morris, S.Brian (1994), "Automated Manufacturing Systems", (McGraw Hill) ISBN: 0-07-113999-0
3) Pessen, David W.(1990), "Industrial Automation, Circuit Design & Components", (John Wiley & Sons, Singapore)
4) Groover, M.P.; Weiss, M.; Nagel, R.N. & Odrey, N.G. "Industrial Robotics, Technology, Programming & Applications", (McGraw Hill Intl. Ed.) ISBN:0-07-024989-X
5) Fu, K.S.; Gonzalez, R.C. & Lee, C.S.G. "Robotics-Control, Sensing, Vision and Intelligence", (McGraw Hill Intl. Ed.) ISBN:0-07-100421-1


**Unitwise Measurable outcomes:**

1. The student shall be able to understand different types of automation
2. The student shall be able to understand the concept of transfer line
3. The student shall be able to understand basics of robotics
4. The student shall be able to understand robotic control system
5. The student shall be able to select appropriate end effectors
6. The student shall be able to write a robot program using suitable programming language

**Title of the Course: Industrial Product Development Lab**
**Course Code: UPRD0737**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Fundamental knowledge of CAD, Design Engineering

**Course Description:**
Design and development of industrial products is the key for manufacturing companies to achieve the long-term success and survive in intensively competitive global market.

**Course Learning Objectives:**
1. Explain the Industrial product development and processes.
2. Explain the technical and business aspects of the Industrial product development process and explore / analyze market needs and appreciate their direct relationship with new products
3. Develop concepts and Select appropriate concept out of available set of concepts.
4. Analyze product teardown process and establish benchmarking of product
5. Apply the guidelines of Design for manufacturing, Assembly and environment in the process of developing new product.
6. Explain the concepts of Intellectual Property Rights (IPR)

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| **CO1** | Explain the Industrial product development and processes. | II | Understanding |
| **CO2** | Explain the technical and business aspects of the industrial product development process and explore / analyze market needs and appreciate their direct relationship with new products | II | Understanding |
| **CO3** | Develop concepts and Select appropriate concept out of available set of concepts. | III | Applying |
| **CO4** | Analyze product teardown process and establish benchmarking of product | IV | Analyzing |
| **CO5** | Apply the guidelines of Design for manufacturing, Assembly and environment in the process of developing new product. | III | Applying |
| **CO6** | Analyze the various phases of the design cycle sequentially and envision the concept of "Scratch to Market" w. r. t a product | IV | Analyzing |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | | |
| CO2 | 2 | 2 | | | | | | | | | | | 1 | |
| CO3 | | 2 | 3 | | | | | | | | | | 3 | |
| CO4 | 1 | | | 2 | | | | | | | | | 2 | |
| CO5 | 1 | | 2 | | | | 1 | | | | | | 1 | |
| CO6 | 2 | | | | | | | | | | | | | |

**Assessments :**
**Teacher Assessment:**
In Semester Evaluation (ISE) is based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc. It is having 100% course content.

| Assessment | Marks |
|---|---|
| ISE | 50 |

**Course Contents:**

**Assignment No. 1** **4 Hrs**

Assignment on Industrial product development processes

**Assignment No. 2** **4 Hrs**

Assignment on technical and business aspects of the product development process

**Assignment No. 3** **4 Hrs**

Assignment on concept generation to product function

**Assignment No. 4** **2 Hrs**

Assignment on Reverse Engineering

**Assignment No. 5** **2 Hrs**

Assignment on Design for Manufacture, Assembly and Environment

**Assignment No. 6** **4 Hrs**

Assignment on intellectual property Rights, Trademarks, copyrights, patents and its procedures

**Assignment No. 7** **4 Hrs**

Development of any Product using high end CAD software considering Following points

a) Need of Customer, Methodology of Market Survey.
b) Invention / Innovation of a product with modifications required.
c) Aesthetics (Form and Color) and Ergonomics consideration in design.
d) Preparation of various Views of the product.
e) Design for Assembly Procedures .
f) Product and Maintenance Manual.
g) Product Database Management.

A report should be prepared with details, drawing sheet, Bill of Material, Assembly – Disassembly Procedure, Maintenance Manual and Cost Estimation (if required) and Presentation of same

**Reference**


1. New Product Development", Tim Jones, Butterworth, Heinemann, Oxford, (1997).
2. "Assembly Automation and Product Design",Geoffrey Boothroyd, Marcel Dekker, CRC,Press.
3. "Industrial Product Design",C W Flureshem.
4. "Industrial Design for Engineers",Mayall W.H, London, Hiffee books Ltd.
5. "Introduction to Ergonomics",R.C. Bridger, Tata McGraw Hill Publication.


**Textbooks:**


1. "Product Design and Development",Karl T. Ulrich, Steven G. Eppinger; Irwin Tata,McGraw Hill, 3rd Edition.
2. "Product Design and Manufacturing",A.C. Chitale and R.C. Gupta, Prentice Hall of India, 3rd Edition.
3. "Product Design",Otto and Wood, Pearson education.
4. "Human Factor Engineering", L P Singh , Galgotia Publication Pvt.Ltd, 1st Edition.


**Unitwise Measurable outcomes:**

1. Students are able to learn processes in industrial product development, Business aspects, etc.
2. Students are able to learn Design for manufacture, Assembly, Environment.
3. Students are able to Develop new product, Understand about Intellectual Property Rights.

**Title of the Course: Machine Tool Design Lab**
**Course Code: UPRD0738**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Pre-Requisite:**
Basic knowledge of Different machine tools and machining processes

**Course Description:**
Course offers detailed understanding on design of machine tools. Detailed analysis on design of Gear box and mechanical stepless regulations. Design of structural elements, guide ways, power screws, spindle and bearings.

**Course Learning Objectives:**
1. To understand core concepts of Machine Tool Design
2. To understand the selection of different machine tools
3. To understand the basic approach for designing machine tool components and implement the appropriate method.
4. To compute the power requirements of various machine tools.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | **Apply** the concepts of machine tool design. | III | Applying |
| CO2 | **Select** the correct design approach & design the important components of Machine tools. | III | Applying |
| CO3 | **Determine** the forces acting and the subsequent power requirements of machine tools. | V | Evaluating |
| CO4 | **Design** the critical components comprising a manufacturing system & emphasize on the quality of the system. | VI | Creating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | 1 | | | | | | | | | | 1 | 1 |
| CO2 | | 2 | 1 | 3 | | | | | | | | | | 1 |
| CO3 | 2 | | 1 | | | | | | | | | | | |
| CO4 | 1 | | 2 | 1 | | | | | | | | | | 2 |

**Assessments :**
**Teacher Assessment:**
In Semester Evaluation (ISE) is based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc. It is having 100% course content.

| Assessment | Marks |
|---|---|
| ISE | 50 |

**Course Contents:**
**Assignment No. 1** **4 Hrs**
Study of different machine tools from the point of view of types of machine parts.

**Assignment No. 2** **4 Hrs**
Selection Eclectic Motor, V belt, Flat Belt From manufacturer's catalogue

**Assignment No. 3** **8 Hrs**

Design of a gear box for speed and feed drive, design of shafts and gears with assembly drawing.

**Assignment No. 4** **4 Hrs**

Selection of bearings from manufacturer's catalogue

**Assignment No. 5** **4 Hrs**

Exercise on design of machine tools from ergonomic aspects suitable in India.

**Reference**


1) Design of Machine Elements, V. B. Bhandari, Tata McGraw-Hill Publishing Company Ltd.
2) Elements of Machine Design, N. C. Pandya and C. S. Shaha, Charotkar Publishing House
3) Design Data Handbook, K. Mahadevan and Balveera Reddy, C.B.S Publishers & Distributors.
4) Engineering Design, a Materials and Processing Approach, G. Dieter, Tata McGraw-Hill Publishing Company Ltd. Catalogues of Bearing Manufacturers, example, S.K.F, NACHI, TIMKEN, NRB etc.


**Textbooks:**


1) Machine tool design by N.K.Mehta ( TMH ).
2) Principles of machine tools by Gopal Chandra Sen and Amitabh Bhattacharya (New Central Book Agency).
3) Machine Tool Design Handbook, C.M.T.I, Bangalore, (TMH).
4) Design Data Handbook, PSG College of Tech., Coimbatore.
5) Design of Machine Tool, Dr. S. K. Basu (Oxford IBH)
6) Design of Machine Elements, Dobrovalsky..


**Unitwise Measurable outcomes:**

1. Principles and requirements of machine tool design
2. Analysis of forces, Design consideration and selection of standard components
3. Kinematics of Machine Tools, Gear box design.
4. Design of Machine Tool Structures like beds, columns, houses etc.
5. Design of Guide Ways, Power Screws ,Ergonomic and aesthetic considerations
6. Design of Spindle and Spindle Bearings

**Title of the Course: Supply Chain Management (Open Elective -II)**
**Course Code: UOEL0746**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Knowledge of Industrial management and production management.

**Course Description:**
Course comprises of introduction to supply chain, performance drivers and metrics of supply chain, inventory planning and supply chain coordination, network design role in supply chain, strategic alliances in supply chain, supply chain coordination and financial factors.

**Course Learning Objectives:**
1. To explain basics of supply chain management
2. To discuss performance drivers and metrics in supply chain coordination
3. To study economies of scale in SCM and supply chain coordination
4. To explain design considerations in supply chain
5. To illustrate strategic alliances in supply chain
6. To study supply chain integration and financial considerations

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Define concepts of supply chain management | I | Remembering |
| CO2 | Illustrate fundamentals of performance drivers and metrics in supply chain coordination | II | Understanding |
| CO3 | Plan economies of scale in SCM and supply chain coordination | III | Applying |
| CO4 | Examine design considerations in supply chain | IV | Analyzing |
| CO5 | Illustrate strategic alliances in supply chain | II | Understanding |
| CO6 | Identify supply chain integration and financial considerations | III | Applying |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | | | 2 | 1 | | |
| CO2 | 1 | | | 1 | | | | | | | 2 | 1 | 1 | 1 |
| CO3 | 1 | | | | | | | | | | 2 | 1 | | |
| CO4 | 1 | | 2 | | 1 | | | | | | 2 | 1 | 1 | 1 |
| CO5 | | | | | | | | | | | 2 | 1 | | |
| CO6 | | | | | | | | | | | 3 | 1 | | |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |

| | |
|---|---|
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:- Introduction to Supply Chain Management: 06 Hrs**

Building a Strategic framework to Analyze Supply Chains: understanding the supply chain, Objectives, advantages, goals, decision phases of supply chain management, SCM strategies, SCM process, stages of development of buyer, supplier relationship, process view of supply chain, key issues in SCM, SCM challenges in India

**Unit 2:- Supply chain performance drivers and metrics: 6 Hrs**

Introduction, competitive and supply chain strategies, concept of value chain, obstacles to achieving strategic fit, key metrics for measuring supply chain performance, supply chain drivers and obstacles

**Unit 3:- Managing economies of scale and supply chain coordination 7 Hrs**

**Managing economies of scale in a supply chain:** Cycle inventory, managing uncertainty in supply chain: safety inventory, determining optimal level of product availability

**Supply chain coordination:** Introduction, obstacles to lack of supply chain coordination, managerial levers to achieve coordination, Bullwhip effect and origin of concept, causes of Bullwhip effect on performance, collaborative planning, forecast and replenishment

**Unit 4:- Design consideration in supply chain 7 Hrs**

**Supply chain network design:** Introduction, network design role in supply design, reasons for network planning, hierarchical steps in network planning, strategic network design

**Transportation and information technology in supply chain:** Transportation in supply chain, information technology in supply chain

**Unit 5:- Strategic alliances in supply chain 7 Hrs**

Introduction, need for strategic alliance , horizontal, vertical strategic alliance, reasons for strategic alliance, success factors, frame work for strategic alliances, three types of strategic alliance, Role of e-business in SCM

**Unit 6:- Supply Chain integration and Financial considerations 7 Hrs**

**Supply chain integration:**

Concept, vertical, horizontal integration, benefits, supply chain integration model, types, forces driving, challenges in supply chain integration

**Financial factors influencing supply chain decisions:**

Financial evaluation of supply chain decisions, impact of financial factors on supply chain decisions

**Reference**


1) R.H. Ballou, "Supply Chain Management" Pearson[2007] ISBN 8131705846
2) Simchi-Levi, Kaminsky, "Designing and Managing the Supply Chain, Concepts Strategies and Case Studies", 2nd edition, Tata McGraw Hill, ISBN 0-07-058666-7
3) R. Monczka, "Purchasing & Supply Chain Management" Cengage learning business Press.,ISBN 140801744X


**Textbooks:**


1) Sunil Chopra & Peter Meindl, "Supply Chain Management: Strategy, Planning, & Operation", Addison Wesley Long man.
2) J. Vanweela, "Purchasing & Supply Chain Management" Cengage learning(Nov2004) ISBN 1844800245

3) Industrial Engineering and Production Management, Martand Telsang, S. Chand publication
4) Supply Chain Management, Sunil Chopra, P. Meindl, D,V. Kalra, Pearson
Introduction To Supply Chain Management Handfield, Nichols, Pearson Publication

**Unitwise Measurable outcomes:**

1. Explain basics of supply chain management
2. Discuss performance drivers and metrics in supply chain coordination
3. Study economies of scale in SCM and supply chain coordination
4. Explain design considerations in supply chain
5. Illustrate strategic alliances in supply chain
6. Study supply chain integration and financial considerations

**Title of the Course: Project Management**
**(Open Elective-II)**
**Course Code: UOEL0747**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Fundamental knowledge of production management

**Course Description:**
Course comprises of introduction to project management, Project identification, selection and project planning. It covers concepts of project Activities, activity duration, resource requirements and costs. It also introduce about network analysis, project risk management and concept of project execution, control and close-out.

**Course Learning Objectives:**
1. To define concept of project and project management
2. To explain various steps in project identification, selection and project planning
3. To identify details of project activities, durations and project resource requirements
4. To decide appropriate project durations using network analysis techniques
5. To analyze various risks involved in handling projects
6. To develop ability of effective project execution

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Define project and principles of project management | I | Remembering |
| CO2 | Explain process of project identification, selection and planning | II | Understanding |
| CO3 | Identify various project activities, activity durations and details of resource requirements | III | Applying |
| CO4 | Decide appropriate project durations using network analysis | V | Evaluating |
| CO5 | Analyze risks involved in project management | IV | Analyzing |
| CO6 | Develop ability of executing project, controlling and close-out | VI | Creating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | | | 3 | 1 | | |
| CO2 | | | | | | | | | | | 3 | 1 | | 1 |
| CO3 | 2 | 2 | | | | | | | | | 3 | 1 | | 1 |
| CO4 | 2 | 2 | | | | | | 2 | | | 3 | 1 | 1 | |
| CO5 | | | | | | | | 2 | | | 3 | 1 | 1 | |
| CO6 | | | | | | | | 2 | | | 3 | 1 | | |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |

| | |
|---|---|
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/Moodle quiz/Topic seminar/Group Discussions, Industrial case study etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1: Introduction to Project Management** **6 Hrs**

Definition of a Project, Types, Need of Project Management, Principles of Project Management, Project Management Life Cycle: Phases of Project Management, Levels of Project Management, The Project Manager (PM)

**Unit 2: Project Identification, Selection, Planning** **8 Hrs**

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point, Introduction, Project Planning, Need of Project Planning, Roles, Responsibility and Team Work, Project Planning Process, Concept of Organisational Structure in Project Management

**Unit 3: Project Activities, Activity Duration, Resource Requirements & Cost** **6 Hrs**

Work Breakdown Structure (WBS), Uses of WBS, Top-Down/ Bottom-Up Approach, Resource Loading versus Activity Duration, Variation in Activity Duration, Methods for Estimating Activity Duration, Estimation Precision; Resources; Estimating Cost, Determining Resource Requirements.

**Unit 4: Network Analysis** **10 Hrs**

PERT: Introduction to Project Evaluation and Review Technique, Event, Activity, Dummy, Network rules, numbering the events, Cycles; Developing the Network, Planning for network construction, modes of network construction, steps in developing network, hierarchies; Time Estimates in PERT

CPM: Introduction to Critical Path Method, Procedure, Networks, Activity time estimate, Earliest event time, Latest allowable occurrence time, Combined tabular computations for TE and TL, Start & Finish times of activity, Float, Critical activities & Critical path. Crashing of project network

**Unit 5: Project Risk Management** **5 Hrs**

Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks

**Unit 6: Project Execution, Control, Close-out:** **5 Hrs**

Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control, Project Close-out, Steps for Closing the Project, Project Termination, Project Follow-up

**Reference**


1) Mike Field and Laurie Keller, ―Project Management, Thompson Business press, 2002
2) Gido and Clements, ―Successful project management, 2nd edition; Thompson south-western, 2003
3) John M Nicholas, ―Project Management for business and technology, 2nd edition, Pearson Education Asia, 2001
4) Effective Project Management Robert K. Wysocki, Robert Beck. Jr., and David B. Crane; - John Wiley & Sons.
5) Project Planning and Control with CPM and PERT- Dr. B.C. Punamia & K.K.Khandelwal; - Laxmi Publications, New Delhi
6) Total Project Management- The Indian Context- P. K. Joy, - Macmillan India Ltd., Delhi

7) Project Management in Manufacturing and High Technology Operations- Adedeji Bodunde Badiru, - John Wiley and Sons.
8) Course in PERT & CPM- R.C.Gupta, - DhanpatRai and Sons, New Delhi
9) Fundamentals of PERT/ CPM and Project Management- S.K. Bhattacharjee; - Khanna Publishers, New Delhi

**Textbooks:**

1) Prasanna Chandra, ―Projects – Planning, Analysis, Financing, Implementation and Review, Tata McGraw Hill,4th Ed, 1997
2) Bhavesh M Patel, ―Project Management – Strategic Financial planning, Evaluation and control,
3) Vikas publishing house, 2000
4) Project Management- S. Choudhury, - TMH Publishing Co. Ltd, New Delhi

**Unitwise Measurable outcomes:**

1. At the end of the unit student will be able to define concepts related to project and project management
2. At the end of the unit student will be able to explain process involved in identifying project along with selection and planning
3. At the end of the unit student will be able to identify various project activities and details like durations and resources.
4. At the end of the unit student will be able to decide optimum project durations
5. At the end of the unit student will be able to analyze risks in handling projects

**Title of the Course: Major Project Phase-I**
**Course Code:UPRD0751**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 2* | 1 |

**Course Pre-Requisite:**
Domain knowledge from production engineering

**Course Description:**
It covers problem identification, Activity planning for the time frame and division of project responsibility to each student, literature survey, designing methodology, synopsis preparation and data collection.

**Course Learning Objectives:**
The practical implementation of theoretical knowledge gained during study to till date is important for Engineering Education. The student should be able implement their ideas/real time industrial problem/ current application of their engineering branch which they have studied in curriculum. This will definitely help in building the confidence in the student what he has learnt theoretically. The dependent study of the state of the art topics in a broad area of his/her specialization

**Note: *For Project Work a group of eight students shall be considered for workload purpose.**

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Find a need or problem faced by manufacturing industry or by general population that can be solved using knowledge and skills acquired during the program | I | Remembering |
| CO2 | Survey the literature available about the problem chosen to assess various methods to solve it. | IV | Analyzing |
| CO3 | Interpret the problem in terms of production engineering to identify the best methodology to solve the problem | II | Understanding |
| CO4 | Create a prototype solution using the methodology / numerical or simulation model for performance assessment of the solution under the variety of working conditions | VI | Creating |
| CO5 | Compare the performance with available alternatives to judge the extent to which the problem was solved along with pros and cons of the chosen method | V | Evaluating |
| CO6 | Compile and document the entire process of project work using prescribed format. | VI | Creating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | 1 | | | | | | | 1 | |
| CO2 | | 2 | 2 | | 1 | | | | | | | | 1 | |
| CO3 | 1 | 2 | 2 | 2 | | | | | | | | | 1 | |
| CO4 | | 2 | 2 | | 2 | 1 | 1 | | | | | 2 | 1 | 1 |
| CO5 | | | 1 | 1 | | | | | | | | 2 | 1 | |
| CO6 | | | | 3 | 1 | | | 2 | 3 | 1 | 2 | 2 | 3 | |

**Assessments :**

**Teacher Assessment:**

One In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50% weights each

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE (O.E.) | 25 |

ISE is based on presentation/report etc.

As a part of ISE, students are expected to do the literature survey and problem definition, in the area student wishes to do the project. The In-Semester Exam ( ISE) will be carried tentatively after one and half month of commencement of VII-Semester

ESE(O.E):

As a part of ESE, students are expected to get their synopsis approved by respective guide and undergo the oral examination( Power point presentation)

**Course Contents:**

The students in a group of ***not more than FOUR*** will work under the guidance of the faculty member on the project work undertaken by them. The work started in Semester VII will be continued in the Semester VIII and the final submission of the report will be at the end of the Semester VIII.

The project work may consist of-

1.A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.

2.Problem Identification

3.Methodology / Design Documents

4.A synopsis of the selected project work (two to three pages typed on A4 size sheets) will be submitted and assessed by the Project Guide and one more faculty member appointed by the Department / concerned responsible official of the sponsoring industry/Co-guide.

5.Data collection

Activity planning for the time frame and division of project responsibility to each student. An interim report of the work **co**mpleted in Semester VII in the form of workbook /project diary and other relevant documents shall be submitted for the term work. The term work shall be assessed by the Guide and one more faculty member appointed by the Head of the Department. The assessment shall be based on a presentation of the work completed and submission of interim report.

**The oral examination shall be based on the work planned and actually completed in Semester-VII**

**Title of the Course: Quality Management**
**Course Code:UPRD0761**

| L | T | P | Credit |
|---|---|---|---|
| 2 | 0 | 0 | 0 |

**Course Pre-Requisite:**
Course describes about the basics of quality management and focuses of the tools and techniques for quality improvement in all fields of engineering.

**Course Description:**
To enhance the ability implement tools and techniques for improvement in quality.

**Course Learning Objectives:**
1. Student should able to demonstrate to the core concepts and the emerging trends in Quality Management.
2. Student should able select tools and techniques of Quality management for industrial problem-solving.
3. To student should able to demonstrate implementation and documentation requirements for Quality system.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | To describe quality. | II | Understanding |
| CO2 | To use statistical tools and techniques | III | Applying |
| CO3 | To demonstrate quality systems. | IV | Analysing |
| CO4 | To evaluate quality of manufacturing process | V | Evaluating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | | | | | | | 3 | | | | |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | | 2 | 3 | 3 | | | 3 | 2 |
| CO3 | | | 2 | | | | 2 | 2 | 3 | 3 | 1 | 2 | | |
| CO4 | | 2 | | 2 | 2 | 1 | 1 | 2 | 3 | 1 | | 2 | | |

**Assessments :**
**Teacher Assessment:**
Is based on the ESE evaluation only for 100%

| Assessment | Marks |
|---|---|
| ESE | 100 |

**Course Contents:**
**Unit 1:--- Quality Management** **03 Hrs.**
Definition, gurus of TQM, TQM Framework, Historical review, evolution of Total quality management, benefits of TQM.

**Unit 2:--- Statistical Process Control** **07 Hrs.**
Pareto diagram, process flow diagram, cause and- effect diagram, check sheets, histograms, scatter diagrams, statistical fundamentals, control charts for variables, control charts for attributes.

**Unit 3:--- Continuous Process Improvement Tools and Techniques** **03 Hrs.**

The PDCA Cycle, Kaizen, Benching marking, failure mode and effect analysis, Taguchi's loss functions,

**Unit 4: Standard Method of improvement** **04 Hrs.**

Six sigma, quality function deployment , RAM approach Process capability

**Unit 5:-Information Technology in Quality Management** **04 Hrs.**

Introduction to I.T., History, computers & quality function, the internet and other electronic communication, information quality issues, technology of future.

**Unit 6:- Quality Management System** **05 Hrs.**

Benefits of ISO registration, ISO 9000 series, IATF-16969, clauses of ISO 9000 requirements, implementation, documentation, internal audit, registration.

**Textbooks:**


1) Dale H. Besterfiled, "Total Quality Management", Pearson Education Asia
2) Rose, J.E. Total Quality Management, Kogan Page Ltd. 1993.
3) John Bank, The essence of total quality management, Prentice Hall, 1993.
4) Greg Bounds and Lyle Yorks, Beyond Total Quality Management, McGraw Hill, 1994.
5) Masaki Imami, KAIZEN, McGraw Hill, 1986.
6) Phil Crosby, Quality Without Tears, McGraw Hill
7) Six Sigma: Hemant UrdhwareshеStatistical Process Control
8) Total Quality Management, B.SentilArasu, SCITECH publications.
9) Total Quality Management, NVR Naidu, New Age International Publications.
10) Quality Engineering Using Robust Design, Madhav S. Phadke
11) Statistical Quality Control, M. Mahajan, Dhanpat Rai& Co.


**Reference**


1) John Bank, The essence of total quality management, Prentice Hall, 1993.
2) Greg Bounds and Lyle Yorks, Beyond Total Quality Management, McGraw Hill, 1994.
3) Managing For Total Quality ,N. LOGOTHETIS, Prentice Hall


**Unitwise Measurable outcomes:**

1. To define quality and explain the evolution of quality
2. To select and explain tools and techniques for problem solving.
3. To choose and demonstrate the statistical process control.
4. To select and explain management tools used for problem solving
5. To describe a quality system

**Title of the Course: Costing and Cost Control**
**Course Code:UPRD0801**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Basic knowledge of Process Engineering

**Course Description:**
Engineering management relies on the knowledge of engineering economics to be able to evaluate projects from a financial perspective. Optimizing financial performance of a project is a key responsibility of an engineer in the decision making process. This course is designed to present engineering students the major concepts and techniques of costing that are needed in the decision making process. The emphasis of this course is on the analytical analysis of cost calculation of component.

**Course Learning Objectives:**
1. To acquire knowledge of Costing to be able to evaluate component/product from a financial perspective.
2. To apply analytical formulae to determine the cost of a component.
3. To present engineering students the major concepts and techniques of costing and cost control analysis that are needed in the decision making process
4. To emphasize the strong correlation between engineering design and manufacturing of products/systems and the economic issues they involve.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Understand elements of cost, demand and supply. | II | Understanding |
| CO2 | Determine the cost of a component. | V | Evaluating |
| CO3 | Evaluate projects from a financial perspective. | V | Evaluating |
| CO4 | Solve engineering economic analysis problems. | III | Applying |
| CO5 | Demonstrate the effects of depreciation, taxes, inflation and price change. | II | Understanding |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | | | | | | | | 3 | 2 | | 2 |
| CO2 | | 1 | | | | | | | | | 3 | 2 | 1 | 2 |
| CO3 | | | | 1 | | | | | 1 | | 3 | 2 | 2 | 1 |
| CO4 | 1 | | | | | 1 | | | | | 3 | 2 | 1 | |
| CO5 | 1 | | | | | | | 1 | | | 3 | 2 | 1 | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively..

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

**Unit 1:--- Introduction** 06 **Hrs.**

**1.1**Flow in an Economy, Law of Supply and Demand, Types Of Efficiency , Definition and scope of Concept of cost, cost unit, cost centre, classification of cost, Definition of costing, cost-price-profit equation, desirable conditions for a costing system. Cost Estimating: Definition, purpose and functions of Cost Estimation, role ofEstimator, estimating procedures.

**1.2**, Break Even Analysis.

**Unit 2:--- Depreciation** 07 **Hrs.**

**2.1** Elements of Cost, Depreciation Causes of depreciation of assets. Calculation of depreciation values using different methods of depreciation

**2.2** Review of purchasing procedure, recording of stock and consumption of
Material by LIFO, FIFO, Weighted average method. (numerical on above)

**Unit 3:--- Estimation In Machine Shop & Foundry Shop** 07 **Hrs.**

**3.1** Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost. Operation time calculation for turning, knurling, facing, drilling, boring, reaming, threading, milling, tapping, shaping, cutting, various grinding operations, planning etc. Machine Hour Rate Calculation. (Numerical on above)

**3.2**Pattern cost estimation: material, labor, overheads, estimation of foundry costs material,labor other costs

**Unit 4:- Estimation In Forging, Welding And Sheet Metal Work** 07**Hrs.**

**4.1**Forging process: and types, forging operations, Estimation procedure, estimating losses and time.

**4.2**Welding: Type of welding processes types of joints. Preparation cost, Actual welding cost; material, labour, finishing on cost, power cost, factors affecting welding cost. Gas cutting cost: material, labour, finishing on cost.

**4.3**Sheet Metal Work: Operations in sheet metal work, joints, blank layout and size, estimation of time, capacity and types of processes.

**Unit 5:- Fund Management and Taxation** 07 **Hrs.**

**5.1** Sources of funds for business organization
Concepts of wants, scarcity, choice, opportunity cost, demand and supply curves, price determination. Minimum Attractive Rate of Returns, Internal Rate of Returns (IRR)

**5.2**Methods of Overhead Allocation, apportionment, absorption of overheads.(Numerical)

**5.3**Cost Accounting Methods: Job costing, Batch costing, Unit costing, Process costing, Contract

costing, Activity based costing. (numerical)
**5.4 Taxation:** Introduction to Direct and Indirect tax, GST – concepts and general principles

**Unit 6:- Cost Control and Cost Reduction** 06 **Hrs.**

Budgetary control, Budget objectives, classification of budgeting, standard cost, variance analysis, marginal cost, , value analysis and value engineering, Zero Base Budgeting. Time value of money. The cash flow diagram, ZED ( Zero Defect Zero Effect) Concept.

**Textbooks:**

1)Mechanical Estimating and Costing By B.P. Sinha. Tata McGraw Hill Publishing Co. Ltd. N. Delhi
2)Mechanical Estimating and Costing T.R. Banga and S.C.Sharma, Khanna Publishers, Delhi-6

**Reference**

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 (SatyaPrakashan)
8) Mechanical Estimation and Costing – TTTI, Chennai (TMH)
9) Theory & Problems of Management & Cost Accounting – M.Y. Khan, P. K. Jain (TMH)

**Unitwise Measurable outcomes:**

1. Students will be able to distinguish elements of cost.
2. Calculate depreciation and value of stock.
3. Estimate weight of a given component and cost of machining.
4. Explain the process of cost estimation of forging, welding etc.
5. Calculate overhead cost, cost accounting methods.
6. Identify cost reduction techniques and estimation of budget.

**Title of the Course: Operations Research**
**Course Code:UPRD0802**

| L | T | P | Credit |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Pre-Requisite:**
Fundamental knowledge of Probability and Statistics

**Course Description:**
Introduction to operation research, LPP, transportation model, assignment model, Sequencing, Queuing, CPM-PERT and decision making.

**Course Learning Objectives:**
1. Illustrate the need to optimally utilize the resources in various types of industries.
2. Formulate a managerial decision problem into a mathematical model.
3. Demonstrate cost effective strategies in various applications in industry.
4. Analyze optimization models and apply them to real-life problems.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | **Understand** and interpretation of operations research modelling approach | II | Understanding |
| CO2 | **Applying** LPP to various managerial decision making problems. | III | Applying |
| CO3 | **Analyze** and solve engineering and managerial situations as Transportation, Assignment and Sequencing problems. | IV | Analyzing |
| CO4 | **Application** of different Queuing techniques | III | Applying |
| CO5 | **Understand** project management &take decision on projects. | II | Understanding |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | | 2 | | | 2 | | | | | 1 | | |
| CO2 | 2 | 2 | | 1 | | | 1 | | | | | | | |
| CO3 | | 2 | | 2 | | | | | | | | | 2 | |
| CO4 | 1 | 2 | | 1 | | | 1 | | | | | | 2 | |
| CO5 | | 1 | | | 1 | | | | | | 3 | | | 1 |

**Assessments :**
**Teacher Assessment:**
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weight age for course content (normally last three modules) covered after MSE

**Course Contents:**

**Unit 1:--- Introduction to Operations research** 04 **Hrs.**

Scope, applications of operations research, phases and models of operations research, advantages and limitations of operations research

**Unit 2:--- Linear programming** (LPP)- 07 **Hrs.**

Formulation of linear programming problem (LPP), graphical method, simplex method, artificial variable technique- Big M method and two phase method, degeneracy, and procedure for resolving degenerate cases, duality in LPP, primal-dual relationships

**Unit 3:--- Transportation Problem**: 09 **Hrs.**

Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation Problem, Degeneracy in transportation problems, Applications of Transportation problems.

**Assignment Problem**: Formulation, unbalanced assignment problem, Travelling salesman problem.

**Unit 4:- Sequencing** 06**Hrs.**

Johnson's algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs m machines without passing sequence. 2 jobs n machines with passing. Graphical solutions priority rules.

**Unit 5:- PERT-CPM Techniques** 08 **Hrs.**

Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks.

**PERT-** Time estimates, construction of Networks. Probability of completing projects by given dates.

**Unit 6:- Replacement Analysis** 06 **Hrs.**

With and without time value of money, single item and group replacement.

**Decision Theory:** Pay off and regret tables, decision rules, decision under uncertainty and risk, decision tree.

**Textbooks:**


1) Gupta P. K. and Hira D. S.: Operations Research, S Chand & Company Ltd.
2) Sharma S. D., KedarNath : Operations Research, Ram Nath& Co.


**Reference**


1) Taha, H. A. 2007, Operations Research, 8th Edition, Pearson
2) Taylor, B. W. III 2013, Introduction to Management Science, 11th edition, Prentice Hall
3) Schrage, L. 1997, Optimization Modeling with LINDO, 5th edn, Thomson.
4) Winston, W. L. 2004, Operations Research: Applications and Algorithms, 4th edition, Thomson


**Unitwise Measurable outcomes:**

1. Understanding of operations research modelling approach
2. Application of LPP to various managerial decision making problems.
3. Solve engineering and managerial situations relating to Transportation and Assignment problems.
4. Application of different Queuing techniques.
5. Understand project management& Decision making.

**Title of the Course: Major Project Phase-II and Internship**
**Course Code:UPRD0851**

| L | T | P | Credit |
|---|---|---|---|
| - | - | 12 | 6 |

**Course Pre-Requisite:**
Domain knowledge from production engineering

**Course Description:**
**Major Project Phase-II** covers problem data analysis, design calculations, manufacturing/ simulation, results and discussion and documentation and submission of project report.
**Under Internship**, every student should undergo Minimum continues 12 week (3Months) training in industry. Each student should identify a problem from selected industry and try to find out a feasible solution of the same and document its report

**Course Learning Objectives:**
1. Practical implementation of theoretical knowledge gained during study.
2. Implement ideas/real time industrial problem/ current application.
3. Evaluate better solution for selected problem using state of the art topics in a broad area of his/her specialization.
4. Internship helps students to build confidence in handling and finding feasible solution of a real time industrial problem.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | Level | Descriptor |
| CO1 | Find a need or problem faced by manufacturing industry or by general population that can be solved using knowledge and skills acquired during the program | I | Remembering |
| CO2 | Survey the literature available about the problem chosen to assess various methods to solve it. | IV | Analyzing |
| CO3 | Interpret the problem in terms of production engineering to identify the best methodology to solve the problem | II | Understanding |
| CO4 | Create a prototype solution using the methodology / numerical or simulation model for performance assessment of the solution under the variety of working conditions | VI | Creating |
| CO5 | Compare the performance with available alternatives to judge the extent to which the problem was solved along with pros and cons of the chosen method | V | Evaluating |
| CO6 | Compile and document the entire process of project work using prescribed format. | VI | Creating |

**CO-PO Mapping:**

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | 1 | | | | | | | 1 | |
| CO2 | | 2 | 2 | | 1 | | | | | | | | 1 | |
| CO3 | 1 | 2 | 2 | 2 | | | | | | | | | 1 | |
| CO4 | | 2 | 2 | | 2 | 1 | 1 | | | | | 2 | 1 | 1 |
| CO5 | | | 1 | 1 | | | | | | | | 2 | 1 | |
| CO6 | | | | 3 | 1 | | | 2 | 3 | 1 | 2 | 2 | 3 | |

**Assessments :**
**Teacher Assessment:**
In Semester Evaluation (ISE-I and ISE-II) and End Semester Examination (ESE) having 50% weights each

| Assessment | Marks |
|---|---|
| ISE –I | 75 |
| ISE-II | 75 |
| ESE(O.E.) | 150 |

ISE-I : Students are expected to undergo the internship and present their **progress** in front of the committee members. Along with this, it is also expected to give the project progress presentation in front of committee.

ISE-II : Progress presentation

a) Project Phase-II
b) Internship

ESE(O.E) :

a) Submission of dissertation and internship report
b) Viva-voce of project phase-II and internship.

**Course Contents:**

**A) Major Project Phase-II**

The work started in Semester VII will be continued in the Semester VIII and the final submission of the report will be at the end of the Semester VIII.

The project work may consist of-

1. Design of equipment /idea
2. Manufacturing / simulation and testing.
3. Critical Analysis of any design or process for optimizing it.
4. Experimental verification of principles used in applications
5. Agricultural based equipment manufacturing

The report of the work completed in Semester VIII in the form of workbook /project diary and other relevant documents shall be submitted for the term work. The term work shall be assessed by the Guide and one more faculty member appointed by the Head of the Department. The assessment shall be based on a presentation of the work completed and submission of final report.

**B) Internship**

Under Internship, every student should undergo Minimum continues 12 week duration (3Months) training in industry. Each student should identify a problem from selected industry and try to find out a feasible solution of the same and document its report

**The oral examination shall be based on the final reports of project and internship**