**SCHEME OF INSTRUCTION & EXAMINATION**
**AICTE Model Curriculum**
**B. E. VI – Semester (MECHANICAL ENGINEERING)**
**(Proposed for the Academic year 2020-2021)**

| S. No. | Course Code | Course Title | Scheme of Instructions | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hours/Week | CIE | SEE | Duration in Hours | |
| **Theory Course** | | | | | | | | | | |
| 1 | PC413ME | Machine Design | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 2 | PC414ME | Metal Cutting and Machine Tools | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 3 | PC415ME | Finite Element Analysis | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 4 | PE52ME | Professional Elective-II | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 5 | PE53ME | Professional Elective-III | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| 6 | OE61 | Open Elective-I | 3 | - | - | 3 | 30 | 70 | 3 | 3 |
| **Practical / Laboratory Course** | | | | | | | | | | |
| 7 | PC458ME | Metrology and Machine Tools Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 8 | PC459ME | Computer Aided Engineering Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 9 | PW701ME | Summer Internship* | | | | | | 50 | | 2 |
| **Total** | | | | | | | | | | **22** |

| **Professional Elective-II** | | | **Professional Elective-III** | | |
|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **S. No.** | **Course Code** | **Course Title** |
| 1. | PE521ME | Thermal Turbo Machines | 1. | PE531ME | Composite Materials |
| 2. | PE522ME | Production and Operations management | 2. | PE532ME | Product Design And Process Planning |
| 3. | PE523ME | Design For Manufacture | 3. | PE533ME | Power Plant Engineering |

| **Open Elective-I** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1 | OE611ME | Industrial Robotics (Not for Mech. Engg. students) |

**MC**: Mandatory Course **BS**: Basic Science **ES:** Engineering Science
**L**: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

**Note: 1.** Each contact hour is a clock hour

2..The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

** **At the end of VI semester students should undergo Summer Internship. Credits for Summer Internship will be awarded in VII semester.***

**MACHINE DESIGN**

# PC413ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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| 1. Importance of helical coil springs and leaf springs in mechanical systems |
| 2. Understand the design of gears such as spur, Helical and bevelgears |
| 3. How to apply design concepts in bearing design |
| 4. Importance of design procedure in designing IC engine components |
| 5. Utilization of curved beams on mechanical components |

**Outcomes:**

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|---|
| 1. Analyze helical coil springs and leaf springs for mechanical systems |
| 2. Evaluate kinematic transmission systems using gears |
| 3. Select bearing system for specific applications |
| 4. Design various IC engine components |
| 5. Determine load carrying capacity of curved beams |

**Note**: Standard Design data book is allowed in University exam.

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| **Unit-I** |
| Mechanical Springs: function of springs, Types of springs and materials used. Eccentric, Buckling and Surge of Compression Springs. Stress, Energy and Deflection of Helical Springs, Springs in Series and Parallel connection, Concentric or Composite Springs. Leaf Springs: Construction of Leaf Springs Equalized, Stress in Spring Leaves (Nipping) |
| **Unit**-II: |
| Gears: Types of gears and materials used. Standards for gear specifications. design of Spur gears, Helical and Bevel Gears based strength criterion -Lewis equation, Wear considerations, Static and dynamic tooth load, Types of gear tooth failure and preventive measures. Proportions and force analysis of worm gears. |
| **Unit-III** |
| Bearings: Materials used for Bearings. Classification of Bearings. Viscosity of Lubricants Theory of Hydrostatic and Hydrodynamic lubrication. Design of sliding contact bearings - for axial and thrust loads *Rolling Contact Bearings*: Different types of rolling element bearings and their constructional details. Static and Dynamic load carrying capacity, Load-life relationship. |
| **Unit-IV** |
| I.C. Engine Parts: Design of piston, connecting rod and crank shafts when the crank is at dead centre. |
| **Unit-V** |
| Curved beams: Theory of bending of members with initial curvature - rectangular, |

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| circular and Trapezoidal sections. Design of crane Hooks, Machine frames and C-clamps. Advantages and Disadvantages of Chain Drive over Belt or Rope Drive. Terms Used in Chain Drive. Classification of Chains. Velocity Ratio of Chain Drives. |

**Suggested Reading:**

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| 1. V. B. Bhandari, “Design of Machine Elements”, Tata McGraw-Hill Publ, 3rd Edn. 2010. |
| 2. J.E. Shigley & Charles R. Mischke “Mechanical Engineering Design”, Tata McGraw-Hill.,6th ed.2010. |
| 3. P. Kannaiah, Machine Design, Sci-Tech Publ., 2009. |
| 4. P.C. Sharma & D.K. Aggarwal, "Machine Design", S.K. Kataria & Sons, 10th edn, 2003 |
| 5. V. B. Bhandari, “Design Data Book ” 2nd edition, ”, Tata McGraw-Hill Publ, 2019 |

**Data Handbook:**

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|---|
| 1. K. Balaveera Reddy and K. Mahadevan “Design Data Handbook for Mechanical Engineers in Si and Metric Units”4$^{th}$ Edition, CBS Publishers & Distributors, 2018. |
| 2. Design Data: Data Book of Engineers By PSG College. |

**Note** : Solution of Numerical problems using Design data book should be practiced

**METAL CUTTING & MACHINE TOOLS**

# PC414ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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|---|
| 1. To learn the tool material, geometry and mechanics of metal cutting for turning, drilling and milling. |
| 2. To know the heat distribution, tool wear, tool life, and machinability |
| 3. To learn the principle and working of various machine tools like lathe, shaper, planer, milling, drilling and grinding machines etc. |
| 4. To learn various types of fixtures, conventional and unconventional machining processes. |

**Outcomes:**

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|---|
| 1. Understand the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting. |
| 2. Understand the thermal aspects of metal cutting, influence of tool wear on tool life and machinability. |
| 3. Identify basic parts and operations of machine tools including lathe, shaper, planer, milling, drilling, and boring machines. |
| 4. Design locating and clamping devices to produce a component. |
| 5. Understand the principles of various finishing processes and gear manufacturing processes |
| 6. Understand the principle and working of various unconventional machining processes. |

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| **Unit-I** |
| **Cutting Tool Materials:** High carbon steel, HSS, Stellites, Carbides, Coated carbides, Diamonds, Tool material properties; **Tool Geometry:** Nomenclature of single point cutting tool by ASA & ORS systems. Geometry of drills, milling cutters; **Chip Formation:** Types of chips, BUE, Chip breakers; **Machining:** Orthogonal and oblique cutting, Mechanics of metal cutting, Merchant's analysis, Shear angle, Solutions of Merchant and Lee & Shafer |
| **Unit**-II: |
| **Thermal Aspects of Metal Cutting:** Sources of heat and heat distribution, various methods of measurement of temperature, Cutting fluids and applications; **Tool Wear, Tool Life and Machinability:** Types of wear, mechanism of tool wear, Tool life & Machinability, Machinability index. Taylor's tool life equation; **Economics of Machining:** Optimum Cutting Speeds for maximum production rate and minimum cost. |
| **Unit-III** |
| **Machine Tools:** Constructional features and specifications of machine tools, various operations on Lathe, Types of Lathes - capstan and turret Lathes; Drilling, Milling and Boring machines. Indexing methods, differences between shaper, planer and slotter, Tool holding and work holding devices Quick return mechanisms. |
| **Unit-IV** |
| **Grinding Machines:** Types of grinding, Abrasives and bonds used for grinding wheels. |

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| Specification and selection of grinding wheels; Broaching, Lapping, Honing, Polishing, Buffing, Super Finishing and Burnishing.<br>**Screws and Gear Manufacturing:** Tapping, Chasers, Thread rolling, Thread milling, Thread grinding. Gear shaping, Gear hobbing, Gear shaving and grinding. |
| **Unit-V** |
| **Jigs and Fixtures:** Design principles for location and clamping. Quick clamping devices Types of Jigs and fixtures. Applications of Jigs and Fixtures.<br>**Unconventional Machining:** Principle of working, merits, demerits and applications of USM, AJM, EDM, ECM, LBM and EBM |

**Suggested Reading:**


1. B.L. JuneJa and Shekon, "Fundamentals of Metal Cutting & Machines Tools", Wiley Eastern Ltd. 1987.
2. P.N. Rao, "Manufacturing Technology – Metal Culling & Machine Tools", Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Amitab Ghosh and Mallick, "Manufacturing Science", Affiliated East West Press 1985.
4. P.K Misha, "Non Traditional Machining Processes", Narosa Publications, 2006.
5. V.K.Jain "Advanced Machining Processes" Allied Publishers, Hyderabad, 2011.
6. A. Bhattacharyya, "Metal Cutting Theory and Practice" New Central Book Agency (P) Ltd. Calcutta, 1996.
7. Stephan Radavich, "Gear Manufacturing", CRC Press, ,1 Edn,2011

**FINITE ELEMENT ANALYSIS**

# PC415ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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| 1. Equip the students with the Finite Element Analysis fundamentals and formulations |
| 2. Enable the students to formulate the axial, truss, beam and 2d problems |
| 3. Enable the students to formulate the heat conduction and dynamics problems |
| 4. Able to understand use of numerical integration and Gaussian quadrature |
| 5. Enable the students to perform engineering simulations using FE software (ANSYS) |

**Outcomes:**

| By the end of this course, the students will be able to |
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| 1. Summarize basic equations of elasticity and formulate finite element modelling of one dimensional element using Potential energy approach. |
| 2. Formulate finite element modelling of truss and frame elements along with the concepts of transformation from local to global matrices. |
| 3. Interpolate Hermitian shape function of beam element in natural coordinate system. |
| 4. Develop stiffness matrix for a plane stress & plane strain conditions on a CST, Axisymmetric elements by interpolating shape functions in natural coordinate system. |
| 5. Formulate finite element model to steady state heat transfer analysis using one & two dimensional elements. |
| 6. Formulate mass and stiffness matrices of 1D & beam elements to establish Eigen values &Eigen vectors using Lagarangian and Hamilton principles |

| **Unit-I** |
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| **Introduction:** Introduction to Finite Element Method for solving field problems, Stress and Equilibrium, Boundary conditions, Strain, Displacement, Stress-Strain relations.<br>**One dimensional problems:** Finite element modelling coordinates and shapes functions, Potential Energy approach: Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Galerkin's approach, Quadratic shape functions. |
| **Unit**-II: |
| **Analysis of trusses and frames:** Element stiffness matrix for a truss member, Analysis of plane truss with two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node, Analysis of Beams: Element stiffness matrix for two nodes (two degrees of freedom per node). |
| **Unit-III** |
| Finite element modelling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modelling of axi-symmetric solids subjected to axi-symmetric loading with triangular elements. |
| **Unit-IV** |
| Two dimensional four noded iso-parametric elements and numerical integration. Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate, Analysis of circular shaft subjected to torsion. |

| **Unit-V** |
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| **Dynamic Analysis:** Formulation of finite element model, element matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and a beam, Time dependent field problems: Application to one dimensional heat flow in a rod. Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements. Introduction to Finite Element Analysis Software. |

**Suggested Reading:**


1. G. Ramamurthy, Applied Finite Element Analysis, I.K. International Publishing House Pvt.Ltd., New Delhi, 2009.
2. Tirupathi R, Chandraputla and Ashok D Belagundu, Introduction to Finite Elements in Engineering, PHI,1997.
3. Rao S S, The Finite Element Method in Engineering, Pergamon Press, 1989.
4. Segerlind L J, Applied Finite Element Analysis, Wiley Eastern, 1984.
5. Reddy JN, An Introduction to Finite Element Method, McGraw-Hill, 1984.

*For the academic years 2020-2024*

**THERMAL TURBO MACHINES**

# PE521ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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|---|
| 1. Understand isentropic flow for variable areas and relations |
| 2. Understand and apply fanno flow, Rayleigh flow and shock flow. |
| 3. Understand centrifugal and axial flow compressor with velocity triangles |
| 4. Understand and analyze impulse and reaction steam turbines with velocity triangles |
| 5. Understand and analyze gas turbines and rocket propulsion. |

**Outcomes:**

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|---|
| 1. Analyze situations of Thermal gradients in Turbo machines and apply the situation of fluid flow analysis with energy conversion principles for work transfer. |
| 2. Develop knowledge about working principles of work absorption and work producing situations |
| 3. Understand applications of Thermodynamics with fluid flow behavior and compressibility effects |
| 4. Attain knowledge of Power production using External combustion engines, with methods of improving efficiencies |
| 5. Demonstrate the learnt fundamentals in applying for real time situations such as undertaking final dissertation projects on Thermal turbo Machines and power plants with knowledge of International standards and testing. |
| 6. Establish and compute one dimensional thermodynamic analysis of Compressors, Turbines (both for air & Vapour working fluids) and analyzing using velocity triangles for single and multi stages. |

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| **Unit-I** |
| **Introduction to compressible flows:** Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow.<br>Isentropic flow with variable area, Mach number variation, Area ratio as function of Mach number, flow through nozzles and diffusers.<br>Flow in constant area ducts with friction-Fanno flow, variation of flow properties, variation of Mach number with duct length, isothermal flow with friction. |
| **Unit**-II: |
| **Flow in constant area duct with Heat Transfer**, -The Rayleigh liner, Rayleigh flow relations, variation of flow properties, Maximum heat transfer.<br>Flow with Shock Waves-Development of Normal Shock waves, governing equations, Prandtl -Meyer relation, Rankine-Hugoniot equations, Stagnation pressure ratio across shock. |
| **Unit-III** |
| **Blade nomenclature of an aerofoil, Rotodynamic compressors:** Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities, Thermodynamic cycles and work done,calculation of various efficiencies. Velocity diagrams and prewhirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling. |
| **Unit-IV** |

**Steam Turbines:** Classification, flow over blades, pressure velocity variations, Compounding of steam turbines- pressure compounding, velocity compounding and pressure-velocity compounding, Impulse turbine with several blade rings, Nozzle efficiency, Blade efficiency and Gross stageefficiency of Impulse turbine, Velocity diagrams for Impulse turbine-De Laval Turbine, blade efficiency of Impulse turbine, Optimum blade speed ratio, Maximum work done and blade efficiency of Impulse turbine, Degree of reaction of Reaction turbine, Parson Reaction turbine, Velocity diagram for Parson Reaction turbine, blade efficiency of Parson Reaction turbine, Maximum work done and blade efficiency of Parson Reaction turbine, Height of blades of Reaction turbine, Balancing of End thrust.

**Unit-V**

**Gas Turbines:** Applications and Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, Maximum pressure ratio in terms of temperature ratio, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance- Inter-cooling, Reheating and Regeneration. Simple Problems on Joule cycle.

**Air Craft Propulsion:** Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines, Rocket Propulsion: Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications.

**Suggested Reading:**


1. Yahya S M, *Fundamentals of Compressible Flow,* New Age International Publishers, Third Edition, 2007.
2. Mathur ML, & Mehta F S, *Thermal Engineering,* Jain Brothers, New Delhi, 2003.
3. Dennis G Shepherd, *Aerospace Propulsion,* Elsevier Publishing Company, New York, 1995.
4. CohenH Rogers G F C, SaravanaMutto H I H, *Gas Turbine Theory,* Longman 5th Edition, New York, 2004.
5. Ganeshan V, *Gas Turbines*, Tata Me Graw Hills, New Delhi, 2003
6. Yadav, R *Steam and Gas Turbines*, Central Publishing House Ltd, Alllahabad, 2003.

**PRODUCTION AND OPERATION MANAGEMENT**

# PE522ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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| 1. To understand the concept of Production & Operations Management. |
| 2. To understand role of work study and work measurement in Industry. |
| 3. To learn use of forecasting and various methods of it. |
| 4. To understand importance Aggregate planning, Materials Requirement Planning for Industry. |
| 5. To understand Project Management approaches in completion of Project. |

**Outcomes:**

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|---|
| 1. Explain various types of Production Systems, develop suitable layout for a given plant |
| 2. Develop various methods for work study and apply suitable Recording techniques. Develop standard procedures and time for the operations. |
| 3. Explain necessity of Forecasting and various methods of it. Develop suitable quantitative forecasting technique for the given past data. Compare accuracy of models in connection with forecast errors. |
| 4. Explain Aggregate planning & Mater scheduling, Materials Requirement Planning Processes. Develop quantitative models for Material requirement and resources based on time span. |
| 5. Elaborate the usages of PERT/CPM techniques for a give project and develop suitable quantitative model for the project in successful competition by identifying the time constraints for start and endof process activities. |

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| **Unit-I** |
| **Production & Operations Managemen**t: Introduction, Types of production Systems. Job shop, Batch, Flow shop.<br>**Plant location and layout**: Factors affecting plant location, Break even analysis, plant layout objectives, Types of layouts, merits and demerits. |
| **Unit**-II: |
| **Work Study:** Introduction to method study, Steps in method study, Recording techniques- Flow process chart, String diagram, Therbligs, Principles of motion economy.<br>**Work measurement**: Stop watch time study, Standard time calculation. Work sampling-procedure, applications, advantages and disadvantages, Wages and incentives, types of incentive plans. |
| **Unit-III** |
| **Forecasting:** Introduction, Forecasting objectives and uses, demand patterns, Qualitative models Market survey, Delphi Tech, Quantitative models, Moving average, Weighted moving average, Simple exponential smoothing, trend adjusted exponential smoothing, Least square method, Simple regression, multiple regression.<br>**Forecast errors:** Mean absolute Deviation (MAD), Mean Square Error (MSE), Mean |

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| Forecast Error(MFE), Mean absolute percentage error (MAPE). |
| **Unit-IV** |
| **Aggregate Planning and Master Scheduling:** Introduction, objectives of aggregate planning, Cost in aggregate planning, Strategies in aggregate planning, Master production scheduling.<br>**Materials Requirement Planning MRP 1**: Importance of MRP, MRP system inputs and outputs, MRP calculations<br>**Manufacturing Resource Planning MRP 2 & Enterprise Resource Planning (ERP):** Features of ERP packages like SAP, BANN, People soft etc., |
| **Unit-V** |
| **Project Management:** Project management: Network fundamentals, difference between PERT/CPM Scheduling the activities. Fulkerson's rule. Earliest and latest times. Determination of ES and EF in the forward path. LS and LF in backward path. Determination of critical path. Free float, independent float, Total float, Program evaluation and review technique, crashing of network. |

**Suggested Reading:**


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|---|
| 1. Joseph Monk, *Operations Management*, TMH Publishers, New Delhi, 2004. |
| 2. Buffa Elwood S, *Modern Production / Operations Management,* John Wiley Publishers, Singapore, 2002. |
| 3. Everett E Adam, Jr and Ronald J. Ebert, *Production and Operations Management – Concepts, Models and Behaviour,* 5th Ed. 1998, (EEE), Prentice Hall of India(P) Ltd., New Delhi. |
| 4. Panneer Selvam R, "*Operations Research*", Second Edition, PHI Learning Pvt. Ltd. New Delhi, 2006. |
| 5. S.D. Sharma, "*Operations Research*", Kedarnnath, Ramnath & Co., Meerut, 2009. |

**DESIGN FOR MANUFACTURE**

# PE523ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

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|---|
| 1. To understand and applications of the basics and working principles of manufacturing. |
| 2. To grasp the knowledge of basic mechanical components and design the simple components. |
| 3. To learn the knowledge of design of different types of machine components to meet varied functional and operational requirements. |

**Outcomes:**

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|---|
| 1. To recognize the strength and mechanical factors of metals and non metals. |
| 2. To understand the design of metallic components and its processes. |
| 3. To understand the advanced design of metallic and non metallic components. |
| 4. To recognize the design of non metallic assembled mechanical components. |
| 5. To understand the varies assemblies and part design with automation. |

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| **Unit-I** |
| Introduction: General design principles for manufacturability, strength and mechanical factors, mechanisms selection, evaluation method, geometrical tolerances, tolerances control and utilization. Economic Use of Raw Materials: Ferrous steel, hot rolled steel, cold finished steel, stainless steel,non ferrous materials aluminium, copper, brass, non metallic materials, plastics, rubber and composites. |
| **Unit**-II: |
| Metallic components design: metal extrusion. Metal stamping , , spring and wire forms, spun metal parts, cold headed parts, tube and section bends, rolled formed parts, power metal parts, forging electro forming parts, special forming methods. |
| **Unit-III** |
| Metallic components design: Turned parts, machined round holes, drilled parts and milled parts. Planned shaped and slotted parts, screw threaded contoured and internal ground parts, center less ground, Electrical discharged, electro chemical and advanced machine parts. |
| **Unit-IV** |
| Non metallic components design: Sand cast , die cast, investment cast and other cast products, injection moulded and rotational moulded parts, blow moulded, welded plastic articles, ceramics. |
| **Unit-V** |
| Assembled parts design: bolted connections, welded parts, arc, resistance , brazed and soldered parts, gear box assembly, bearing assembly, flanged connections, press fitted connections, surface finishing, plated parts, Heat treated parts, NC machining , Group technology, low cost automation, computer aided manufacture, product design requirements. |

**Suggested Reading:**


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|---|---|
| *1* | *Hand book of product design for manufacturing by James G.Bralla, MC Graw Hill Co., 1986.* |
| *2* | *Knowledge based design for manufacture by K.G. Swift, Kogan page limited, 1987.* |
| *3* | *Design for manufacturability by David M. Anderson, Productivity Press, 2014.* |
| *4* | *Design for Manufacturability Handbook, McGraw-Hill Handbooks,1998.* |
| *5* | *Product Design for Manufacture and Assembly by Geoffrey Boothroyd, CNC Press, 2010* |

**COMPOSITE MATERIALS**

# PE531ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

| The objectives of this course are to: |
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| 1. Discuss the basic structure of composites |
| 2. Define Elastic constants and Hygro-thermal stresses |
| 3. identify stress-strain relations in composites |
| 4. Describe the behaviour and Design with composites |
| 5. Demonstrate the basic equations of plate bending |

**Outcomes:**

| On completion of the course the student will be able to: |
|---|
| 1. demonstrate knowledge of composites and their structure |
| 2. predict the Elastic constants and Hygrothermal stresses |
| 3. analyse the stress - strain relationship in composites |
| 4. summarise and apply the Design procedure and the failure criteria. |
| 5. formulate Plate bending equations for various Boundary conditions of composite plates. |

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| **Unit-I** |
| **Introduction:** Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composite, carbon fibre composites. |
| **Unit**-II: |
| **Micromechanics of Composites:** Mechanical Properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre. |
| **Unit-III** |
| **Macromechanics of Composites:** Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams. |
| **Unit-IV** |
| **Strength, fracture, fatigue and design:** Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de- lamination failure, fatigue of laminate composites, Effect of variability of fibre strength.<br>**Strength of an orthotropic lamina:** Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials. |
| **Unit-V** |
| **Analysis of plates and stress:** Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite material. Analysis of composite |

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| cylindrical shells under axially symmetric loads. |

**Suggested Reading:**


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| 1. Jones, R.M., ‘Mechanics of Composite Materials’, Mc-Graw Hill Co., 1967. |
| 2. Calcote, L.R., ‘The Analysis of Laminated Composite Structures’, Van Nostrand, 1969. |
| 3. Whitney. I.M., Daniel, R.B. Pipes, ‘Experimental Mechanics of Fibre Reinforced Composite Materials’, Prentice Hall, 1984. |
| 4. Hyer. M.W., ‘Stress Analysis of Fibre-Reinforced Composite Materials’, McGraw Hill Co., 1998. |
| 5. Carl. T. Herakovich, ‘Mechanics of Fibrous Composites’, John Wiley Sons Inc., 1998. |

*For the academic years 2020-2024*

**PRODUCT DESIGN AND PROCESS PLANNING**

# PE532ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

| A student shall understand |
|---|
| 1. The Product Design and Process Functions |
| 2. The essence of innovation in product development |
| 3. The Human Machine Interactions (ergonomics) |
| 4. The various Intellectual Property Rights |
| 5. The interaction between Design, Manufacturing, Quality and Marketing |
| 6. The awareness about overall view of Process Planning |

**Outcomes:**

| At the end of the course, the students will be able to |
|---|
| 1. Identify the functions of design of a product in a system in a given situation and select a suitable product; identify the procedure for technological innovation of a product; explain the importance of brainstorming and Delphi techniques in innovation |
| 2. Explain the importance of design, human machine interaction in project selection and evaluation methods including ergonomic considerations |
| 3. Explain the importance of research in new product development; describe the process of patenting including search of patents, patent laws and international code and discriminate the scope of IPR for a product patent. |
| 4. Discuss the features of design of a new product with respect to manufacture, quality testing and marketing; and steps to evaluate a new product for introduction; |
| 5. Develop process planning including creating process sheets; explain value engineering, group technology and concurrent engineering in the selection of manufacturing process. |

| **Unit-I** |
|---|
| Product Design and Process Design functions. Selection of right product. Systematic procedure of product innovation. Factors contributing to successful technological innovation - need for creativity and innovation. Techniques of innovation like brain storming and Delphi techniques. |
| **Unit**-II: |
| Project Selection and Evaluation: Function of design - Design with Human Machine Interaction (HMI). Collection of ideas and purpose of project. Selection criteria - screening ideas for new products using evaluation techniques. Principles of ergonomics. |
| **Unit-III** |
| New Product Development: Research and new product development. Patents, definitions, patent search, patent laws, international code for patents -Intellectual Property Rights (IPR). |
| **Unit-IV** |
| New - Product Planning: Interaction between the functions of design, manufacture, quality & testing and marketing. Steps for introducing new products after evaluation. Product Design Practice and Industry – *Product Strategies, Analysis of the Product, The Three S's.* |
| **Unit-V** |

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|---|
| Process-Planning: Process planning, process sheets. Selection of manufacturing process, estimation of machining time in various cutting operations - estimation of costs for manufacture. Value engineering in<br>product design, group technology, concepts of concurrent engineering. |

**Suggested Reading:**


| |
|---|
| 1. Niebel BW & DraperAB: "*Production Design & Process Engg*.", McGraw Hill, Kogakusha, 1974. |
| 2. Chitale, A. K & Gupta R.C., "*Product Design & Manufacturing*" -PHI, 1997 |
| 3. Harry Nystrom, "*Creativity and Innovation*", John Wiley & Sons, 1979. |
| 4. Brain Twiss, "*Managing Technological Innovation*", Pittman Publ, 1992. |
| 5. Harry, B. Waton, "*New Product Planning*", Prentice Hall Inc., 1992 |
| 6. G Dieter, "*Engineering Design - a materials and processing approach*", McGraw Hill, NY, 2000 |

*For the academic years 2020-2024*

**POWER PLANT ENGINEERING**

## PE533ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

| Student has to understand the |
|---|
| 1. Operation of steam turbine and gas turbine power plants |
| 2. About hydraulic power plant, hydrology, dams and spillways |
| 3. Various types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor |
| 4. The power plant economics |
| 5. The environmental and safety aspects of power plant operation. |

**Outcomes:**

| At the end of the course, the students will be able to demonstrate |
|---|
| 1. Select coal and ash handling methods for a coal fired power plant. |
| 2. Comprehend basic working principle of steam and gas turbine power plant |
| 3. Classify Dams and Spillways. |
| 4. Demonstrate the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized- water, boiling-water, and heavy-water reactors. |
| 5. Analyse load factor, capacity factor, average load and peak load on a power plant. |
| 6. Illustrate the control methods of major pollutants emitted from fossil-fuel power plants. |

| **Unit-I** |
|---|
| Introduction to Sources of Energy-Resources and Development of Power in India. Steam ***Power Plant:*** Plant layout, working of different Circuits, Fuel and handling equipment, types of coal, coal handling, choice of handling equipment, coal storage, ash handling systems. |
| **Unit**-II: |
| ***Combustion Process:*** Properties of coal- overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers, and heat rejection, corrosion and feed water treatment.<br>***Gas Turbine Power Plant:*** Introduction -Classification-Layout with Auxiliaries-Principles of working of closed and open cycle gas turbines |
| **Unit-III** |
| ***Hydro Electric Power Plant:*** Water Power-Hydrological cycle, flow measurement- drainage area Characteristics-Hydrographs-storage and pondage- classification of dams and spill ways |
| **Unit-IV** |
| ***Nuclear Power Station:*** Nuclear fuel-breeding and fertile materials -Nuclear reactor-reactor Operation- Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas-cooled reactor.<br>Radiation hazards and shielding -radioactive waste disposal. |
| **Unit-V** |
| ***Power Plant Economics and Environmental Considerations:*** Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, |

| |
|---|
| average load and load factor,delivery factor-related exercises Effluents from power plants and impact on environment -Pollutants and Pollution Standards -Methods of pollution control |

**Suggested Reading:**


| |
|---|
| 1. Rajput, RK, *A Text Book of 'Power Plant Engineering*, 3rd Edition. Laxmi Publications, New Delhi. |
| 2. Arora SC, Domukundwar S, *A Course in Power Plant Engineering,* Dhanpat Rai & Sons, New Delhi. |
| 3. YadavR, *Steam & Gas Turbines and Power Plant Engineering,* 7th Edition, Central Publishing House, Allahabad, 2007. |
| 4. Nag P K, *Power Plant Engineering,* 2nd Edition, Tata McGraw Hills Co. Ltd, New Delhi, 2002. |
| 5. Wakil M M, *Power Plant Technology*, Me Graw Hill Publications, New york, 2005. |

**INDUSTRIAL ROBOTICS**

# OE611ME

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits : 3*

**Objectives:**

| |
|---|
| 1. To familiarize the student with the anatomy of robot and their applications. |
| 2. To provide knowledge about various kinds of end effectors usage. |
| 3. To equip the students with information about various sensors used in industrial robots. |
| 4. To make the student understand the importance of spatial transformation of robots using forward and inverse kinematics. |
| 5. To specify and provide the knowledge of techniques involved in robot vision in industry. |
| 6. To equip students with latest robot languages implemented in industrial manipulators. |

**Outcomes:**

| |
|---|
| 1. Able to demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics and have an understanding of the functionality and limitations of robot actuators and sensors. |
| 2. Able to demonstrate an ability to apply spatial transformation to obtain forward/Inverse kinematics equation of robot manipulators using analytical/numerical/simulation tools. |
| 3. Able to apply knowledge and choose the best & economically suitable sensors/end effectors required for specific applications. |
| 4. Able to understand the importance of robot vision and apply the learnt techniques to get the required information from input images. |
| 5. Able to design and develop a industrial robot for a given purpose economically. |
| 6. Appreciate the current state and potential for robotics in new application areas. |

| |
|---|
| **Unit-I** |
| **Introduction to Robotics:** Basic structure of Robots. Degree of freedom of Robots, Work envelope, Classification of Robots based on Drive Technology, Work-Envelope and motion control methods. Application of Robots in Industry, Repeatability, Precision and Accuracy as applied to Robots, Specifications of robots used for various applications. End effectors, Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, Two fingered and three fingered grippers, internal grippers and external grippers, Selection and design considerations |
| **Unit**-II: |
| **Requirements of a Sensor:** Principles and Applications of the following types of sensors- Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors), Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters), Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors), Touch sensors (Binary sensors, Analog sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. |
| **Unit-III** |

| |
|---|
| **Kinematic Analysis of Robots:** Rotation matrix. Homogeneous transformation matrix, Denavit & Hartenberg representation, Euler and RPY angles representation. Representation of absolute position and orientation in terms of joint parameters, Direct Kinematics of manipulators, Inverse kinematics of Robot arm for position and orientation. Redundancy in Robots, Static force analysis |
| **Unit-IV** |
| **Introduction to Techniques used in Robot Vision:** Image acquisition, illumination techniques, imaging geometry, basic relationship pixels, preprocessing, segmentation & description of 3- dimensional structures, their recognition and interpretation. Types of Camera, frame grabbing, sensing and digitizing image data, Signal conversion, Image Storage, Lighting techniques, Image processing and analysis, Data reduction, Segmentation, Feature extraction, Object recognition, and various algorithms, Applications, Inspection, identification, visual serving and navigation. |
| **Unit-V** |
| **Robot Programming Languages:** Characteristics of robot level languages, task level languages. Teach pendant programming, Lead through programming, Robot programming languages, VAL programming, Motion commands, Sensor commands. End effecter commands, Simple programs. RGV, AGV, Implementation of robots in industries, various steps, Safety considerations for robot operations. Economic analysis of robots, Pay back method, EUAC method and Rate of return method |

**Suggested Reading:**


| |
|---|
| 1. Groover M P, "Industrial Robotics", McGraw Hill Publications, 1999. |
| 2. Fu. K.S., Gon Zalez R.C., Lee C.S.G. "Robotics, Control-sensing vision and Intelligence", McGraw Hill, Int. Ed., 1987. |
| 3. Spong and Vidyasagar, "Robot Dynamics & Control", John Wiley and Sons, Ed.,1990. |
| 4. Mittal and Nagrath, "Industrial Robotics", Tata McGraw Hill Publications, 2004. |
| 5. Saha & Subir kumar saha, ‘Robotics’, TMH, India. |

**METROLOGY & MACHINE TOOLS LAB**

# PC458ME

*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits : 1*

**Objectives:**

| |
|---|
| 1. To have knowledge of various precision measuring instruments. |
| 2. To familiarise machining and metal cutting operations. |

**Outcomes:**

| After completing this course, the student will be able to: |
|---|
| 1. Select and apply the knowledge of measuring tools for external, internal and angular measurements for promoting the qualitative production management. |
| 2. Adapt the principles of optical measurements in measurement of screw and gear profiles. |
| 3. Choose and practice the appropriate methods of force measuring devices principles for required situation. |
| 4. Demonstrate the need of machine alignment test for qualitative production. |
| 5. Practice calibration principles for maintaining the required precision of instruments / tools. |
| 6. Select and practice the methods of temperature measurement. |
| 7. Select cutting tool materials and tool geometries along with appropriate cutting conditions for different work materials and grind the cutting tools to the required geometry. |
| 8. Recognize and summarize the features and applications of various machine tools like Lathe, Milling, Drilling, Grinding, Shaping, Slotting etc. |

| **List of Experiments:** |
|---|
| A) Metrology & Instrumentation: |
| 1. Measurement with inside, outside and depth micrometers, Vernier calipers and Height gauges. |
| 2. Measurement of roundness errors with Bench Centres, V-block and dial guage. |
| 3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope: Flat specimens.Plain cylindrical specimens with centers and threaded components. |
| 4. Measurement of angles with Sinebar, Bevel protractor and Precision level. |
| 5. Measurement with Dial Indicator / Electrical Comparator / Mechanical Comparator / Dial Bore Gauge / Snap Gauge/Plug gauges. |
| 6. Calibration and Force measurement with Strain gauge type load cell/Proving Ring/spring type sensor |
| B) Machining Operations: |
| 1. Thread cutting exercise on lathe machine as single start and multi start threads. |
| 2. Typical exercises on lathe machine (Turning,Step turning,Facin,Parting off &Taper turning). |
| 3. Typical exercises on shaper, cylindrical grinding machine. |
| 4. Exercise of simple gear manufacturing on milling machine. |
| 5. Production of threads with taps and threading dies and milling cutters. |
| C) Metal Cutting: |
| 1. Estimation of shear angle by measuring thickness and length of chips. |
| 2. Measurement of Cutting forces with Lathe tool dynamometer and determination of friction angle and stresses on shear plane and rake plane. |
| 3. Study of geometrical tests on lathe machine. |

**Note:** At least ten experiments should be conducted

**COMPUTER AIDED ENGINEERING LAB**

# PC459ME

*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 25 marks* *SEE: 50 marks*
*Credits : 1*

**Objectives:**

| |
|---|
| 1. To introduce fundamentals of the analysis software, its features and applications. |
| 2. To learn the basic element types in Finite Element analysis. |
| 3. To know the concept of discretization of continuum. Loading conditions and analyze the structure using pre-processor and postprocessor conditions. |

**Outcomes:**

| **Course Outcomes:** |
|---|
| 1. Classify the types of Trusses (Plane Truss & Spatial Truss) and Beams (2D & 3D) with various cross sections to determine Stress, Strains and deflections under static, thermal and combined loading |
| 2. Generalized Plane stress, plane strain conditions & axi-symmetric loading on inplane members to predicting the failure behavior and finding the SCF |
| 3. Analyse connecting rod with tetrahedron and brick elements, performing static analysis on flat & curved shells to determine stresses, strains with different boundary conditions. |
| 4. Predict the natural frequencies and modes shapes using Modal, Harmonic analysis. Also finding the critical load using Buckling analysis |
| 5. Simulate steady state heat transfer analysis of chimney, Transient heat transfer of castings, Non linear, Buckling analysis of shells CFD analysis |
| 6. Evaluate the stiffness matrix, B matrix and loading matrices of beam in plane/solid elements using MATLAB / Python software |

**List of Experiments**

| |
|---|
| 1. Analysis of Plane Truss & Spatial Truss with various cross sections and materials to determine member forces, member strains & stresses, joint deflections under static, thermal and combined loading. |
| 2. 2D & 3D beam analysis with different sections, different materials for different loads (forces and moments with different end supports. |
| 3. 1D, 2D and 3D meshing with different element sizes for different CAD geometry (Proposed Experiment) |
| 4. Static analysis of plates with a hole to determine the deformations, the Stresses to study the failure behavior and SCF. |
| 5. Plane stress, plane strain and axi-symmetric loading on the in plane members with in plane landing to study the stresses and strains. |
| 6. Static analysis of connecting rod with tetrahedron and brick elements |
| 7. Buckling analysis of plates, shells and beams to estimate BF and modes. |
| 8. Modal analysis of beams, plates and shells for natural frequencies and mode shapes |

| |
|---|
| 9. Harmonic analysis of a Shaft subjected to periodic force and transient analysis of plate subjected to stepped and ramped loading with varying time . |
| 10. Steady state heat transfer Analysis Cross section of chimney and transient heat transfer analysis of solidification of castings. |
| 11. Flow analysis of pipe with different fluids/gasses/air for velocity and pressure gradients. |
| 12. CFD analysis of aerofoil design. |
| 13. CFD analysis of ducts/impeller/fan. |
| 14. Use of MATLAB / Python for finding B matrix, stiffness matrix and loading matrices of beam/in plane/solid elements and interfacing with CAE software's |

**Note : Any 10 experiments to be conducted**

**SUMMER INTERNSHIP**

# PW701ME

*Instruction: 2 periods per week* *Duration of SEE: 3 hours*
*CIE: 50 marks* *SEE: -*
*Credits : 2*

**Objectives:**

| |
|---|
| 1. Produce an accurate record of work performed during the Internship/Co-op |
| 2. Apply engineering knowledge to a problem in industry |
| 3. Produce a technical report |
| 4. Discuss work in a team environment, if relevant to the project |
| 5. Conduct herself/himself responsibly, safely, and ethically in a professional environment |

**Outcomes:**

| After completing this course, the student will be able to |
|---|
| 1. Able to design/develop a small and simple product in hardware or software. |
| 2. Able to complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it. |
| 3. Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria. |
| 4. Able to implement the selected solution and document the same. |

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organisations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co- ordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Award of sessionals are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (25 Marks) followed by presentation

before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Industry Attachment Program.

**Note:** Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

| Open Elective 1 | | |
|---|---|---|
| **Sl.No** | **Code** | **Name of Subject** |
| **1** | **OE601 EE** | Electrical Energy Conservation and Safety (Not for EEE & EIE Students) |
| **2** | **OE602 EE** | Reliability Engineering (Not for EEE & EIE Students) |
| **3** | **OE611 AE** | Basics of Automobile Engineering (Not for Mech./Prod./Automobile Engg. students) |
| **4** | **OE611 ME** | Industrial Robotics (Not for Mech./Prod./Automobile Engg. students) |
| **5** | **OE601 EG** | Soft Skills & Interpersonal Skills |
| **6** | **OE602 MB** | Human Resource Development and Organizational Behaviour |
| **7** | **OE601 LW** | Cyber Law and Ethics |
| **8** | **OE601 CS** | Operating Systems (Not for CSE Students) |
| **9** | **OE602 CS** | OOP using Java (Not for CSE Students) |
| **10** | **OE601 IT** | Database Systems (Not for IT Students) |
| **11** | **OE602 IT** | Data Structures (Not for IT Students) |
| **12** | **OE601 CE** | Disaster Mitigation (Not for Civil Engg. Students) |

**OPEN ELECTIVES - I**
**ELECTRICAL ENERGY CONSERVATION AND SAFETY**

**OE 601 EE**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. To understandthe concepts ofbasicenergyand variousformsofenergy. |
| 2. To understandthe energymanagementand needof energyaudit. |
| 3. To understandtheenergyefficiencytechnologies. |

**Outcomes:**

| At theend ofthe course studentswillbe ableto |
|---|
| 1. Understandthecurrentenergyscenario and importanceofenergyconservation. |
| 2. Understandtheconcepts ofenergy management. |
| 3. Understandthemethods ofimprovingenergyefficiencyin differentelectricalsystems. |
| 4. Understandtheconcepts ofdifferentenergyefficientdevices.Explain the basic concepts related to Infrastructure Projects. |

**UNIT – I**

***EnergyScenario:***CommercialandNon-commercial energy,primaryenergy resources,commercialenergy production,finalenergyconsumption,energyneedsofgrowingeconomy,longterm energyscenario,energy pricing,energysectorreforms,energyandenvironment,energysecurity,energyconservationanditsimportance, restructuring oftheenergy supply sector, energy strategy for the future,airpollution, climatechange.Energy Conservation Act-2001 anditsfeatures.

**UNIT – II**

***Basics of Energyanditsvariousforms:***Electricity tariff,loadmanagementandmaximumdemandcontrol, owerfactorimprovement,selection&locationof capacitors,Thermal Basics-fuels,thermalenergycontentsof fuel,temperature&pressure,heatcapacity, sensibleandlatentheat,evaporation,condensation,steam,moistair and humidity&heattransfer, units andconversion.

**UNIT – III**

***EnergyEfficiencyinElectricalSystems:***Electricalsystem:Electricitybilling,electricalload managementand maximum demandcontrol,powerfactorimprovementanditsbenefit,selectionandlocationofcapacitors, performanceassessmentofPFcapacitors,distribution and transformerlosses.Electricmotors: Types, losses in inductionmotors,motorefficiency,factorsaffecting motorperformance,rewinding andmotorreplacement issues, energysavingopportunitieswithenergyefficientmotors.

| |
|---|
| **UNIT – IV** |
| ***EnergyEfficientTechnologies inElectricalSystems:***Maximum demandcontrollers,automaticpowerfactor controllers,energy efficientmotors,softstarterswithenergy saver,variable speeddrives,energy efficient transformers,electronicballast,occupancysensors,energyefficientlightingcontrols,energysavingpotentialof eachtechnology. |
| **UNIT – V** |
| ***Electrical Safety:*** Physiological effects of Electricity, Important Susceptibility parameters, Distribution of Electric Power, Macro shock hazards, Micro Shock hazards, Electrical - Safety codes and Standards, Basic Approaches to protection against shock, Protection: Power distribution, Protection: Equipment Design, Electrical Safety Analyzers, Testing the Electrical System. Test of Electric Appliances. |

***Suggested Readings:***

| | |
|---|---|
| 1. | Guide books forNationalCertification Examination for EnergyManager/EnergyAuditors Book-1, GeneralAspects (availableonline). |
| 2. | Guide books forNationalCertification ExaminationforEnergyManager/EnergyAuditors Book-3, ElectricalUtilities (available online). |
| 3. | S. C. Tripathy,*UtilizationofElectricalEnergy and Conservation*,McGraw Hill,1991. |
| 4. | Success storiesofEnergyConservationbyBEE, New Delhi(www.bee-india.org). |

## RELIABILITYENGINEERING

**OE 602 EE**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. Description of the design aspects of different types spillways. |
| 2. Knowledge regarding the design of energy dissipation arrangements. |
| 3. Awareness about urban storm drainage and concepts of dam safety. |

**Outcomes:**

| At theend ofthe course studentswillbe ableto |
|---|
| 1. Understandthemeaningofdiscrete and continuousrandomvariablesandtheirsignificance,causesof failuresofasystem. |
| 2. Acquire the knowledge ofdifferentdistribution functions andtheirapplications. |
| 3. Able to developreliabilityblockdiagrams and evaluation of reliabilityofdifferentsystems. |

| |
|---|
| **UNIT-I** |
| Discreteandcontinuousrandom variables.Probabilitydensity functionandCumulativedistributionfunction. Meanand variance. Binomial, Poisson, Exponentialand WeibulIdistributions. |
| **UNIT-II** |
| Failureandcauses of failure.Failure rateandfailuredensity.Reliabilityfunctionand MTTF.Bathtubcurvefor differentsystems. Parametric methodsforabove distributions. Non-Parametricmethods fromfielddata. |
| **UNIT-III** |
| Reliability block diagram.Seriesandparallelsystems.Network reduction technique,Examples.Evaluation of failurerate,MTTFandreliability,ActiveandStandbyRedundancy,routofnconfiguration.Non-series–parallel systems. Path basedand cutsetmethods. |
| **UNIT - IV** |
| Availability,MTTRand MTBF, MarkovmodelsandStatetransitionmatrices. Reliability modelsforsingle component.twocomponents, Load sharingand standbysystems. |

| |
|---|
| Reliabilityand availabilitymodelsoftwo-unit parallelsystemswith repairand standbysystems with repair. |
| **UNIT – V** |
| RepairableSystems.maintainability.Preventivemaintenance,Evaluation ofreliabilityandJ1TTF.Overhauling andreplacement.Optimummaintenancepolicy.Markovmodelofapowerplant with identicalunitsandnon- identicalunits. Capacityoutage probabilitytable. Frequencyoffailuresand Cumulative frequency. |

***Suggested Readings:***

| | |
|---|---|
| 1. | CharlesE. Ebeling, *Reliabilityand MaintainabilityEngineering*, McGraw HillInternationalEdition, 1997. |
| 2. | Balaguruswamy, *ReliabilityEngineering*, Tata McGraw HillPublishingCompanyLtd, 1984. |
| 3. | R.N. Allan, *ReliabilityEvaluationofEngineeringSystems*, Pitman Publishing, 1996. |
| 4. | Endrenyi, *ReliabilityModelingin Electric PowerSystems,*JohnWiley&Sons, 1978. |

**BASICS OF AUTOMOBILE ENGINEERING**

**OE 611 AE**

*For the academic years 2020-2024*

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. Understand the Working of Fuel, Ignition, and cooling Systems |
| 2. Understand the Working of Lubrication and Electrical Systems. |
| 3. Understand the Working of transmission, Suspension, Steering and Braking Systems |
| 4. To provide broad introduction to Alternative Energy Sources, Euro norms and Bharat Norms |

**Outcomes:**

| |
|---|
| 1. Generalize the different types of automobiles and engine components |
| 2. Differentiate the Fuel system and electrical system |
| 3. Describe and differentiate the Transmission Systems |
| 4. To identify different components and working of Steering, Brakes and Suspension systems |
| 5. Adapt techniques, skills and modern engineering tools necessary to control the pollution |

| |
|---|
| **UNIT – I** |
| ***Vehicle Structure and Engines*:** Types of Automobiles, Vehicle Construction, Chassis, Frame and Body , Components of Engine , Cooling and Lubrication systems in Engine, Turbo Chargers, Engine Emission Control by 3 Way Catalytic Controller, Electronic Engine Management System. |
| **UNIT – II** |
| ***Engine Auxiliary Systems:***Carburettor working principle, Electronic fuel injection system, single-point and Multi-Point Injection Systems, Electrical systems, Battery, generator, Starting Motor and Lighting and Ignition. |
| **UNIT – III** |
| ***Transmission Systems-Clutch:*** *Types* and Construction, Gear Boxes-Manual and Automatic, , Over Drives, Transfer Box Fluid flywheel Torque convertors, Propeller shaft – Slip Joint – Universal Joints, Differential and Rear Axle, Hotchkiss Drive and Torque Tube Drive. |
| **UNIT – IV** |
| ***Steering, Brakes and Suspension:***Wheels and Tires – Wheel Alignment Parameters, Steering Geometry and Types of steering gear box, Power Steering, Types of Front Axle – Suspension systems. Braking Systems, Types and Construction, Antilock Braking System. |
| **UNIT – V** |
| ***Alternative Energy Sources****:* Use of Natural Gas, LPG, Biodiesel, Gasohol and Hydrogen in Automobiles, Electric and Hybrid Vehicles, Fuel Cells. Euro and Bharat Norms. Recent trends. |

**Suggested Reading:**

| | |
|---|---|
| 1 | Crouse & Anglin, 'Automotive Mechanics' Tata McGraw Hill, Publishing Co., Ltd., New Delhi, Tenth edition - 2004. |
| 2 | Kirpal Singh, "Automobile Engineering", Vol I & II Standard Publishers, Delhi. |
| 3 | Joseph Heitner, 'Automotive Mechanics', Affiliated East West Pvt., Ltd |
| 4 | C.P. Nakra, "Basic Automobile Engineering", Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2003 |

## INDUSTRIAL ROBOTICS

**OE 611ME**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 *marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. To familiarize the student with the anatomy of robot and theirapplications. |
| 2. To provide knowledge about various kinds of end effectorsusage. |
| 3. To equip the students with information about various sensors used in industrialrobots. |
| 4. To make the student understand the importance of spatial transformation of robots using forward and inversekinematics. |
| 5. To specify and provide the knowledge of techniques involved in robot vision inindustry. |
| 6. To equip students with latest robot languages implemented in industrialmanipulators. |

**Outcomes:**

| Student will be able to |
|---|
| 1. Able to demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics and have an understanding of the functionality and limitations of robot actuators andsensors. |
| 2. Able to demonstrate an ability to apply spatial transformation to obtain forward/Inverse kinematics equation of robot manipulators using analytical/numerical/simulationtools. |
| 3. Able to apply knowledge and choose the best & economically suitable sensors/end effectors required for specificapplications. |
| 4. Able to understand the importance of robot vision and apply the learnt techniques to get the required information from inputimages. |
| 5. Able to design and develop a industrial robot for a given purposeeconomically. |
| 6. Appreciate the current state and potential for robotics in new applicationareas. |

| **UNIT – I** |
|---|
| **Introduction to Robotics:** Basic structure of Robots. Degree of freedom of Robots, Work envelope, Classification of Robots based on Drive Technology, Work-Envelope and motion control methods. Application of Robots in Industry, Repeatability, Precision and Accuracy as applied to Robots, Specifications of robots used for various applications. End effectors, Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, Two fingered and three fingered grippers, internal grippers and external grippers, Selection and design considerations. |
| **UNIT – II** |
| **Requirements of a Sensor:** Principles and Applications of the following types of sensors- Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors), Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters), Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors), Touch sensors (Binary sensors, Analog sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. |
| **UNIT – III** |
| **Kinematic Analysis of Robots:** Rotation matrix. Homogeneous transformation matrix, Denavit&Hartenberg representation, Euler and RPY angles representation. Representation of absolute position and orientation in terms of joint parameters, Direct |

| |
|---|
| Kinematics of manipulators, Inverse kinematics of Robot arm for position and orientation. Redundancy in Robots, Static force analysis |
| **UNIT – IV** |
| **Introduction to Techniques used in Robot Vision:** Image acquisition, illumination techniques, imaging geometry, basic relationship pixels, preprocessing, segmentation & description of 3- dimensional structures, their recognition and interpretation. Types of Camera, frame grabbing, sensing and digitizing image data, Signal conversion, Image Storage, Lighting techniques, Image processing and analysis, Data reduction, Segmentation, Feature extraction, Object recognition, and various algorithms, Applications, Inspection, identification, visual serving and navigation. |
| **UNIT – V** |
| **Robot Programming Languages:** Characteristics of robot level languages, task level languages. Teach pendant programming, Lead through programming, Robot programming languages, VAL programming, Motion commands, Sensor commands. End effecter commands, Simple programs. RGV, AGV, Implementation of robots in industries, various steps, Safety considerations for robot operations. Economic analysis of robots, Pay back method, EUAC method and Rate of return method. |

**Suggested Readings:**


| |
|---|
| 1. Groover M P, "Industrial Robotics", McGraw Hill Publications, 1999. |
| 2. Fu. K.S., Gon Zalez R.C., Lee C.S.G. "Robotics, Control-sensing vision and Intelligence", McGraw Hill, Int. Ed., 1987. |
| 3. Spong and Vidyasagar, "Robot Dynamics & Control", John Wiley and Sons, Ed.,1990. |
| 4. Mittal and Nagrath, "Industrial Robotics", Tata McGraw Hill Publications, 2004. |
| 5. Saha&Subirkumarsaha, ‘Robotics’, TMH, India. |

## SOFT SKILLS AND INTERPERSONAL SKILLS

**OE 601 EG**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. Learn conversational skills |
| 2. Learn reading strategies |
| 3. Learn time management |
| 4. Learn stress management |
| 5. Learn career planning |

**Outcomes:**

| Student will be able to |
|---|
| 1. Express conversational skills |
| 2. Specify reading strategies |
| 3. Perform time management |
| 4. Perform stress management |
| 5. Explore career planning |

| **UNIT – I** |
|---|
| Conversation skills, Listening dialogues from TV/radio/Ted talk/Podcast<br>Group discussion<br>Interview skills, Making presentation<br>Listening to Lectures and News Programmes, Listening to Talk show<br>Watching videos on interesting events on Youtube, |
| **UNIT – II** |
| Reading different genres of tests ranging from newspapers to philosophical treatises<br>Readingstrategies – graphic organizers, Readingstrategies – summarizing<br>Readingstrategies – interpretation, Reports<br>Cover letter, Resume, |
| **UNIT – III** |
| Writingfor publications, Letters, Memos, Emails and blogs<br>Civil Service (Language related), Verbal ability<br>Motivation, Self image<br>Goal setting, Managing changes |
| **UNIT – IV** |

| |
|---|
| Time management, Stress management<br><br>Leadership traits<br><br>Team work<br><br>Career and life planning. |
| **UNIT – V** |
| Multiple intelligences<br><br>Emotional intelligence<br><br>Spiritual quotient (ethics)<br><br>Interculturalcommunication<br><br>Creative and critical thinking<br><br>Learning styles and strategies |

**Suggested Readings:**

| |
|---|
| 1. Business English Certificate Materials, Cambridge University Press. |
| 2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London. |
| 3. International English Language Testing System Practice Tests, Cambridge University Press. |
| 4. Interactive Multimedia Programs on Managing Time and Stress. |
| 5. Personality Development (CD-ROM), Times Multimedia, Mumbai. |
| 6. Robert M Sherfield and et al. “Developing Soft Skills” 4th edition, New Delhi: Pearson Education, 2009. |

**Web Sources:**

| |
|---|
| 1. http://www.slideshare.net/rohitjsh/presentation-on-group-discussion |
| 2. http://www.washington.edu/doit/TeamN/present_tips.html |
| 3. http://www.oxforddictionaries.com/words/writing-job-applications |
| 4. http://www.kent.ac.uk/careers/cv/coveringletters.htm |
| 5. http://www.mindtools.com/pages/article/newCDV_34.htm |

## HUMAN RESOURCE DEVELOPMENT AND ORGANIZATIONAL BEHAVIOR

**OE 602MB**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. Understand management process and functions |
| 2. Comprehend decision making and negotiations |
| 3. Learn psychological contract |
| 4. Study the models of organization behaviour |
| 5. Managing stress and counseling |

**Outcomes:**

| Student will be able to |
|---|
| 1. Explain various facets of management |
| 2. Elaborate on ways of making decision |
| 3. Elucidate different motivation content theories |
| 4. Describe approaches to leadership |
| 5. Suggest methods for stress management and counseling |

| **UNIT – I** |
|---|
| Management Process and Functions, Scientific and Modern Management, 3D Model of Managerial Behavior - MBO - MBWA - Line and Staff - The Peter's Principle - Parkinson's Law - Approaches to Organization Structure-Management - Classical, Human Relations, Systems and Contingency Approaches, Hawthorne's Experiments - Human Engineering. |
| **UNIT – II** |
| Decision Making and Negotiations: Approaches to Decision making - Rational, Behavioral, Practical, and Personal Approaches - Open and Closed Models of Decision Making, Types and steps in planning, Authority, Responsibility, Centralization, Decentralization and Recentralization, Bureaucracy. |
| **UNIT – III** |
| Psychological contract - Personality Traits, Big 5 personality traits, MBTI inventory, the Process of Perception - Perceptual distortions and errors, Kelly's personal construct Theory, Motivation-Content Theories: Maslow, Alderfer, Herzberg, McCleland. Process Theories: Vroom, Potter and Lawler, Equity Theory - Goal Theory - Attribution Theory. |
| **UNIT – IV** |
| Models of Organization Behavior - Autocratic, Custodial, Supportive, Collegial and System Models, Transactional Analysis, Johari Window. Group Dynamics: Typology of Groups - Conflicts in groups - The nature, of conflict - Reactions to conflict - A model of conflict. Trait and Behavioral Approaches to Leadership, Managerial Grid, Path-Goal |

| |
|---|
| Theory, Vroom's Decision Tree Approach to Leadership - Hersey and Blanchard Model. |
| **UNIT – V** |
| Organization Design, Organization culture and organization climate, Stress Management and Counseling, Management of change and organization development. Communication - Emerging aspects of OB. |

**Suggested Readings:**

| |
|---|
| 1. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 9th Edition, McGraw Hill Education, 2015. |
| 2. Curtis W. Cook and Phillip L. Hunsaker, *Management and Organizational Behavior,* 3rd Edition, McGraw-Hill,2010. |

## CYBER LAW AND ETHICS

**OE 601 LW**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. To familiarize various Cyber laws and IT Acts |
| 2. To give cyber security regulations and forensics |
| 3. To study the risk managements and code of ethics |

**Outcomes:**

| Student will be able to |
|---|
| 1. Understand the various Cyber laws and IT Acts |
| 2. Learn the cyber security regulations and forensics |

3. Analyse the risks and assessment of implications and code of ethics

**UNIT – I**

***Cyber laws and rights in today's digital age:*** IT Act, Intellectual Property Issues connected with use and management of Digital Data The similar Acts of other countries

***Information Warfare****:* Nature of information warfare, including computer crime and information terrorism; Threats to information resources, including military and economic espionage, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, distortion and fabrication of information, forgery, control and disruption of information How, electronic bombs, and sops and perception management.

**UNIT – II**

***Cyberspace and the Law & Cyber Forensics****:* Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing

**UNIT – III**

Legal, Ethical, and Professional Issues in Information Security Ethical Component in Information System, Codes of Ethics, Certification Security Analysis: Risk Management, Identifying and assessing risk, and Controlling Risk.

**UNIT – IV**

**Cyber Security**: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing.

**UNIT – V**

Security risks and perils for organizations, social computing and the associated challenges for organizations. Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

**Suggested Readings:**

1. Nina GodboleandSunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley 2017
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, 2018.

## OPERATING SYSTEMS

**OE 601 CS**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. To understand CPU, Memory, File andDevicemanagement |
| 2. To learn about concurrency control, protectionandsecurity |
| 3. To gain knowledge of Linux and Windows NTinternals |

**Outcomes:**

| |
|---|
| Student will be able to |

| |
|---|
| 1. Explain the components and functions ofoperatingsystems |
| 2. Analyze various Schedulingalgorithms |
| 3. Apply the principles ofconcurrency |
| 4. Compare and contrast various memorymanagementschemes |
| 5. Perform administrative tasks on Linux WindowsSystems |

| **UNIT-I** |
|---|
| Introduction to Operating Systems: OS structure and strategies, Process concepts, Threads, Inter process communication. CPU scheduling algorithms, Process synchronization, Critical section problem, Semaphores, Monitors. |
| **UNIT-II** |
| Memory management, Swapping, Contiguous allocation, Paging, Static and Dynamic partitions, Demand paging, Page replacement algorithms, Thrashing, Segmentation, Segmentation with paging. File system interface: File concepts, Access methods and protection. File system implementation: File system structure, Allocation methods, Directory implementation. |
| **UNIT-III** |
| Deadlocks: Necessary conditions, Resource allocation graph, Methods for handling deadlocks, Prevention, Avoidance, Detection and Recovery. Protection: Goals, Domain of protection, Access matrix. Security: Authentication, Threat monitoring,Encryption. |
| **UNIT-IV** |
| Device Management: Disk scheduling methods, Disk management, Device drivers and interfaces, CPU-Device interactions, I/O optimization. |
| **UNIT-V** |
| ***Case Studies:***The Linux System–Design principles, Kernel modules, Process management, Scheduling, Memory management, File systems, Input and Output, Inter process communication<br><br>Windows NT – General Architecture, The NT kernel, The NT executive. |

**Suggested Reading:**

| | |
|---|---|
| 1. | Abraham Silberschatz, Peter B Galvin, Operating System Concepts, Addison Wesley,2006 |
| 2. | William Stallings, Operating Systems-Internals and Design Principles, 5th edition, PHI, 2005 |
| 3. | Andrew S Tanenbaum, Modern Operating Systems, 4th edition, Pearson,2016 |

## OOP USING JAVA

**OE 602 CS**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. To introduce fundamental object oriented concepts of Java programming Language |

| |
|---|
| such as classes, inheritance, packages andinterfaces |
| 2. To introduce concepts of exception handling and multi-threading |
| 3. To use various classes and interfaces in java collection framework and utility classes To understand the concepts of GUI programming using AWT controls |
| 4. To introduce Java I/O streams and serialization |

**Outcomes:**

| Student will be able to |
|---|
| 1. develop java applications using OO concepts and packages write multi threaded programs with synchronization |
| 2. implement real world applications using java collection frame work and I/O classes |
| 3. write Event driven GUI programs usingAWT/Swing |

| **UNIT – I** |
|---|
| ***Object Oriented System Development****:* understanding object oriented development, understanding object oriented concepts, benefits of object oriented development.<br><br>***Java Programming Fundamentals****:* Introduction, overview of Java, data types, variables and arrays, operators, control statements. |
| **UNIT – II** |
| ***Java Programming OO concepts****:* classes, methods, inheritance, packages and interfaces. Exceptional Handling, Multithreaded Programming |
| **UNIT – III** |
| I/O Basics, Reading Console Input and Output, Reading and Writing Files, Print Writer Class, String Handling<br><br>Exploring Java.Lang, Collections Overview, Collection Interfaces, Collection Classes, Iterators, Random Access Interface, Maps, Comparators, Arrays, Legacy Classes and Interfaces, String Tokenizer |
| **UNIT – IV** |
| ***Introducing AWT working With Graphics****:* AWT Classes, Working with Graphics.<br><br>***Event Handling****:* Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces<br><br>**AWT Controls**: Control Fundamentals, Labels, Using Buttons, Applying Check Boxes, CheckboxGroup, Choice Controls, Using Lists, Managing Scroll Bars, Using TextField, Using TextArea, Understanding Layout Managers, Menu bars and Menus, Dialog Boxes, FileDialog,Handling events by Extending AWT Components, Exploring the controls, Menus and Layout Managers. |
| **UNIT – V** |
| Java I/O Classes and Interfaces, Files, Stream and Byte Classes, Character Streams, Serialization. |

**Suggested Readings:**


| |
|---|
| 1. Herbert Schildt, The Complete Reference JAVA, Tata McGraw Hill, 7thEdition,2005 |
| 2. James M Slack, Programming and Problem Solving with JAVA, Thomson learning, 2002 |
| 3. C.Thomas Wu, An Introduction to Object-Oriented Programming with Java, Tata McGraw Hill, 5thEdition,2005**.** |

## DATABASE SYSTEMS

**OE 601 IT**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. To understand the basic concept of DBMS |
| 2. To learn to design, develop and query the database |
| 3. To learn database administration and transaction processing |

**Outcomes:**

| Student will be able to |
|---|
| 1. Apply the basic concept of DBMS |
| 2. Design, develop and query the database |
| 3. Develop database administration and transaction processing methods |

| **UNIT – I** |
|---|
| ***Data and Data Management:*** Role of Data and Databases<br><br>***Database and Database Management System:*** Key Database concepts-Basic Database Models-Database Components<br><br>***Data Modeling***: Database Design-Relational Database Models- Relationships-Comparing Data Models |
| **UNIT – II** |
| ***SQL language:*** SQL features- command basics-SELECT Fundamentals-Operators and Functions-DDL Commands-DML Commands. |

| |
|---|
| ***Data Access and Manipulation:*** SELECT statement Advanced Syntax-Joins and Sub Queries.<br><br>***SQL Procedures:*** SQL procedures and Functions-Triggers |
| **UNIT – III** |
| ***Designing a Database:*** Designing Relational Tables-Comparing Relational Designs-Normalizing Data.<br><br>***Implementing a Database:*** Physical Design and Implementation- Adjusting Design to the Real World-Implementing Database Objects. |
| **UNIT – IV** |
| ***Improving Data Access:*** Performance Rollbacks-Using Indexes and Views-Using Programmable objects.<br><br>***Database Administration:***Need for Administration-Administration Responsibilities-Management Task. |
| **UNIT – V** |
| ***Transactions and Locking:*** Transaction Basics-Managing Concurrency control-SQL server transaction management.<br><br>***Database Access and Security:*** Database Connections-Managing Access Control-Protecting data. |

**Suggested Readings:**


1. Mark L. Gillenson, Paulraj Ponniah., "*Introduction to Database Management*", John Wiley & Sons Ltd, 2008.
2. Lee Chao, *"Database Development and Management"*, Auerbach Publications, 2006.
3. Rob Coronel, *"Database Systems: Design, Implementation & Management"* Thomson Course Technology, 2000.

## DATA STRUCTURES

**OE 602IT**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 *marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| |
|---|
| 1. To develop proficiency in the specification, representation, and implementation of abstract data types and data structures. |
| 2. To discuss the linear and non-linear data structures and their applications. |
| 3. To introduce the creation, insertion and deletion operations on binary search trees and balanced binary search trees. |
| 4. To introduce various internal sorting, searching techniques and their time complexities |

**Outcomes:**

| Student will be able to |
|---|
| 1. Implement linear, non-linear data structures and balanced binary trees |
| 2. Understand the basic data structures arrays and linked lists. |
| 3. Analyse time complexity of both iterative and recursive functions. |
| 4. Define ADT necessary for solving problems based on Stacks and Queues. |
| 5. Develop solutions using binary trees, advanced search trees, tries and graphs. |
| 6. Use hash functions and handle collisions. |

| **UNIT – I** |
|---|
| ***Performance and Complexity Analysis:*** Space complexity, Time complexity, Asymptotic notation (big-Oh), complexity analysis examples.<br><br>***Linear list-array representation:*** vector representation, multiple lists single array.<br><br>***Linear list-linked representation:*** singly linked lists, circular lists, doubly linked lists, Applications (polynomial arithmetic).<br><br>***Arrays and matrices:*** row and column major representations, special matrices, sparse matrices. |
| **UNIT – II** |
| ***Stacks:*** Array representation, linked representation, applications (recursive calls, infix to postfix, postfix evaluation).<br><br>***Queues:*** Array representation, linked representation.<br><br>***Skip lists and Hashing:*** skip lists representation, hash table representation, application- text compression. |
| **UNIT – III** |
| ***Trees:*** Definitions and properties, representation of binary trees, operations, binary tree traversal.<br><br>***Binary Search Trees:*** Definitions, and Operations on binary search trees.<br><br>***Balanced Search Trees:*** AVL trees, and B-trees. |
| **UNIT – IV** |
| ***Graphs:*** Definitions and properties, representation, graph search methods (Depth First Search and Breadth First Search)<br><br>***Application of Graphs:*** shortest path algorithm (Dijkstra), minimum spanning tree(Prim's and Kruskal's algorithms). |
| **UNIT – V** |
| ***Sorting and Complexity Analysis:*** Selection sort, Insertion sort, Quick sort, Merge sort, Closest pair of points, and Heap sort. |

**Suggested Readings:**


1. Sartaj Sahni, "*Data Structures--Algorithms and Applications in C++*" 2nd Edition, Universities Press (India) Pvt. Ltd., 2005.
2. Mark Allen Weiss, "*Data Structures and Problem Solving using C++*" Pearson Education International, 2003.
3. Michael T. Goodrich, Roberto Tamassia, David M. Mount "*Data Structures and Algorithms in C++*", John Wiley & Sons, 2010.

*For the academic years 2020-2024*

**DISASTER MITIGATION**

**OE 601 CE**

*Instruction: 3 periods per week* *Duration of SEE: 3 hours*
*CIE: 30 marks* *SEE: 70 marks*
*Credits: 3*

**Objectives:**

| | |
|---|---|
| 1. | To impart knowledge of the basic principles of disaster management. |
| 2. | To give knowledge of the various types of disasters. |
| 3. | To understand the disaster management cycle and framework. |
| 4. | To become aware of the disaster management systems in India. |
| 5. | To become aware of the applications of the latest technologies in disaster management |

**Outcomes:**

| | |
|---|---|
| | After completing this course, the student will be able to |
| 1. | Define and explain the terms and concepts related to disaster management. |
| 2. | Describe the various categories of disasters and their specific characteristics. |
| 3. | Explain the pre-disaster, during disaster and post-disaster measures and framework |
| 4. | Describe the disaster management acts and frameworks specific to India |
| 5. | List and explain the various technological applications to aid disaster management. |

**UNIT-I**

***Introduction:*** Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, and Capacity – Disaster and Development, and disaster management.

**UNIT-II**

***Disasters:***Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

**UNIT-III**

***Disaster Management Cycle and Framework:***Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness.

During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation.

Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure –

| |
|---|
| Early Recovery – Reconstruction and Redevelopment; IDNDR. |
| **UNIT-IV** |
| ***Disaster Management in India:***Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter Governmental Agencies. |
| **UNIT-V** |
| ***Applications of Science and Technology for Disaster Management*****:** Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India. |

***Suggested Reading:***


| | |
|---|---|
| 1. | Rajib, S and Krishna Murthy, R. R, *Disaster Management Global Challenges and Local Solutions"* CRC Press, 2009. |
| 2. | Navele, P & Raja, C. K, *Earth and Atmospheric Disasters Management, Natural and Manmade. B. S. Publications.2009* |
| 3. | Battacharya, T., *Disaster Science and Management*. Tata McGraw hill Company, 2017 |
| 4. | Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi |
| 5. | *An overview on natural & man-made disasters and their reduction*, R K Bhandani, CSIR, New Delhi |
| 6. | Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006 |
| 7. | Disasters in India Studies of grim reality, Anu Kapur& others, 2005, 283 pages, Rawat Publishers, Jaipur |
| 8. | *Disaster Management Act 2005*, Publisher by Govt. of India |
| 9. | *Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management* |
| 10. | National Disaster Management Policy, 2009, Govt. of India |
| 11. | Jagbirsingh, Disaster management–Future challenges and opportunities, |

| | |
|---|---|
| | I.K. International publishing house, 1st edition, 2007. |
| 12. | Coppala P Damon, Introduction to International Disaster management, Butterworth-Heinemann, 2015. |