Syllabus
of
B.Tech.-Mechanical Engineering

Rajiv Gandhi Institute of Petroleum Technology
(Institution of National Importance) Jais, Amethi-
229304, Uttar Pradesh

Fifth Semester

Design of Machine Elements

Course Number: ME311

Contact Hours: 3-1-0 Credits:11

Semester-offered: 3rd Year - Odd

Syllabus Committee Members: Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

Course Content

Unit-wise distribution of content and number of lectures.

Unit	Topics	Sub-Topic	Lectures
I	Introduction & Design for Static Loading	Introduction Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads. Design for Static Load Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.	8
II	Design for fluctuating loads and riveted joints	Design for Fluctuating Loads Cyclic stresses, Fatigue and endurance limit, Stress concentration factor,Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria. Riveted Joints Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint	9
III	Shafts	Shafts Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity.	8
IV	Mechanical Springs	Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading.	9
V	Keys and Couplings & Power Screws	Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid and flexible couplings. Power Screws: Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack.	8
Total			42

Readings

Textbooks & Reference Books:

1. Design of Machine Elements,V.B. Bhandari, Tata McGraw Hill Co.
2. Machine Design-Sharma and Agrawal, S.K. Kataria& Sons.
3. Machine Design, U C Jindal, Pearson Eductaion.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Elements-M.F. Spott, Pearson Eductaion
6. Machine Design-Maleev and Hartman, CBS Publishers.
7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
8. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons

IC engine and Gas Turbine

Course Number: ME312

Contact Hours: 3-0-0 Credits: 9

Semester-offered: 3rd Year - Odd

Syllabus Committee Members: Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Introduction to I.C. & Fuels	Introduction to I.C. Engines Engine classification, Air standard cycles, Otto, Diesel, Stirling, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine. Fuels: Fuels for SI and CI engine, important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.	8
II	SI Engines	Carburetion, Mixture requirements, Carburetor types Theory of carburetor, MPFI, Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and its control, combustion chamber design for SI engines. Ignition system requirements; Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.	8
III	CI Engine	Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timing. Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines. Scavenging in 2 Stroke engines, pollution and its control.	8
IV	Engine Cooling, Lubrication, Supercharging & Testing and Performance	Engine Cooling: Different cooling systems, Radiators and cooling fans. Lubrication: Engine friction, Lubrication principal, Type of lubrication, Lubrication oils, Crankcase ventilation. Supercharging: Effect of altitude on power output, types of supercharging. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.	9
V	Compressors	Classification, Reciprocating compressors, Single and multi-stage, Intercooling, volumetric efficiency. Rotary compressors, Classification, Centrifugal compressor, Elementary theory, Vector diagram efficiencies, Elementary	9

		analysis of axial compressors, Surging and stalling, Roots blower, Waned Compressor, performance analysis.	
Total			42

Readings

Textbooks & Reference Books:

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing CO.
2. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India
3. A Course in International Combustion Engines, by Mathur& Sharma, DhanpatRai& Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata McGraw Hill Pub.
9. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek,,Pearson Eductaion

Manufacturing Processes – II

1. Course Details

1.1 Course Code: ME313

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 3rd Year - Odd

1.4 Prerequisite: Basic knowledge of physics, engineering materials, thermodynamics, and mechanics with interest in production technologies.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Prof. Amit Ranjan, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas, Dr. Sushanta Kumar Sahoo, Dr. Hreetabh Kishore, Dr. Avneesh Kumar

2. Objective of the Course: The course aims to provide fundamental knowledge of machining processes and machine tools. It enables students to understand process principles, equipment, material behavior, and process parameters to analyze, select, and apply appropriate manufacturing techniques in engineering production and product development.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Machining	Introduction to material removal processes, Geometry of cutting tools, Mechanics of Machining including force and temperature generation, Methods of measurement of forces, Merchant circle, Surface roughness, Machinability, Cutting tool materials, Cutting fluids, Tool wear mechanisms, Tool life criteria, Basic concepts of cost and economics of machining.	9
II	Machine Tools	General Purpose Machine Tools, Turning, Drilling, Milling and finishing processes, Introduction to CNC machining,	8
III	Grinding & Super finishing	Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centreless grinding. Super finishing: Honing, lapping and polishing.	8

IV	Unconventional Machining Processes	Abrasive Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electrochemical machining (ECM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM).	9
V	Additive manufacturing	Introduction to rapid prototyping, material, applications, limitations., Techniques: Stereo lithography, Powder Bed Fusion, Selective Laser Sintering, 3D Printing, Laminated Object Manufacturing.	7
Total			41

4. Readings

Textbooks & Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Ghosh A. and Mallick A.K., Manufacturing Science, Affiliated East West Press, 2001.
3. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
4. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
5. Materials and Manufacturing by Paul Degarmo.
6. Manufacturing Processes by Kaushish, PHI.
7. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
8. Production Technology by RK Jain.
9. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

5. Course Outcome:

- At the end students will be able to select and apply a suitable machining process and cutting tool upon the work piece material and geometry.
- At the end students Apply knowledge of manufacturing processes to select appropriate techniques for specific engineering applications.

Industrial Engineering & Operation Research

1. Course Details

1.1 Course Code: ME314

1.2 Contact Hours: 3-0-0; Credits: 09

1.3 Semester offered: 2nd Year - Odd

1.4 Prerequisite: Fundamental basic mathematics, understanding of work study, ergonomics, probabilistic and introduction to economics/management skills. Basic familiarity with spreadsheets and introductory programming is often required, since solving industrial engineering and operations research problems commonly involves computational tools and simulations.

1.5 Syllabus Committee Members: Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas, Dr. Hreetabh Kishore, Dr. Sushanta Kumar Sahoo, Dr. Avneesh Kumar

2. Objective of the Course: The course aims to systematically analyze, design, and optimize complex production and service systems, integrating human resources, machines, materials, information, and energy for increased efficiency and productivity. To develop skills in modelling and solving engineering and management problems using analytical, computational, simulation, and mathematical techniques from operations research (including linear, non-linear programming, queuing theory, inventory control, and decision analysis).

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	**Introduction**	Industrial Engineering, Definition and evolution, Understanding Industrial systems focus: Production/Service system. Performance measures of a production system-production, productivity, Efficiency, Effectiveness, and Classical Industrial Engineering-Work study: Method Study and Time study, Human factors, Ergonomics.	06
II	**Quality Control**	Quality, TQM, SQC, Control Charts, Acceptance Quality Level (AQL), Lot Tolerance Percentage	08

		Defective (LTPD), Producer's Risk, Consumer's Risk, Operating Characteristic Curve, Simple Numerical problems.	
III	**Value Engineering**	Concept of value analysis, Aim and Objectives, Phases in value analysis, Test for value analysis, Difference between V.E. and Cost Reduction Techniques, Functional Analysis system techniques (FAST), principles of value analysis.	08
IV	**Mechatronics in Industrial Engineering**	The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics, Electrical, Control, computer and Instrumentation, sensors and actuators, Pneumatics and hydraulics.	06
V	**Operation Research**	Introduction, historical development, characteristics and application of operations research, scope of operations research, classification of optimization techniques in brief. Linear programming, Transport model, Assignment model, Project Management, PERT & CPM, Queuing model.	12
Total			40

4. Readings

Textbooks & Reference Books:

10. S. S. Rao, Engineering Optimization, New Age International.
11. P. K. Gupta & D. S. Hira, Operation Research, Prentice Hall of India.

Reference Books:

1. Martand Telsang, Industrial Engineering & Management, S. Chand Publications.
2. W. Bolten, Mechatronics, Pearson Education.
3. A. H. Taha, Operations Research.

5. Course Outcome(s):

- Understand and apply the basic concept of Industrial engineering techniques associated with work study/method study.

- Develop and analyses the application of inventory control model in the plant based on the knowledge of selection of forecasting technique and compute material requirement needed in product quality management.
- Ability to integrate the process through automation and control approach.
- Learn the basic concepts and issues of engineering optimization and application of optimization techniques.
- Formulate the general linear programming problem (LPP) using different approaches and attempt the variations of the class of problems.
- Formulate the transportation and assignment model and attempt the variations of the class of problems.
- Draw the network diagrams for project management and assess the project completion time based on the concepts of queuing theory and case to case studies.

Dynamics of Machine

1. Course Details

1.1 Course Code: ME315

1.2 Contact Hours: 2-0-0; Credits: 06

1.3 Semester offered: 2nd Year - Odd

1.4 Prerequisite: Basic understanding of Engineering mechanics, Machine drawing, physics, mathematics, and fundamentals of Kinematics, dynamics, and mechanical systems.

1.5 Syllabus Committee Members: Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas, Dr. Hreetabh Kishore, Dr. Sushanta Kumar Sahoo, Dr. Avneesh Kumar

2. Objective of the Course: The course aims to provide application-based knowledge of the kinematics and dynamics of machines. It enables students to analyze mechanisms understand motion and power transmissions, and study the forces acting on machine components (vibrational and frictional forces), preparing them for the design and analysis of mechanical systems such as belt, ropes, linkages, gyroscope etc.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	**Belt, Rope & Belt drive**	Introduction, flat and V-belt drive, velocity ratio, Creep, slip in belt drive, velocity law, compression in belt, tension in belt, and angle of contact, power transmission. Belt, chain and rope drive.	06
II	**Applied Linkages**	Radial engines and master crank, straight line motion and indicator mechanisms steering mechanisms, quick return mechanisms, intermittent motion mechanisms, Geneva mechanism, analog computing mechanisms, various types of ingenious mechanisms and their functioning.	06
III	**Friction**	Types, Laws of friction, Coefficient of friction, Inclined plane, Motion down the plane, Screw	04

		threads, Screw jack, Wedge Pivots and collars, Rolling friction.	
IV	**Gyroscope**	Angular velocity, Angular acceleration, Gyroscopic torque (couple) Gyroscopic effect on aeroplanes, Gyroscopic effect on naval ships, stability of an automobile, Stability of a two-wheel vehicle, Rigid disc at an angle fixed to a rotating shaft.	05
V	**Vibrations**	Introduction, types, Features of vibrating systems, Degree of freedom, Displacement, velocity and acceleration, Simple harmonic motion, Magnification factor, Rayleigh's method, Introduction to longitudinal, transverse and torsional vibrations, Vibration isolation, Transmissibility, Shaft load analysis.	05
Total			27

4. Readings

Textbooks & Reference Books:

12. Theory of Machines: S.S. Rattan, McGraw Hill.
13. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.

Reference Books:

4. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
5. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press.
6. Kinematics and dynamics of machinery: R L Norton, McGraw Hill.

5. Course Outcome(s):

- Study of working and analyzing various machine components such as, belt, rope, and belt drives based on the prior knowledge of theory of machines.
- Formulate the mechanism for the applied linkages in different mechanical systems crucial for ensuring stability and safety in engineering design.

- Ability to analyze the equilibrium and impending motion of bodies subjected to frictional forces, including applications to wedges, screws, belts, and bearings in practical engineering problems.
- Gain a practical knowledge related to vibration measurement, mitigation, and control in engineering applications.
- Understanding free and forced vibrations of mechanical systems, including damping effects and resonance conditions.

Sixth Semester

Finite Element Analysis

1. Course Details

1.1. Course Code: ME323

1.2. Contact Hours: 3-0-0; Credits: 9

1.3. Semester offered: 3rd year - Even

1.4. Prerequisite: Engineering Mathematics (Differential Equations & Linear Algebra), Strength of Materials, Engineering Mechanics, Engineering visualization etc.

1.5. Syllabus Committee Members: Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Avneesh Kumar, Dr. Hreetabh Kishore, Dr. Sushanta Kumar Sahoo.

2. Objective of the course: The course aims to develop a fundamental understanding of the finite element method (FEM) for solving engineering problems related to solid mechanics, heat transfer, fluid flow, and structural analysis. It equips students with the ability to formulate, model, and analyse 1-D, 2-D, and time-dependent problems using FEM. Students will gain practical skills in mesh generation, numerical integration, post-processing, and interpretation of finite element results, enabling them to solve real-world engineering design and analysis works.

3. Course content:

Unit-wise distribution of content and number of lectures:

Units	Topics	Sub-Topic	Lectures
I	**Introduction to FEM**	Historical background; Stresses and equilibrium, Boundary conditions, strain-displacement relations, vectors and matrices, basic concepts of FEM; comparison with finite difference method; need and advantages of FEM; general steps in FEM	8
II	**1-D Finite Element Modelling**	Formulation using direct, potential energy, and Galerkin approaches, derivation of elemental equations, assembly of global stiffness matrices, load vector, properties of stiffness matrix, application in heat transfer, fluid mechanics, and solid mechanics; truss and beam elements	8
III	**2-D Finite Element Modelling and scalar field problems**	Constant strain Triangle (CST), Four, nine, eight nodes quadrilateral, Triangular and rectangular elements, interpolation functions, Higher, order elements, plane stress and plane strain problems,	9

		plane trusses, applications in heat transfer, fluid mechanics, and solid mechanics.	
IV	**Variational Methods & Weighted Residual Methods**	Calculus of variations; Rayleigh–Ritz method; Galerkin method; formulation of differential equations using variational principles	8
V	**Dynamic considerations & Computer integration**	Element mass matrices, Evaluation of Eigen values and eigen vectors, Numerical integration, Gaussian quadrature, error analysis, convergence and mesh refinement, time-dependent problems, introduction to pre-processors, postprocessors, and FEM software packages for calculation of system matrices	9
Total			42

4. Readings

Textbook:

1. J.N. Reddy, *An Introduction to the Finite Element Method*
2. Chandrupatla & Belegundu, *Introduction to Finite Elements in Engineering*.
3. T.J.R. Hughes, *The Finite Element Method: Linear Static and Dynamic Analysis*.
4. S.S. Rao, *The Finite Element Method in Engineering*.

Reference Books:

1. K. J. Bathe, *Finite Element Procedures*.
2. O.C. Zienkiewicz & R.L. Taylor, *The Finite Element Method*.
3. Cook, Malkus, Plesha & Witt, *Concepts and Applications of Finite Element Analysis*.
4. Logan, *A First Course in the Finite Element Method*.
5. Fish & Belytschko, *A First Course in Finite Elements*.

5. Course Outcomes:

- Understand the fundamental principles and mathematical background of the finite element method.
- Formulate and analyse 1-D and 2-D finite element models for engineering applications.
- Apply variational and weighted residual methods to derive finite element equations.

- Solve problems in solid mechanics, heat transfer, and fluid mechanics using FEM.
- Evaluate numerical errors, perform mesh refinement, and interpret FEM results using commercial software tools.

Production Planning and Inventory Control

1. Course Details

1.1 Course Code: ME322

1.2 Contact Hours: 2-1-0; Credits: 08

1.3 Semester offered: 3rd Year – Even Semester

1.4 Prerequisite: Knowledge in basic Manufacturing Processes, Industrial Management, and Operations Research.

1.5 Syllabus Committee Members: Dr. Tushar Sharma, Prof. Amit Ranjan, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas, Dr. Sushanta Kumar Sahoo, Dr. Hreetabh Kishore, Dr. Avneesh Kumar

2. Objective of the Course: The course aims to provide fundamental knowledge of planning and control, different forecasting techniques, and inventory management. Gain a comprehensive understanding of PPC functions in both manufacturing and service environments. Examine key Operations Management planning topics, including production planning and inventory control.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Introduction	Introduction to PPC, Objectives and benefits of PPC, Type of manufacturing systems, Factors affecting manufacturing systems, Product design and development Introduction, marketing aspects, functional aspects, operational aspects, durability and dependability, aesthetic aspects, economic analysis, profit and competitiveness, the three S's, break even analysis, economics of a new design	9
II	Forecasting	Importance of forecasting, types of forecasting, their uses general principles of forecasting techniques, Qualitative methods and quantitative methods.	8
III	Inventory Management	Introduction, Inventory related costs, EOQ model, Inventory models allowing shortages, Inventory models allowing price discounts, Inventory model under risk conditions, Inventory control systems: continuous review,	8

		periodic review, optional replenishment etc., Inventory classification systems: ABC, FMS, VED etc, MRP	
IV	Scheduling	Introduction, Scheduling types: Forward, Backward scheduling, Job shop scheduling methods, Loading and Scheduling, General scheduling problem, Significance of loading and scheduling, Factors affecting scheduling, Scheduling system, Flow shop scheduling, Job shop scheduling, Sequencing, Line balancing.	9
V	Quality Control	Introduction, Control charts, Control charts for attributes, Productivity and work study	8
Total			42

4. Readings

Textbooks & Reference Books:

14. S.N. Chary. Production And Operations Management. McGraw Hill Publ, 5th Edition.
15. Samuel Eilon, "Elements of Production Planning and Control", Universal Publishing Corporation.
16. Martin K. Starr and David W. Miller, "Inventory Control Theory and Practice", Prentice Hall.
17. O.P. Khanna. Industrial engineering and management. Dhanpat Rai & Sons.
18. Russell R. S. & Taylor B. W., "Operations Management", International Student Version, 7/e, John Wiley and Sons (Asia) Pte. Ltd., 2011
19. Chase, R.B., Aquilano, N.J., and Jacobs, F.R., "Operation Management for Competitive Advantage", 9th Edition, Tata McGraw-Hill, Delhi, 2002.
20. Krajewski, L.J., and Ritzman, L.P., "Operations Management: Strategy and Analysis", 6th Edition, Pearson Education Asia, India, 2003

5. Course Outcome:

- At the end students will be able to understand the role production planning and control activities in manufacturing and services.
- Understand and perform various Forecasting techniques and problems.
- Understand and perform various Inventory Management techniques and apply in real manufacturing scenario.
- Solve routing and scheduling problems effectively.

Power Plant Engineering

1. Course Details

1.1 Course Code: ME324

1.2 Contact Hours: 2-0-0; Credits: 06

1.3 Semester offered: 3rd year - Even

1.4 **Prerequisite:** Basic understanding of Applied Thermodynamics, steam generation, turbines, power generation mechanism in turbines, statics and economics for industrial engineering. Environmental aspects on gas emission, and advantages and disadvantages of harnessing conventional and non-conventional sources of energy available in nature.

1.5 **Syllabus Committee Members:** Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Hreetabh Kishore, Dr. Sushanta Kumar Sahoo, Dr. Avneesh Kumar.

2 Objective of the course: The main aim is to provide basic knowledge about different types of power plants (steam, hydro, nuclear, gas turbine, non-conventional, etc) and their principles of operation, components, and site selection criteria. To introduce economic aspects of power generation, including load estimation, load curves, cost curves, cost analysis, and plant economics. To explain modern and advanced technologies in power plant operation, non-conventional energy energy generation, and alterative power conversion systems.

3 Course content:

Unit-wise distribution of content and number of lectures:

Units	Topics	Sub-Topic	Lectures
I	**Introduction**	Various energy resources and its availability, Types of power plants, selection of the power plants, revision of basic thermodynamic cycles used in power plants. Load estimation, load curves, various terms and factors involved in power plant assessment. Effect of variable load on power plant operation, Selection of power plant units.	03
II	**Hydroelectric**	Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydroelectric	04

		power plants, site selection criteria, Advantages and comparison with each other types of power plants.	
III	**Steam and Nuclear Power Plants**	Flow sheet and working of modern-thermal power plants, Classification of turbine cycles, its working and governing, analysis, condenser, cooling ponds, cooling towers, Feed water treatment, site selection, coal storage, preparation, coal handling systems, dust collection, electrostatic precipitator. Principles of nuclear energy, basic nuclear reactions, Different nuclear reactors. Effect of radiation and waste disposal.	06
IV	**Gas and Steam Turbine Combined Cycles**	Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems with organics fluids, parameters affecting thermodynamic efficiency and performance of combined cycles.	06
V	**Power Plant Economics**	Overview of Load curve, different terminology and definitions, cost of electrical energy, performance & operating characteristics of power plants-incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing. Introduction to air and water pollution by thermal power plants, Radioactive pollution of environment by nuclear power plants, Noise pollution, Methods for reducing the pollution.	07
Total			26

4 Readings

Textbook:

1. Power Plant Engineering by P.K. Nag.
2. Power Plant Engineering by P.C. Sharma.

Reference Books:

1. Power Plant Engineering by M. Wakil.

2. Power Plant Engineering by Arora S. Domkundwar.

5 Course Outcome(s):

- Understand the present scenario of energy production in India and understand the different working aspects of hydropower plant.
- Explain the construction detail and the working of thermodynamic cycle of the thermal as well as gas power plant.
- To understand the power production techniques of nuclear power plant and to apply the knowledge for power plant economics for different load situations.
- Explore the knowledge in the field of non-conventional power generation methods and the direct energy conversion methods.
- Understand the pollution effects of power generation and ways to control them for the betterment of society.

CAD & CAM

1. Course Details

1.1 Course Code: ME325

1.2 Contact Hours: 2-0-0; Credits: 06

1.3 Semester offered: 2nd Year - Even

1.4 Prerequisite: Basic understanding of Engineering visualization, Machine drawing, Geometrical shapes and mathematical formulation, Manufacturing processes planning, CNC tooling with analytical and problem-solving skills. physics, instrumentation, mathematics, mechanics, and electrical fundamentals with analytical and problem-solving skills.

1.5 Syllabus Committee Members: Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas, Dr. Hreetabh Kishore, Dr. Sushanta Kumar Sahoo, Dr. Avneesh Kumar

2. Objective of the Course: The CAD & CAM course aims to equip the students with knowledge and practical skills to use computer technology to design, analyze, and manufacture mechanical components and systems efficiently and precisely. It will enrich the students in Mastering Geometric Modeling, Engineering Analysis and Optimization, Bridging Design and Manufacturing, Understanding Modern Manufacturing Systems, and Enhancing Productivity and Quality.

3. Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	**Fundamentals of CAD & CAM**	Introduction to CAD & CAM, Definition of CAD & CAM tools, Design process and application of computers in design, Creating manufacturing database, Benefits of CAD & CAM.	02
II	**CAD Hardware and Software**	Introduction to input and Output devices, Display devices, Central Processing Unit (CPU), Graphic Standards: GKS, IGES, PHIGS, Data structure and Database management of a Graphics system. Coordinate systems: WCS, MCS, SCS, Software modules: Operating system, Graphics, Application, Programming and Communication.	05

III	**Geometric Transformations**	Introduction to free form curves, B-spline and NURBS, Surfaces, Plane, Cylindrical, Spherical, rules, coons, patch, swept, revolved, Bezier, B-spline, Introduction to solid models, Solid representation, B-rep, CSG, Sweep representation, Formulation, translation, rotation, scaling, reflection, mapping of geometric models, projections. Understanding of line drawing algorithms with numerical problems.	10
IV	**Fundamental of Computer Numerical Control and NC Programming**	Principles of NC, Classification of NC: Motion control, control loops, Positioning systems, CNC, DNC, Combined CNC/DNC systems. constructional details of CNC machines. Tooling for NC machines: automatic tool changes, multiple pallets, Manual part programming, Format and codes, Tool length and radius compensation, Computer assisted part programming, APT, Tool path simulation.	05
V	**Computer Integrated Manufacturing System**	Role of computers in QC, Contact and Non-contact inspection methods, CMM, 3D scanners, Material requirement planning-concepts, inputs, output, benefits. Manufacturing resource planning (ERP). Introduction group technology, Computer aided process planning (CAPP)-variant and generative approach, Reverse engineering, Rapid prototyping, flexible manufacturing systems, Concurrent engineering.	06
Total			28

4. Readings

Textbooks & Reference Books:

3. Zeid, Ibrahim, CAD/CAM – Theory and Practice, Tata McGraw Hill.

4. Mikell P Groover and Emory W. Zimmers, CAD/CAM: Computer aided design manufacturing, Prentice Hall, 1996.

Reference Books:

7. Kundra, Rao Tiwari, Numerical Control and Computer Aided Manufacture, Tata McGraw Hill.
8. Mark E. Cotichhia, George W. Crawford, and Edward J. Preston, CAD/CAM/CAE systems: justification, implementation, and productivity measurement, 2nd edition, New York, Marcel Dekker, 1993.
9. Chris MacMahon and Jimmie Browne CAD CAM: principles, practice and manufacturing management, 2nd edition, Addison Wesley, 1998.
10. P. Radhakrishnan, S. Subramanyan, and V. Raju, CAD/CAM/CIM, 2nd edition, New Age, 2000.

5. Course Outcome(s):

- Identify the application of computers in designing.
- Understand the hardware in a CAD & CAM system.
- designing and analysis ability in field of modeling the parts.
- Understand the knowledge related to the use of computers in manufacturing.
- Apply CAD software to produce 2D and 3D designs.
- Understand fundamental concepts of background coding and mathematical formulation associated with different geometries in CAD software.
- Provide high skills in product design, manufacturing, planning, and automation in specialized area of design, analysis, and advanced manufacturing.

Department Elective

Turbo Machinery

Course Number: ME317

Contact Hours: 2-0-0 Credits: 6

Semester-offered: Department effective

Syllabus Committee Members: Prof. Amit Ranjan, Dr. Tushar Sharma, Dr. Naveen Mani Tripathi, Dr. Hakeem Niyas

Course Content

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
I	Introduction	Introduction to incompressible and compressible flow. Classification and field of application of fluid machines, Jet Striking Plates Water Turbines: Theory of Rotodynamic Machines-Euler's Equation, components of energy transfer, Classification – Impulse and Reaction Turbines, Construction, Operation, Head and efficiencies, Power calculation and governing of Pelton, Francis and Kaplan turbines; Draft tube; Surge tank	9
II	Application	Application of dimensional analysis in fluid machines - Unit quantities and Specific speed	5
III	Pumps	Centrifugal Pumps: Types; Heads and efficiencies; Construction of impeller and casing; Multi-stage pumps; Specific speed; Model testing; Characteristic curves; NPSH; Cavitation; Selection of centrifugal pump.	5
IV	Pumps	Reciprocating Pumps: Classification with constructional details; Theory; Indicator diagram; Effect of acceleration of piston; Effect of friction in pipes; Air vessel and its effects; NPSH. Rotary Positive Displacement Pumps: Types and constructional details.	7
V	Air compressors	Air compressors, selection steps and testing procedure of fluid machines.	4
Total			28

Readings

Textbooks:

1. G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994