GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

Teaching and Evaluation Scheme

TE (Full-Time) in Mechanical Engineering

SEMESTER-V

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
							Test	TA	ESE			
THEORY COURSES												
1	ME341	Applied Mathematics	3	-	-	3	20	20	60	-	-	100
2	ME342	Design of Machine Elements-I	3	1	-	4	20	20	60	-	-	100
3	ME343	Theory of Machines	4	-	-	4	20	20	60	-	-	100
4	ME344	Engineering Materials and Metallurgy	3	-	-	3	20	20	60	-	-	100
5	ME345	Fluid Mechanics and Hydraulic Machines	3	1	-	4	20	20	60	-	-	100
LABORATORY COURSES												
1	ME346	Lab Design of Machine Elements-I	-	-	4	2	-	-	-	50	50	100
2	ME347	Lab Theory of Machines	-	-	2	1	-	-	-	25	25	50
3	ME348	Lab Engineering Materials and Metallurgy	-	-	2	1	-	-	-	25	25	50
4	ME349	Lab Fluid Mechanics and Hydraulic Machines	-	-	2	1	-	-	-	25	25	50
5	ME350	Lab CAME-II	-	-	2	1	-	-	-	25	25	50
			16	2	12	24	100	100	300	150	150	800

SEMESTER-VI

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
							Test	TA	ESE			
THEORY COURSES												
1	ME351	Design of Machine Elements-II	3	1	-	4	20	20	60	-	-	100
2	ME352	Heat and Mass Transfer	3	1	-	4	20	20	60	-	-	100
3	ME353	Metrology and Quality Control	3	-	-	3	20	20	60	-	-	100
4	ME354	Industrial Engineering	3	-	-	3	20	20	60	-	-	100
5	ME355	Mechanical Measurements	2	-	-	2	10	10	30	-	-	50
6		Department Elective-I (ME361-ME368)	3	-	-	3	20	20	60	-	-	100
LABORATORY COURSES												
1	ME356	Lab Design of Machine Elements-II	-	-	2	1	-	-	-	25	25	50
2	ME357	Lab Heat and Mass Transfer	-	-	2	1	-	-	-	25	25	50
3	ME358	Lab Metrology and QC	-	-	2	1	-	-	-	25	25	50
4	ME359	Lab Mechanical Measurements	-	-	2	1	-	-	-	25	25	50
5	ME360	Industrial Interaction	-	-	2	1	-	-	-	25	25	50
			17	2	10	24	110	110	330	125	125	800

Dr. R.K. Shrivastva
Chairman-Mech.-Engg
Govt. College, Aurangabad

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

Department Elective – I

1) ME 361: Power Plant Engineering
2) ME 362: Industrial and Operation Management
3) ME 363: Introduction to FEM
4) ME 364: Renewable Energy Engineering
5) ME 365: Material Handling
6) ME 366: Mechanical Vibrations and Noise Control
7) ME 367: Machine Tool Design

GOVERNMENT COLLEGE OF ENGINEERING, AURANGABAD

(An Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

Teaching and Evaluation Scheme

TE (Part-Time) in Mechanical Engineering

SEMESTER-IV

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
							Test	TA	ESE			
THEORY COURSES												
1	ME341	Applied Mathematics	3	-	-	3	20	20	60	-	-	100
2	ME342	Design of Machine Elements-I	3	1	-	4	20	20	60	-	-	100
3	ME343	Theory of Machines	4	-	-	4	20	20	60	-	-	100
4	ME344	Engineering Materials and Metallurgy	3	-	-	3	20	20	60	-	-	100
LABORATORY COURSES												
1	ME346	Lab Design of Machine Elements-I	-	-	4	2	-	-	-	50	50	100
2	ME347	Lab Theory of Machines	-	-	2	1	-	-	-	25	25	50
3	ME348	Lab Engineering Materials and Metallurgy	-	-	2	1	-	-	-	25	25	50
			13	1	8	18	80	80	240	100	100	600

SEMESTER-V

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
							Test	TA	ESE			
THEORY COURSES												
1	ME345	Fluid Mechanics and Hydraulic Machines	3	1	-	4	20	20	60	-	-	100
2	ME351	Design of Machine Elements-II	3	1	-	4	20	20	60	-	-	100
3	ME353	Metrology and Quality Control	3	-	-	3	20	20	60	-	-	100
LABORATORY COURSES												
1	ME349	Lab Fluid Mechanics and Hydraulic Machines	-	-	2	1	-	-	-	25	25	50
2	ME350	Lab CAME-II	-	-	2	1	-	-	-	25	25	50
3	ME356	Lab Design of Machine Elements-II	-	-	2	1	-	-	-	25	25	50
4	ME358	Lab Metrology and QC	-	-	2	1	-	-	-	25	25	50
			9	2	8	15	60	60	180	100	100	500

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SEMESTER-VI

S. No.	Course Code	Subject	Scheme of Teaching (Hrs/Week)			Total Credits	Scheme of Evaluation (Marks)					
			L	T	P		Theory			Term Work	Practical/ Viva-voce	Total
							Test	TA	ESE			
THEORY COURSES												
1	ME352	Heat and Mass Transfer	3	1	-	4	20	20	60	-	-	100
2	ME354	Industrial Engineering	3	-	-	3	20	20	60	-	-	100
3	ME355	Mechanical Measurements	2	-	-	2	10	10	30	-	-	50
4		Department Elective-I (ME361-ME368)	3	-	-	3	20	20	60	-	-	100
LABORATORY COURSES												
1	ME357	Lab Heat and Mass Transfer	-	-	2	1	-	-	-	25	25	50
2	ME359	Lab Mechanical Measurements	-	-	2	1	-	-	-	25	25	50
3	ME360	Industrial Interaction	-	-	2	1	-	-	-	25	25	50
			11	1	6	15	70	70	210	75	75	500

L-Lectures, T-Tutorials, P-Practicals, TA-Teacher Assessment, ESE-End-Semester Examination

Department Elective – I

1) ME 361: Power Plant Engineering
2) ME 362: Industrial and Operation Management
3) ME 363: Introduction to FEM
4) ME 364: Renewable Energy Engineering
5) ME 365: Material Handling
6) ME 366: Mechanical Vibrations and Noise Control
7) ME 367: Machine Tool Design

ME 341: APPLIED MATHEMATICS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Class Test – 20 marks
Teachers Assessment – 20 marks
End Sem. Exam – 60 marks

Course Objectives

1. To inculcate an ability to relate engineering problems to mathematical context
2. To provide a solid foundation in mathematical fundamentals required to solve engineering problem
3. To study complex variables and complex integrals
4. To study the basic principles of statistics and probability and complex integration.
5. To study different numerical methods and curve fitting

Course Outcomes

1. Understand and apply knowledge of complex variables and integral for real life and engineering problems
2. Able to apply the knowledge of various numerical methods and interpolation
3. Understand and apply the concept of probability distribution to engineering problems.
4. Apply knowledge of curve fitting for engineering problems
5. Identify, formulate and solve engineering problems.

Unit-I:

Function of Complex variables: Analytic functions, Cauchy-Riemann conditions, Harmonic functions, Conjugate functions and their applications.

Complex integral: Integration of complex functions, simply and multiply connected regions, Cauchy's integral theorem, Cauchy's integral formula, Singularities, Zeroes, Residues and Residue theorem.

Unit-II:

Numerical solutions of algebraic and transcendental equations: Bisection method, Regula-Falsi method, Newton-Raphson method, Direct iterative method, Graffe's root squaring method.

Solution of system of linear algebraic equation: Matrix inversion method, Gauss- elimination Method, Jordan's method, Crout's method. Gauss-Seidel iterative method

Unit-III:

Interpolation: Finite difference operator, Interpolation formula with equal and unequal intervals. Divided differences and central differences.

Numerical differentiation and integration: Differentiation using forward, backward and divided difference, General quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, Weddle's rule.

Unit-IV:

Basics of probability, Bayes theorem, Random variables, Probability and density functions, Binomial, Poisson and Normal distributions.

Probability Distributions: Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, Variance.
Probability Distributions: Binomial, Poisson and Normal Distributions.

Unit-V:
Curve Fitting: Least square curve fitting procedures for straight line, Nonlinear curve fitting, weighted least square approximation, Method of least square for continuous function.

Text Books
1. B. S. Grewal, Engineering Mathematics, Khanna Publishers, 12/e, 2006.
2. Pipes & Pipes, Mathematics for Engineers, ELBS Publication
3. S. S. Sastry, Engineering Mathematics, Vol I, II Prentice Hall Publication, 3/e, 2004.

Reference Books:
1. Francis J. Scheid, Schaum's Outline of Numerical Analysis, McGraw-Hill, New York, 1989.
2. Gupta P. P. & Malik G.S., Calculus of Finite Differences and Numerical Analysis, Krishna Prakashan Mandir, Meerut, 21/e, 2006.
3. Murray R. Spiegel, Schaum's Outline of Complex Variables, McGraw-Hill, NewYork, 1968.

ME 342: DESIGN OF MACHINE ELEMENTS-I

Teaching Scheme
Lectures: 3 hrs/week
Tutorials: 1 hr / week

Examination Scheme
Class Test – 20 marks
Teachers Assessment – 20 marks
End Sem. Exam – 60 marks

Course Objectives
1. To understand procedure of machine design and develop an ability to apply it for simple component design by using design data hand book.
2. To understand the different theories of failure and develop an ability to apply its knowledge for design of mechanical component and determine the resisting areas against failure
3. To determine forces on transmission shaft and design of transmission shaft
4. To determine the endurance strength and design of components subjected to fluctuating loads
5. To determine the forces in welds and riveted joints and formulate design solution for size of weld and size of rivet
6. To determine forces on power screw and bolted joints and formulate design solution for size of power screw and size of bolt.

Course Outcomes
1. Ability to apply Knowledge of Engineering Graphics, Machine Drawing, Basic Science and Basic Applied Mathematics, Basic Machining Processes, Material Science, for design procedures of Mechanical components use in Industries and incorporated in Machine Design.
2. Be able to apply knowledge of the stress and strain of mechanical components; and understand, identify and quantify factor of safety, failure modes for simple mechanical components subjected to direct and bending and combined loading. Acquire a skill and logic of finding resisting areas against failure and simple component design by using design data hand book.

3. Develop Logical and Analytical ability to apply Knowledge of various theories of failures for design of Mechanical components use in Industries like Joints, Bolts, Shafts etc. and Understand and develop analytical ability to design shaft subjected to combined loading.
4. Understanding the mechanism of fatigue failures of parts and its use in mechanical component design. Be able to estimate endurance strength of ductile and brittle materials and develop analytical ability to apply fatigue theories for ductile and brittle material in static and dynamic loading
5. Understand different welded and riveted joints structure and able to apply its knowledge to analyze its strength when subjected to simple, coplanar and eccentric loading.
6. Understand different stress in Power Screws and Bolted Joints and able to apply its knowledge for design of screw jack and simple bolted joint

Unit – 1: Introduction – Design for Static Strength

Basic procedure for Machine design, Phases of Design, Design Considerations, Use of Standardization in design, Aesthetic, Ergonomic and Manufacturing considerations in design, Design for static strength, stress strain relationship for CI, MS, brass, rubber, Factor of safety, design considerations for cast and forged components, modes of failure, stresses due to bending, torsion, strain energy, eccentric loading, principal stresses, combined loading, Design of simple machine parts like as cotter joint and knuckle joint

Introduction and use of software CAD and Hyperworks in design and drafting

Unit – 2: Theories of Failures and Design of Power Transmission Shafts

Theories of failures: Maximum Principal stress, Maximum Shear Stress, Distortion Energy, Max. Strain theory, Maximum total strain energy theory, Applications and problems based on above

Transmission Shaft material, design of shaft on strength basis, design of shaft on torsional and rigidity basis, design of shaft for Lateral rigidity basis, Bending and torsional moments, ASME code for standard sizes of shaft, Effect of stress concentration, design of shaft against fluctuating loads

Unit - 3: Design against Fluctuating Loads

Stress concentration, stress concentration factors, reduction of stress concentration effect, fluctuating stress- fully reversed, repeated, fluctuating, Fatigue failures, mechanism of fatigue failure, Mean stress effect- master diagram for steel, ferrous and non ferrous metals, endurance limit, S-N curve, Moore's test, low cycle and high cycle fatigue, notch sensitivity, Effect of surface finish, size, reliability, temperature, surface treatment, residual stress, manufacturing process on fatigue life, design for fatigue - finite and infinite life, Soderberg's and Goodman diagrams, modified Goodman diagram, Gerber equation, ASME Elliptic criterion, combined stresses- Miner's rule

Unit- 4: Design of Welded and Riveted Joints

Welded Joints, Types of welded joints, standard welding symbols, weld materials, design of welded joints, weld joint design for but weld, parallel fillet, transverse fillet, symmetrical section, Unsymmetrical sections, eccentric loads in plane of weld, bending moment, selection of joint by referring design data handbook

Riveted Joints: Rivet materials, rivet heads, rivet terminology, types of riveted joints, Types of failures, strength equations, efficiency of riveted joints, boiler joint- longitudinal and circumferential lap joint, design of eccentrically loaded riveted joints

Unit – 5: Design of Power Screws and Fasteners

Power screws: Terminology of power screw, Force analysis for square, trapezoidal thread, self locking of screw, efficiency of square thread, collar friction, stresses in screws, Design of screw jack, introduction to differential and compound screw, recirculating ball screw **Threaded Joints:** Terminology of ISO metric screw threads, material and manufacturing process, stresses in thread, Design of bolted joints in tension, compression, eccentrically loaded- in shear and perpendicular to axis of bolt, preloaded bolts, torque requirement for bolt tightening, use of design data hand handbook for ISO standard screw thread selection

Teachers Assessment

e- Assignments

It shall consist of the preparation presentation and submission of e-assignments by student individually based on above syllabus. (It shall consist of knowledge of above topics, linking above topics and collection of Market standard, ISO standards, Company standards, survey for design of product)

Mini Project

One design Mini-Projects is required to submit by group of two students to develop and apply knowledge of Machine Design and drafting software for any product or design system on basis of: (1) idea generation, (2) Creativity, Reliability and safety, (3) bounding solutions (4) Ergonomic Considerations (5) Use of International standard

Text Books

1. Shigley J. E. and Mischkey C. R., "Mechanical Engineering Design", TMH, New Delhi
2. Spotts M. F. and Shoup T. E., "Design of Machine Elements", Prentice Hall International
3. Hall A. S., Holowenko A. R. and Laughlin H. G., "Theory and Problems of Machine Design", Schaum's outline series, Tata McGraw Hill Publication. Co. Ltd, New Delhi
4. Bhandari V. B., "Design of Machine Elements", Tata McGraw Hill Publication. Co. Ltd, New Delhi

Reference Books

1. Black P. H. and O. E. Adam, "Machine Design", Tata McGraw Hill Publication. Co. Ltd, New Delhi
2. Burghardt M. D., "Introduction to engineering design and Problem Solving", McGraw Hill Publications
3. K. Lingaiah, "Machine Design Data book", Tata McGraw Hill Publication. Co. Ltd, New Delhi
4. Alfred Hall, Alfred Holowenko, Herman Laughlin, S. Somani, "Machine Design", Tata McGraw Hill Publication. Co. Ltd, New Delhi

ME 343: THEORY OF MACHINES

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Class Test – 20 marks
Teachers Assessment – 20 marks
End Sem. Exam – 60 marks

Course Objectives

1. To determine the balancing of masses of rotating and reciprocating machine elements
2. To understand the principles of gyroscope and governors
3. To determine the forces and power calculations for brakes and dynamometer
4. To determine the static and dynamic forces for mechanical systems
5. To understand the principles of vibrations

Course Outcomes

1. Ability to apply the principles of balancing of masses to various links, mechanisms and engines
2. Ability to apply the principles of gyroscopic effects and stabilization on various transport vehicles and applications of various governors
3. Ability to analyze the force analysis and power calculations of brakes and dynamometer
4. Ability to conduct static and dynamic force analysis and equilibrium of forces for mechanical systems
5. Ability to study the various principles of vibrations of different systems

Unit –1:

Balancing: Static balancing, dynamic balancing, balancing of several masses in different planes, force balancing of linkages, balancing of reciprocating mass, balancing of locomotives, effect of partial balancing in locomotives, balancing of inline engines, balancing of V,W,V-8 and V-12 engines, balancing of radial engines

Unit-2:

Governor: Introduction to centrifugal & inertia types governor, classification, Watt, porter, prowell spring loaded governor, Sensitivity & stability, Force diagram (Numerical)

Gyroscopic action in Machines: Introduction, Motion of a Rigid Body in Three- Dimensions, Principal Axes, Angular Velocity and Momentum about Principal Axes, Euler's Equation of Motion, Euler's Modified Equation, Simple Precession of a Symmetrical Gyroscope in Angular Precession, Gyroscopic Effects in Machines, Gyroscopic Stabilization.

Unit-3:

Brake & Dynamometers: Introduction, brake materials, types of brakes, shoe brake, pivoted shoe brake, double block brake, simple and differential block brake ,band and block brake, braking force, braking torque calculations, internal expanding brake, normal pressure braking force, braking torque, braking of vehicle when brake is applied on real wheel, front wheel , four wheels ,Types of dynamometer, rope brake, epicyclic train ,belt transmission, torsion and eddy current dynamometer, numerical treatment

Unit–4:

Static and Dynamic force analysis: Introduction to Coupler Curves- Condition of equilibrium, Constraint and applied forces, static equilibrium, equilibrium of two and three force members, equilibrium of four forces and torque, force convention and free body diagrams, principle of virtual work D'Alemberts principle, equivalent offset inertia force, dynamic analysis of four link mechanism and slider crank mechanism, Angular velocity and acceleration of connecting rod, engine force analysis

Unit-5:

Vibration: Introduction, Definitions, Types of vibration, Basic features of vibrating system, cause effects and terminology, degree of freedom, Free longitudinal vibration, displacement, velocity and acceleration, Inertia effect of the mass of spring, Damped vibration, logarithmic decrement, forced vibration, forced damped vibration, free torsional vibration (Single and Two rotor system)

Text Books

1. Rattan, "Theory of machine", Tata McGraw-Hill Publishing Co. Ltd, New Delhi
2. P. Ballaney, "Theory of machine", Khanna Publication, New Delhi
3. Jagdish Lal, "Theory of machine and Mechanisms", Metropolitan publication
4. Thomas Beven, "Theory of machine", C B S Publisher
5. K. G. Grover, "Mechanical vibration", New Chand publication, New Delhi

Reference Books

1. Shigley and Vicker, "Theory of machine", McGraw-Hill Publishing Co. Ltd, New Delhi
2. J. S. Rao & R. V. Dukkipati, Mechanism & Machine Theory, New Age Publication

ME 344: ENGINEERING MATERIALS AND METALLURGY

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Class Test – 20 marks
Teachers Assessment – 20 marks
End Term Exam – 60 marks

Course Objectives

1. To enhance the basic knowledge in the field of Material Science.
2. To get Exposure to Iron – Carbon Equilibrium Diagram and solidification of steels.
3. To understand the basic concept of Time Temperature Transformation Diagram and properties /Heat treatment of High Speed steels.
4. To correlate & understand Cast iron and Maurer's Diagram.
5. To able to explain the necessity of various Heat treatment
6. To understand the concept of Harden ability and End Quench Test.
7. To understand the concept of Non Ferrous Alloys, Bearing materials and their essential properties.
8. To be able to understand the necessity of Powder metallurgy and various manufacturing methods.

Course Outcomes

1. Understand the importance of material properties in designing the mechanical systems and identify the material for specific applications
2. Understand the changes in phases of material with respect to time and temperature
3. Identify the role of Carbon content in the material and accordingly the type of material and properties of material changes like steel and cast iron
4. Understand the change in the properties of materials by heat treatment and importance of various heat treatments and its procedures
5. Understand the types of non-ferrous materials and its alloys and their microstructure and behavior, applications

Unit – 1:

Properties of metals: Toughness, impact strength, creep and fatigue resistance etc., Relevance of properties in selection of material, Classification of Metallurgy as Ferrous and non ferrous metallurgy, Brief idea about-Iron and steel making, cast iron manufacture. Equilibrium Diagrams: construction with reference of solidification of metals and alloys, cooling curves

Unit - 2:

Equilibrium Diagrams for systems like isomorphous, eutectic, peritectic etc., Lever rule and its application with numerical, Iron carbon diagram, Study of different phases and compounds, Critical temperatures and their significance during heating and cooling, Introduction to classification of ferrous materials, Constitution of alloys and phase diagram

Unit – 3:

Alloy steel: Classification of alloying elements on Fe-C, TTT diagrams, study of tool steels like HCHC, free cutting steels, spring steels, HSLA steel, Maraging steels - heat treatments, properties and uses, HSS- heat treatment, Subzero Treatment, Stainless Steels, classification, problem of sensitization, weld decay and remedies

Cast Irons: Maurer's diagram, classification of cast irons, effect of shape and size and distribution of graphite on the properties, Gray C.I., Mechanite, malleable C.I. Nodular C.I., manufacture and applications, Comparison of steels with C.I.

Advanced Materials: Super Alloys, non metallic materials, Composites and ceramics

Unit – 4:

Necessity of heat treatments, transformations of steels during heating and cooling, Non-equilibrium cooling and transformation product of austenite, TTT diagrams, Different hardening methods, quenching media, Tempering of plane C-steels and its effects, Other heat treatments like annealing, normalizing etc; Concept of hardenability, critical diameter, End quench test; Surface / case hardening: principles of case hardening and without changing the composition, classification of the process, Flame & Induction hardening, Solid Liquid, Gas Carburizing, Nitriding, Carbonitriding, Relative merits and de merits, selection of process for an engineering components, Introduction to crystal structure

Defects in Heat treatment: Defects during heating, over heating of steels Grain coarsening, decarburizing, oxidation remedies

Unit – 5:

Non Ferrous Metals: Engineering Non Ferrous Metals and alloys Copper alloys, phase diagram for Cu-Zn and Cu-Sn, Brass Bronze, Aluminum Alloy,Al-Si, Al-Cu systems, Age hardening, Bearing materials and their essential properties, Important heat treatment on non ferrous alloys, mechanical properties and testing

Methods of surface improvement, corrosion prevention-methods, material selection, and atmosphere control

Text Books

1. V. Raghvan, "Material Science & Engineering", PHI Publication
2. V. D. Kodgire, "Metallurgy & Material Science", Everest Publication

Reference Books

1. S. Avener, "Physical Metallurgy", McGraw Hill Publication
2. Callister, "Material Science and Engineering", Wiley publication
3. Dieter, "Mechanical Metallurgy", McGraw Hill
4. ASM Handbook- Vol. 12, Material Characteristics
5. ASM Handbook- Vol. 12, Properties and selection

ME 345: FLUID MECHANICS AND HYDRAULIC MACHINES

Teaching Scheme:
Lectures: 3 hrs / week
Tutorials: 1 hr / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. To study the different types of fluid properties and their determination
2. To study and analyze the behavior of fluids under static, kinematic and dynamic states
3. To study and analyze the construction, working and performance of different impulse and reaction turbines
4. To study and analyze the construction, working and performance of centrifugal pumps and other hydraulic machines

Course Outcomes

1. Ability enhancement for the analysis of fluids under static, kinematic and dynamic states
2. Ability enhancement for the analysis and performance evaluation of different impulse and reaction turbines
3. Ability enhancement for the analysis and performance evaluation of centrifugal pumps and other hydraulic machines

4. Ability enhancement for the determination of stability of different floating objects

Unit-1: Fluid Properties & Fluid Statics

Definitions of fluid & fluid mechanics, properties of fluids like viscosity, surface tension, capillarity etc., types of fluids, illustrative examples, Definition of Fluid Statics, pressure in fluids at rest, Pascal's law, manometry, total pressure, center of pressure, hydrostatic forces on immersed plane and curved surfaces, buoyancy, metacenter and metacentric height, different kinds of equilibrium of floating bodies, illustrative examples

Unit-2: Fluid Kinematics & Fluid Dynamics

Definitions of stream line, path line, streak line, stream tube, types of fluid flows, continuity equation in Cartesian and cylindrical co-ordinates, illustrative examples

Euler's equation of motion, Bernoulli's equation from Euler's equation, energy correction factor, practical applications of Bernoulli's equation, momentum equation, momentum correction factor, engineering applications of momentum equation such as force on pipe bend and jet propulsion of ships, illustrative examples

Unit-3: Dimensional Analysis & Flow through Pipes

Dimensions of different fluid parameters, Buckingham's pie theorem, different dimensionless groups, physical meaning of dimensionless groups, types of similarities, laws of similitude, practical applications, illustrative examples, Loss of energy in pipes, major and minor losses, Hydraulic Gradient Line (HGL) and Total Energy Line (TEL), flow through series pipes, parallel pipes and branched pipes, equivalent pipe, power transmission through pipes, condition for maximum power transmission, efficiency for maximum power transmission, water hammer in pipes, illustrative examples

Unit-4: Impulse Turbines & Reaction Turbines

Impact of jet, force of jet impinging on fixed and moving flat plate, fixed and moving curved plate, hinged plate, series of moving plates, illustrative examples

Introduction to turbines, types of turbines, efficiencies of turbines, work done by an impulse turbine, power produced by an impulse turbine, Pelton turbine and its components, design of Pelton wheel, governing of Pelton wheel, illustrative examples

Components of a reaction turbine, difference between impulse and reaction turbines, classifications of reaction turbines, efficiencies of reaction turbines, Francis Turbine, Kaplan Turbine, draft tube, types of draft tubes, efficiency of draft tube, unit power, unit speed, unit discharge, specific speed of a turbine, significance of specific speed, cavitation in turbines

Unit-5: Centrifugal Pumps & Other Machines

Introduction, types of pumps, types of impellers, types of casings, priming, various heads & efficiencies of centrifugal pump, minimum starting speed of a centrifugal pump, multistage centrifugal pump, performance of pumps, principles of similarity applied to centrifugal pump, specific speed, NPSH, cavitation in pumps, illustrative examples

Text Books

1. Bansal R. K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd. New Delhi

2. Modi and Seth, “Fluid Mechanics and Hydraulic Machines”, Standard Book House, New Delhi
3. Jagdish Lal, “Hydraulic Machines”, Metropolitan Book Company

Recommended Books

1. Durgaiah Rama D., “Fluid Mechanics and Hydraulic Machines”, New Age International, New Delhi
2. E. H. Shames, “Fluid Mechanics”, McGraw Hill Publications
3. Streeter and Wylie, “Fluid Mechanics”, McGraw Hill Publications
4. Rajput R. K., “Fluid Mechanics”, S. Chand and Co., New Delhi

ME 346: LAB-DESIGN OF MACHINE ELEMENTS-I

Teaching Scheme
Practical: 4 hrs/week

Examination Scheme
Term Work – 50 marks
Practical/oral Exam– 50 marks

Course Objectives

1. To understand procedure of machine design and develop an ability to apply it for Cotter Joint Design and Knuckle Joint Design etc. and determine resisting areas against failure. Understand use of Design Data Hand Book and ISO standards for selection of materials, strengths, standard dimensions.
2. To acquire a skill of design and drafting the Bolted joint, Coupling, Cotter joint , Knuckle Joint etc by using CAD software
3. To understand the use of CAD software for design and Analysis of shaft subjected to direct and combined loading
4. To acquire a skill of design and drafting of standard welded and riveted joint as per ISO standard by using CAD software, Understand its analysis by applying forces by using software and its comparison with analytical result
5. To determine maximum force the given power screw can lift Understand its analysis by applying forces by using software and its comparison with analytical result

Course Outcomes

1. Be able to apply design knowledge for Design of Cotter Joint and Knuckle Joint etc and formulate the design procedure and acquire skill of finding resisting areas against failure. Apply the knowledge of Design Data Hand Book and ISO standards for selection of materials, strengths, standard dimensions of design components.
2. Able to apply design and drafting knowledge of CAD software for drafting assembly and details of Bolted joint, Coupling, Cotter joint, Knuckle Joint etc.
3. Develop Logical and Analytical ability to apply Knowledge of CAD for design of Shaft subjected to direct and combined loading
4. Be able to apply skill of design and drafting CAD software for standard welded and riveted joint as per ISO standard. Apply the design knowledge and formulation for safe design
5. Able to apply design procedure for finding the maximum force the given power screw can lift and able to draft and design on CAD software and compare it with analytical results.
6. Able to draft assembly and details of power screw by using CAD software and, Develop Logical and Analytical ability to check different stresses in power screw assembly

Term Work

Students shall complete the following practical

1. Design of Joint with systematic procedure of design for given loads. Drawing the assembly details and the failure areas of each component of design solution. Selection of all components Material, Strengths, standard dimensions, by using Design Data Hand Book and ISO standards (Use A1 sheet)
2. Drafting assembly and details of above joint by using CAD software and checking safe stresses on software.
3. Design of Shafts subjected to direct and combined loading for given loads and conditions and comparing design by using CAD
4. Design of standard welded or riveted joint for given loads and conditions, Analysis of design solution by using CAD software, comparison of analytical result and software results
5. Design of power screw, Drawing the assembly details and the failure areas of each component of design solution and checking safe stresses on CAD software.

Practical Examination

The Practical Examination will comprise of performing the analytical designing of components and Design on software based on above syllabus along with viva voce on the syllabus

The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 347: LAB-THEORY OF MACHINES

Teaching Scheme

Practical: 2 hrs/week

Examination Scheme

Term Work – 25 marks

Practical/oral Exam– 25 marks

Course Objectives

1. To determine the balancing of masses of rotating and reciprocating machine elements
2. To understand the principles of gyroscope and governors
3. To study working of brakes and dynamometer
4. To determine the moment of inertia of various mechanical systems
5. To understand the vibrational behavior of systems

Course Outcomes

1. Ability to apply the principles of balancing of masses to various links, mechanisms and engines
2. Ability to apply the principles of gyroscopic effects and stabilization on various transport vehicles and applications of various governors
3. Ability to understand the working principles of brakes and dynamometer
4. Ability to determine moment of inertia of mechanical systems
5. Ability to determine the vibration parameters of different systems

Term Work

Students shall complete the following practical (Any eight)

1. Draw solution of eight problems on balancing of masses (Minimum four half imperial size drawing sheets)
2. Experimental investigation on performance of balancing of masses
3. Verification of Gyroscopic principle and determination of gyroscopic couple
4. To study the Performance of Governor
5. To study principles of at least one dynamometer
6. To study the different types of brakes using models
7. To determine moment of inertia of a disc by using Single rotor system and Trifiller suspension
8. To determine moment of inertia of a uniform rod by using
    a) Bifiller suspension
    b) Compound pendulum
9. To determine equivalent mass of spring for a spring mass system
10. To determine the damping coefficient for a spring mass dash pot system to obtain experimentally frequency response curves

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 348: LAB – ENGINEERING MATERIALS AND METALLURGY

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term Work – 25 Marks
Practical / Oral: 25 Marks

Course Objectives

1. To study different crystal systems and various calculations included in the study of various crystal system.
2. To enhance knowledge in the basic operation of metallurgical microscope.
3. To study and able to interpret the observation of microstructure of Plain carbon steels.
4. To be able to study and observe microstructure of Alloy steels.
5. To be able to study microstructure of Cast iron.
6. To be able to study microstructure of Non ferrous alloys.
7. To study change of mechanical properties due to change in microstructure.
8. To be able to study change in structure due to surface / case hardening of steels.

Course Outcomes

1. Exposure to different crystal systems and various calculation included in the study of crystal system.
2. Overview of operation of metallurgical microscope and various parameters included in it.
3. Significance of observation of microstructure of plain carbon steels.
4. Significance of observation of microstructure of alloy steels
5. To be able to interpret and observe microstructure of Cast iron.
6. Exposure to study of microstructure of Non ferrous alloys.

7. Necessity and study of mechanical properties due to change in microstructure.
8. Study of change in structure due to surface /case hardening of steels.

Term Work

The term work shall consist of file of experiments based on the above syllabus as mentioned below-

1. Observation of the different crystal systems
2. Operations of metallurgical microscope
3. Preparation of the specimen for microscopic examination
4. Mounting of the specimen in a plastic mould
5. Observations of the microstructure of the plain carbon steels
6. Observations of the microstructures of alloy steels
7. Observations of microstructure of the cast iron
8. Observations of the microstructure of the nonferrous alloys
9. Study of change of mechanical properties due to the change in microstructure
10. Study of the change in the structures due to surface/case hardening of steels

• The term work will consist of submitting a file for all the experiments with neatly written records of the study, observations, calculations and diagrams.
• The term work will be assessed by the course coordinator

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 349: LAB-FLUID MECHANICS AND HYDRAULIC MACHINES

Teaching Scheme:
Practical: 2 hrs / week

Examination Scheme:
Term Work: 25 Marks
Practical / Oral: 25 Marks

Course Objectives

1. To know the practical application of Redwood viscometer to determine the kinematic viscosity of the fluid
2. To know the practical usefulness of Reynolds number, Bernoulli's theorem & momentum principle
3. To know how to determine practically the metacentric height of any floating object and to study its effect on stability
4. To know the practical determination of powers and efficiencies of impulse and reaction turbines
5. To know the practical working of various types of pumps and how to determine their efficiencies

Course Outcomes

1. Ability enhancement in practical determination of fluid viscosities and to decide the flow patterns
2. Ability enhancement in applying Bernoulli's theorem & momentum principle to various flow patterns
3. Ability enhancement in applying theoretical knowledge to find the performance of different turbines and pumps

Term Work

The term work shall consist of the record of at least eight experiments performed from the following list of experiments:

List of experiments in Fluid Mechanics:

1. Experiment on Red wood viscometer
2. Experiment on Reynolds's apparatus
3. Experiment on Bernoulli's theorem
4. Experiment on flow measurement by orifice & venturimeter
5. Experiment on verification of momentum principle
6. Experiment on determination of force due to impact of jet
7. Experiment on determination of metacentric height of a floating body
8. Experiment on flow through pipes

List of experiments in fluid machines

1. Trial on Pelton wheel
2. Trial on Francis turbine
3. Trial on Kaplan turbine
4. Trial on centrifugal pump
5. Trial on gear pump
6. Trial on torque converter
7. Trial on reciprocating pump
8. Visit to hydroelectric power station

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 350: LAB-COMPUTER APPLICATION IN MECHANICAL ENGINEERING-II

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term work: 25 marks
Practical/Oral: 25 marks

Course Objectives

1. To understand 3D drafting and analysis software used for modeling and analysis

Course Outcomes

1. Ability to perform both 2D and 3D drafting of component using CAD software
2. Ability to visualize and model the parts of machine
3. Ability to construct assemblies from the concepts learnt using drafting softwares

Term work

At least two problems on 3D drafting and analysis of mechanical components on any of the available 3D CAD packages in the laboratory. The problems should be done individually by the students.

• The term work will consist of submitting a file for all the problems with neatly written records and printouts of the models.
• The term work will be assessed by the course coordinator

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 351: DESIGN OF MACHINE ELEMENTS – II

Teaching Scheme:
Lectures: 3 hrs / week
Tutorials: 1 hr / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. To understand use of different types springs and determine safe design of spring under given conditions by using design data hand book.
2. To understand the standard nomenclature, forces, failures, application, design procedure of Spur and Helical gears (As per AGMA) and to determine standard geometry under given loading condition by using design data hand book and AGMA procedure.
3. To understand the standard nomenclature, forces, failures, application, design procedure of Bevel and Worm gears (As per AGMA) and to determine standard geometry under given loading condition by using design data hand book and AGMA procedure.
4. To understand different types of clutches and brakes, its failures, applications and determine standard design procedure for single and multi-plate clutches and different types of brakes
5. To understand the different types of bearings, application, failures, design procedure of Ball Bearings (As per Manufacturer Catalog) and Sliding contact bearing and to determine standard design procedure of bearing under different loading condition by using design data hand book
6. Understand the design optimization and various methods of Optimization

Course Outcomes

1. Ability to apply Knowledge of Machine Drawing, Material Science, Design of Machine Element-I for design procedures of Mechanical components use in Industries and incorporated in Machine Design.
2. Apply the design and development procedure for different types of springs by using Design Data Hand book
3. Understand the standard geometry, application, failures of Spur and Helical Gear and Design and Developed effectively Spur and Helical Gears for different loading conditions, Analyze working of gear trains.
4. Understand the standard geometry, application, failures of Bevel and Worm Gear and Design and Developed effectively Bevel and Worm Gear for different loading conditions.

5. Understand the standard geometry, applications, failures of Ball bearing and Sliding contact bearings and Design and Developed effectively Ball Bearing and Sliding contact bearings for different loading conditions as per manufacturer catalog.
6. Understand different methods of Optimization and ability to apply Jonson's Optimization for simple design conditions.

Unit – 1: Springs

Functions of springs, types of springs, spring rate, closed coil helical springs, design equations, Wahl's correction factor, deflection of springs, design against static load, design against fluctuating load, effect of end turns, surging, optimum design of springs, fatigue loading, helical torsion spring, leaf spring, nipping of leaf spring, design equations

Unit - 2: Design of Spur and Helical Gears

Spur gear: nomenclature, force analysis, types of failures, beam and wear strength equations, effective load, dynamic effect, Buckingham's equation, AGMA approach, Spott's equation, different approaches used in design.

Helical Gear: terminology of helical gears, formative number of teeth, force analysis, beam strength, effective load on gear tooth, wear strength, Design of simple and compound gear trains.

Unit – 3: Design of Bevel and Worm Gears

Bevel gears: terminology, bevel factor, relations of different angles, beam strength, wear strength, effective load, design equations

Worm gears: geometry, terminology, force analysis, friction in worm gears, design for beam strength, wear consideration, and heat dissipation, empirical relations (only AGMA approach)

Unit – 4: Design of Clutches and Brakes

Clutches: friction clutches, uniform intensity of pressure and uniform rate of wear in conical and flat pivot, materials and design equations for single, multi-plate cone and centrifugal clutch

Brakes: types, short shoe brakes, frictional torque, long shoe brakes, internal and external shoe brakes, frictional torque and force analysis, simple, differential and additive types of bond brakes, heat dissipation, material for lining

Unit – 5: Design of sliding and rolling contact bearings and Design optimization

Sliding contact bearings: viscosity, petroff's law, hydrostatic lubrication, hydrostatic step bearing, hydrodynamic theory, Reynolds's equation, Summerfield number, hydrodynamic bearing performance, Raimondi and Boyd's method

Rolling contact bearings: Types of rolling contact bearings, Hertz contact stresses, static load carrying capacity, striebeck equation, dynamic load carrying capacity, equivalent bearing load, load life relationship, load factor, selection of bearing, roller bearings, lubrication and mounting of bearings. Design optimization, Different Methods of Optimization. Johnson's Method for size, shape, weight for simple parts.

Teachers Assessment

e- Assignments

It shall consist of the preparation presentation and submission of e-assignments by student individually based on above syllabus. (It shall consist of knowledge of above topics, linking above topics and collection of Market standard, ISO standards, Company standards, survey for design of product)

Mini Project

One design Mini-Projects is required to submit by group of two students to develop and apply knowledge of Machine Design and drafting software for any product or design system on basis of : (1) idea generation, (2) Creativity, Reliability and safety, (3) bounding solutions (4) Ergonomic Considerations (5) Use of International standard

Text Books

1. Shigley J. E. and Mischkey C. R., "Mechanical Engineering Design", TMH, New Delhi
2. Spotts M. F. and Shoup T. E., "Design of Machine Elements", Prentice Hall International
3. Hall A. S., Holowenko A. R. and Laughlin H. G., "Theory and Problems of Machine Design", Schaum's outline series, Tata McGraw Hill Publication. Co. Ltd, New Delhi
4. Bhandari V. B., "Design of Machine Elements", Tata McGraw Hill Publication. Co. Ltd, New Delhi

Reference Books

1. Black P. H. and O. E. Adam, "Machine Design", Tata McGraw Hill Publication. Co. Ltd, New Delhi
2. Burghardt M. D., "Introduction to engineering design and Problem Solving", McGraw Hill Publications
3. K. Lingaiah, "Machine Design Data book", Tata McGraw Hill Publication. Co. Ltd, New Delhi
4. Alfred Hall, Alfred Holowenko, Herman Laughlin, Somani, "MACHINE DESIGN", Tata McGraw Hill Publication. Co. Ltd, New Delhi

ME 352: HEAT AND MASS TRANSFER

Teaching Scheme:
Lectures: 3 hrs / week
Tutorials: 1 hr / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. To understand the different laws and mechanisms of different modes of heat transfer like conduction, convection and radiation
2. To understand to analyze the steady state and unsteady state conduction mode of heat transfer
3. To understand the need, application and performance evaluation of various types of fins
4. To understand the construction, working and performance of different heat exchangers

Course Outcomes

1. Students will demonstrate an understanding of the basic concepts of conduction, radiation, and convection heat transfer.
2. To extend the basic principle of conservation of energy to systems which involve multi mode of heat transfer.
3. Calculate steady and unsteady state heat conduction in one dimension.
4. Calculate the convection heat transfer coefficient in different convection environments.
5. Calculate the radiant heat transfer between solid bodies, black or gray in nature.
6. To analyze and solve heat transfer problems in all three modes, formulate the necessary equations and calculate the temperature distributions and rates of heat transfer.
7. To apply the basic concepts of heat transfer and fluid flow to heat exchanger design.
8. Test performance and measure heat/ mass transfer parameters of several engineering systems

Unit-1: Steady State Heat Conduction

Modes of heat transfer, basic laws governing modes of heat transfer, general three dimensional heat conduction equation in Cartesian and cylindrical co-ordinates, simplification to steady state, unidirectional heat transfer equation and temperature distribution equation, with and without internal heat generation for simple case like slabs, cylinders & spheres; electrical analogy, contact resistance, composite system, critical thickness of insulation, illustrative examples

Unit-2: Unsteady State Heat Conduction & Fins

Lumped heat capacity system, Biot number, unsteady state heat transfer for lumped capacity system, time constant of thermocouples, illustrative examples. Definition, need, types of extended surfaces, temperature distribution equations and heat transfer equations for pin fins and rectangular circumferential fins with various end conditions, fin efficiency, fin effectiveness, thermometric error using fin theory, illustrative examples

Two dimensional heat conduction with numerical method for solution.

Unit-3: Convection

Thermal boundary layer, heat transfer in flow through pipe, entry length, heat transfer in high speed flow, free and forced convection over vertical / horizontal plate, pipe/cylinder and sphere using empirical relations only, cup temperature; pool boiling, Nusselt theory of condensation, film-wise/drop-wise condensation, heat transfer through pipe at constant temperature & constant heat flow, illustrative examples

Unit-4: Radiation

Mechanism of radiation, thermal radiation, definitions like black body, white body, grey body, reflectivity, absorptive, transmitivity, emissivity, emissive power, monochromatic emissive power, solid angle, intensity of radiation, radioity, irradiation Lambert's cosine law, Kirchhoff's law, Plank's distribution law, Wien's displacement law, radiation shape factor for geometrical arrangements, electrical analogy, radiative heat transfer between two large grey surfaces placed at distance with different temperature, heat transfer between concentric cylinders, spheres with different temperature, use of radiation shields, errors in thermo couple reading in radiative heat transfer, illustrative examples

Unit-5: Heat Exchangers and Mass transfer

Introduction, classification, parallel flow and counter flow heat exchangers, applications, fouling and fouling factors, overall heat transfer coefficient, LMTD method, NTU effectiveness method of design, pressure drop, optimizations, design by LMTD method for condensers, illustrative examples, Compact heat exchanger: plat-fin type heat exchanger.

Introduction to mass transfer, Fick's law, dimensionless numbers: Sherwood, Schmidt, Peclet, Rayleigh

Text Books

1. Sukhatme S. P., "A text book of Heat Transfer", Universities Press (Pvt Ltd), Hyderabad
2. Holman J. P., "Heat transfer", McGraw Hill Publishing, New York
3. Sucec James, "Heat transfer", JAICO publication house, New Delhi

Reference Books

1. Sachdeva R. C., "Fundamentals of Engineering Heat and Mass Transfer", New Age Science Limited, Delhi
2. Frank Kreith, "Principles of Heat transfer", Cengage Learning, New York
3. Kothandraman, "Heat and Mass transfer Data Book" New Age International Publication, Delhi
4. Thirumaleshwar M., "Fundamentals of Heat and Mass Transfer", Pearson Education., New Delhi

ME 353: METROLOGY AND QUALITY CONTROL

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. To determine measuring instruments capabilities
2. To introduce measuring instruments used for linear and angular measurement
3. To introduce concept of limits and fits for engineering applications
4. To study Various comparative measurements
5. To study Control chart techniques in quality control
6. To study Purpose and use of sampling and its benefits

Course Outcomes

1. To process and assess the quality of measured data engineering. - Ways of verification: laboratory works, Ability to gather, classify, select measurement data and assess
2. Students will be able to work in Quality control and quality assurances divisions in industries
3. Students will be able to maintain quality in engineering products.

4. Understand the basic theoretical, technical and legislative aspects of metrology, testing and quality management
5. To acquire knowledge of the exact measurements of selected physical quantity and the evaluation of metrological measurements
6. To know the organizational structures of metrology and testing laboratory in the world. Understand the principles of quality management, quality tools, SQC.

Unit 1

Definition and concept of metrology, Standardization and standardizations, International system of units, Methods of measurements, standards of measurements: Standards, standards of linear measurement, Line standard including linear standard meter, End standard, wavelength standard,
Classification of standards of traceability, Linear measurements: Surface palate, angle plate, V-block, Bench centers, Combination set, radius gauges, Feeler gauges, Angle gauges, Pitch screw gauge, Principle of venires, venire height gauge, venire depth gauge, Micrometers, Types of micrometers, Slip gauges, wringing of slip gauges, care in use of slip gauges

Unit 2

Limits: tolerances, different ways of expressing accumulation, relationship between tolerances and cost, maximum and minimum metal conditions, Indian standard (IS 919-1963) **Fits:** terminology for limits and fits, types of fits, hole basis system, shaft basis system, selection of fits, types of assemblies like trial and error, interchangeable assembly, Gauges: Plain gauges, ring gauges, snap gauges, adjustable gap gauges, control and profile gauges, material for gauges, Gauge design: Taylor's principle, gauge maker's tolerance, wear allowances, numerical on gauge design

Unit 3

Comparators: Introduction, types of comparators, construction and working of different types of comparators like mechanical, optical, electric, pneumatic, Angular measurements: Venire bevel protector, universal bevel protector, sine bar, angle gauges, optical instrument like auto collimator, angle dekkor Measurement of surface finish: Definition, terminology, methods of measuring surface finish, Analysis of surface traces, assessment of surface roughness as per Indian standards, Metrology of screw threads: Screw threads terminology, error in threads and their effects, measurements of various elements of threads

Unit 4

Quality Control: Quality : Definitions, meaning of quality of product & services, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Concept of reliability, Cost, Quantity assurance, Cost of rework & repair, Quality & Inspection, Inspection stages.
ISO 9000 Series & other standards: Concept, ISO 9000 series quality standards, QS14000, Standards in general, Its evaluation & Implications, necessity of ISO certification, other Quality systems

Unit 5

Statistical Quality Control – Meaning and importance of SQC, Variable and attribute Measurement. control charts – inherent and assignable sources of variation, control charts for variables – X & R charts,

control charts for attributes p, np, C charts, process capability of machine, determination of statistical limits, different possibilities, Rejection area, Statistically capable and incapable processes, Cp, Cpk.
Acceptance Sampling – Concept, Comparison with 100% inspection, Different types of sampling plans, with merits and demerits, OC curve, It's importance and significance, Producers risk, Consumer's risk, AQL, AOQL, IQL, LTPD

Text Books
1. Jain R. K., "Engineering Metrology", Khanna Publishers, Delhi
2. Gupta I. C., A Text book of Engineering Metrology, Dhanpat Rai and Sons.

Reference Books
1. ASTE, Handbook of Industrial Metrology, PHI Publications.
2. Grant and Leavenworth, "Statistical Quality Control", McGraw Hill publication
3. Quality Control, NITTTR Madras, Tata McGraw Hill Publishing Ltd.
4. Hume K J, "Engineering Metrology", Macdonald & Company Limited, London

ME 354: INDUSTRIAL ENGINEERING

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives
1) To study the basics and details of Production, planning and control
2) To understand the use of work study, method study and Time study analysis related to production
3) To enable students to do the material and purchase management and inventory control
4) To study about the Plant location and lay outs
5) To enable to use the Demand forecasting and Production information system

Course Outcomes
1) To provide an introductory course in Production.
2) To present the student with an overall view of the decision-making process as it relates to the major areas of Production.
3) To present the principles of operations economies (how to employ labor materials, machines, and capital) in a balance to match the changing relative values of the basic components.
4) The course will provide students with knowledge that can be applied in an industry for production planning and scheduling, as well as for its realization by production management.

Unit - 1: Production Planning & Control (PPC)
Introduction, need, objectives, phases, functions of PPC, aggregate planning, master production schedule, capacity planning, measurement of capacity, process of capacity planning, routing, techniques

of routing, scheduling, objectives of scheduling, scheduling methodology, loading, production control, objectives of production control, techniques of production control.

Unit - 2: Work Study

Introduction, advantages of work study, method study, objectives of method study, scope of method study, steps involved in method study, charts used in method study, motion study, principles of motion study, recording techniques of motion and study, work measurement, objectives of work measurement, techniques of work measurement, time study, computation of standard time, introduction to MOST

Unit - 3: Materials Management

Introduction and meaning, objectives of materials management, importance of materials management, purchasing, purchasing procedure, reasons for keeping inventory, inventory control, benefits of inventory control, standardization, simplification, value analysis

Unit - 4:

Plant Location: Introduction, importance of plant location, dynamic nature of plant location, factors responsible for plant location, location analysis

Layout Planning: Introduction and meaning, objectives of layout, principles of plant layout, advantages of good layout, types of layout, techniques of plant layout, features of good layout, factors relevant for the choice of layout, revising and improving plant layout

Unit - 5:

Demand Forecasting: Introduction, objectives of demand forecasting, importance of demand forecasting, steps in forecasting, techniques of forecasting, other methods of forecasting

Production Information System: Introduction, fundamentals of production information system, production planning system, production control system, materials management information systems

Reliability: Introduction, Concepts and applications in Engineering

Text Books

1. K C Jain, L N Agrawal, "Production, Planning and Control", Khanna publishers, Delhi.
2. S. N. Chary, "Production and Operations Management", Tata Mc-Graw Hill Publishing Company Limited, New Delhi
3. Dr. B. S. Goel, "Production Operations Management", Pragati Prakashan,Meerut, India

Reference Books

1. S. Anil Kumar, "Production and Operations Management", New Age International Publishers.
2. "Introduction to Work Study", ILO, Geneva
3. Everett E. Adam, Jr, Ronald J. Ebert, "Production and Operations Management", Prentice Hall of India, Private Limited, New Delhi

ME 355: MECHANICAL MEASUREMENTS

Teaching Scheme:
Lectures: 2 hrs / week

Examination Scheme:
Class Test: 10 Marks

Teachers Assessment: 10 Marks
End Sem. Exam: 30 Marks

Course Objectives

1) To study the basics and principle of measurement systems
2) To enable the students for use of displacement, Torque and strain measuring devices
3) To study the angular velocity, pressure and Vaccum measuring devices
4) To know the working and principles of acceleration and temperature measuring instruments

Course Outcomes

1) To able to understand the use and principles of measuring devices and error measurements
2) To study the working of various displacements, strain measuring devices
3) Enable the students to measure angular velocity, pressure measurement and vaccum by using various instruments
4) To study working and principles of acceleration and temperature measuring instruments

Unit -I

Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. **Static characteristics:** Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc.

Error in measurement: Types of errors, Effect of component errors on combination and distribution of combination errors on components, Probable errors.

Unit -II

Displacement measurement: Transducers for displacement measurement, Potentiometers, LVDT, Capacitance type, Digital transducers (optical encoder), Nozzle flapper transducer.

Strain measurement: Theory of Strain Gauges, Gauge factor, Temperature compensation, Bridge circuit, Orientation of Strain Gauges for Force and Torque measurement, Strain Gauge based Load Cells and Torque Sensors.

Unit -III

Measurement of angular velocity: Tachometers, Tacho-generators, digital tachometers and stroboscopic methods.

Pressure measurement: Pressure standards, Elastic pressure transducers viz. Bourdon Tubes, Diaphragm, Bellows and piezoelectric pressure sensors. High−pressure measurements, Bridgman gauges Calibration of pressure sensors.

Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges.

Unit -IV

Acceleration Measurement: Theory of accelerometers and vibro-meters, Practical Accelerometers, strain gauge based and piezoelectric accelerometers.

Temperature measurement: Thermodynamic Temperature Scale and IPTS, Electrical methods of temperature measurement, Resistance thermometers, Thermistors and Thermocouples, Pyrometers.

Text Books

1. Sawhney A K, "Mechanical Measurements and Instruments", Dhanpat Rai & Sons. New Delhi.
2. Rangan C. S, Sarma G. R.," Instrumentation Devices and Systems", Tata McGraw Hill, Delhi
3. Kumar D S," Mechanical Measurements and Control" Metropolitan publication, Delhi

Reference Books:

1. J. P. Holman, Experimental Methods for Engineers, McGraw Hills Int. Edition.
2. E. O. Doebelin, "Engineering Experimentation: planning , Execution, Reporting", McGraw Hills Int. Edition.
3. Richard, Figliola," Theory and Design for Mechanical Measurements", 3rd ed., Wiley
4. E. O. Doebelin, Measurement Systems: Applications and Design", 5th ed., McGraw Hill.
5.Thomas Beckwith, N. Lewis Buck, Roy Marangoni, "Mechanical Engineering Measurement", Narosa Publishing House, Bombay.

ME 356: LAB- DESIGN OF MACHINE ELEMENTS – II

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term work: 25 marks
Practical/Oral: 25 marks

Course Objectives

1. Analyze and develop design procedure for single plate or multi-plate clutches for given loading by use of Design Data Hand Book
2. To acquire a skill of modeling and analysis of single plate or multi-plate clutches by using CAD software
3. Analyze and develop design procedure for Spur Gear or Bevel Gear for given loading by use of Design Data Hand Book
4. Analyze and develop design procedure for Bevel Gear or Worm Gear for given loading by use of Design Data Hand Book
5. To acquire a skill of modeling and analysis of Gear Train by using CAD software
6. To acquire a skill of modeling and analysis of Ball Bearings or Sliding Bearing and optimization of sizes by using CAD software

Course Outcomes

1. Be able to apply design knowledge for Design of single plate or multi-plate clutches and formulate the design procedure for different loading conditions.
2. Able to apply design and modeling knowledge of CAD software for single plate or multi-plate clutches
3. Be able to apply design knowledge for Design of Spur Gear or Helical Gear for given loading and formulate the design procedure for different loading conditions.
4. Able to apply design knowledge for Design of Bevel Gear or Worm Gear for given loading and formulate the design procedure for different loading conditions.

5. Able to apply design and modeling knowledge of CAD software for "Gear Train" and determining its stress analysis.
6. Able to apply design and modeling knowledge of CAD software for Ball Bearings or Sliding Contact Bearing and determining its stress analysis.
7. Able to apply design and modeling knowledge of CAD software for "Design Optimization" for any component

Term Work

Students shall complete the following practical

1. Design of single plate or multi-plate clutches and formulates the design procedure for different loading conditions.
2. 2D and 3D Modeling assembly and details of single plate or multi-plate clutches by using CAD software and Analyzing safe stresses on software.
3. Design of Spur Gear or Helical Gear, Bevel Gear or Worm Gear and formulate the design procedure for different loading conditions.
4. 2D and 3D Modeling details of Spur Gear or Helical Gear, Bevel Gear or Worm Gear by using CAD software and Analyzing safe stresses on software.
5. Design of "Gear Train" and formulate the design procedure for different loading conditions and its 2D and 3D Modeling assembly and details
6. Design of Ball Bearings or Sliding Contact Bearing and formulate the design procedure for different loading conditions.
7. "Design Optimization" for any above component by using CAD software

Practical Examination

The Practical Examination will comprise of performing the analytical designing of components and Design on software based on above syllabus along with viva voce on the syllabus

The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 357: LAB-HEAT AND MASS TRANSFER

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term work: 25 marks
Practical/Oral: 25 marks

Course Objectives

This course is designed to introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems. Experiments are designed to demonstrate computation of performance using measurement of temperature field and fundamentals of heat and mass transfer.

Performance of heat exchangers, extended surfaces under different operating conditions is evaluated by measuring some engineering parameters.

Course Outcomes

Upon successful completion of this course, the student will be able to:

1. Understand the basic laws of heat transfer.
2. Account for the consequence of heat transfer in thermal analyses of engineering systems.
3. Analyze problems involving steady state heat conduction in simple geometries.
4. Develop solutions for transient heat conduction in simple geometries.
5. Obtain numerical solutions for conduction and radiation heat transfer problems.
6. Understand the fundamentals of convective heat transfer process.
7. Calculate performance of composite wall in heat transfer
8. Calculate thermal conductivity of metal rod, insulting powder.
9. Determine performance of pin fin under different tip conditions.
10. Determine Steffen Boltzmann constant
11. Determine emissivity of test surface.
12. Determination of critical heat flux.
13. Analyze heat exchanger performance by using the method of log mean temperature difference.
14. Calculate radiation heat transfer between black body surfaces.
15. Calculate radiation heat exchange between gray body surfaces.

Term Work

The practical work shall consist of a record of set of at least eight experiments as listed below

1. Determination of thermal conductivity of composite wall
2. Determination of thermal conductivity of metal rod in one dimension
3. Determination of thermal conductivity of insulating material
4. Determination of time constant of lumped heat capacity system.
5. Determination of pin fins performance under different tip condition
6. Experiment on forced convection
7. Determination of critical heat flux
8. Study of drop-wise & film-wise condensation
9. Experimental determination of Stefan-Boltzmann constant
10. Determination of emissivity of test surface
11. Determination of LMTD of double pipe heat exchanger
12. Determination of LMTD of shell & tube heat exchanger

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 358: LAB METROLOGY AND QUALITY CONTROL

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term work: 25 marks
Practical/Oral: 25 marks

Course Objectives

Students will be able to:

1. Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology

2. Select appropriate instrument/s for specific measurement.
3. Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.
4. Construct and draw the control charts.
5. Understand ISO certification procedure and quality system.

Course Outcomes

Able to
1. Proper alignment of the instrument with work piece
2. Handling of measuring instruments
3. Care and maintenance of instruments.
4. Measure the angle, surface finish using the instruments.
5. Calibration and traceability of the instruments
6. Graphical representation of data.

Term work

The practical work shall consist of a record of experiments as listed below
1. Demonstration and experimentation on measuring instruments for linear measurements
2. Demonstration and experimentation on sine bar, sine centre
3. Demonstration and experimentation on different types of comparators
4. Demonstration and experimentation on auto-collimator/angle dekkor
5. Demonstration and experimentation on surface finish measuring instruments
6. Demonstration and experimentation on screw thread measuring instruments
7. Inspection of production job by statistical process control
8. Study control charts for statistical quality control

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 359: LAB – MECHANICAL MEASUREMENTS

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term work: 25 marks
Practical/Oral: 25 marks

Course Objectives

1. Familiarity with different types of measurement systems/devices for engineering measurements
2. General knowledge and hands-on experience using transducers for measurement of force, strain, position, velocity, and temperature
3. Capability to handle different types of measurement signals and utilize this capability to obtain reliable measurement results
4. Ability and practice in engineering report writing, including assessment and manipulation of data, and drawing conclusions from that data

5. Development of team working skills, organization, and task management

Course Outcomes

Able to

1. To understand principle, working of various measuring instruments.
2. Selection of proper instruments for measurement
3. Setting the instruments for zero error adjustment
4. Calculation of least count of instrument
5. Use a variety of equipment and techniques to measure force, flow, pressure, temperature, speed, strain, rotational position.
6. Collection, recording and analysis of data
7. Apply analytical and experimental methods to make measurements and to find and correct defects in measurement systems.

Term work

1. Study and demonstration of generalized measurement system with a typical instruments
2. Measurement of force using any one force measuring instrument
3. Measurement of flow using any one flow measuring instrument
4. Measurement of pressure using any one pressure measuring instrument
5. Measurement of temperature using any one temperature measuring instrument
6. Measurement of speed using any one speed measuring instrument
7. Measurement of displacement using LVDT
8. Measurement of torque using any one torque measuring instrument

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 360: LAB- INDUSTRIAL INTERACTION

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term work: 25 marks
Practical/Oral: 25 marks

Course Objectives

1. To cultivate symbiotic relationship between college and industry as well as college and other research institutes.
2. To provide ample opportunities for industry exposure to students through industry visits, summer internship and industry projects.
3. Interact with the engineers in industry and get acquainted with the latest technologies and use theoretical knowledge for solving ‘real life’ problems encountered in industry

Course Outcomes

1. Awareness about the job functions in the industry

2. Attitudes to adapt to industrial environment
3. Proper practical and relevant knowledge and skills
4. Capabilities to become self-employed

Term Work

Student has undergo industrial training of minimum three weeks and submit a report of industrial training of atleast 30 pages containing Organization goal, history, structure, layout, departmental details, PPC, material management, R&D etc

Practical Examination

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus
The practical will be assessed by two examiners, one will be the course coordinator and other will be examiner appointed by BOS

ME 361: POWER PLANT ENGINEERING

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. Define terms and factors associated with power plant economics.
2. Calculate present worth, depreciation cost of different types of power plants.
3. List types, principles of operations, components and applications of steam turbine power plants, steam generators.
4. Describe basic working principles of gas turbine and diesel engine power plants.
5. Define the performance characteristics and components of such power plants.
6. List the principal components and types of nuclear reactors.
7. Understand the basics of pollution from power plants, thermal pollution, air pollution, and its environmental effects.
8. Understand the various devices for energy storage.

Course Outcomes: students will be able to

1. Analyze the economics of power generation.
2. Understand basics of steam turbine power plants.
3. knowledge of power generation systems like thermal power, hydraulic power, nuclear power
4. knowledge of environmental impact of power plant and their remedies
5. Knowledge of various energy storage devices.

Unit –1: Economics of Power Generation:

Type of loads, demand factor, load factor, diversity factor, utilization factor, plant capacity factor, and plant use factor. Load curves, load duration curves. (Numerical) Location of power plant, Layout of power plant building. Cost analysis: capital cost, operational cost, initial cost, interest, depreciation cost. Selection of type of power generation, selection of power plant equipments, economics in plant

selection, factors affecting economics of generation and distribution of power. Performance and operating characteristics of power plants, economic load sharing.

Unit-2: Steam power plants:
Classification, layout of a modern steam power plant, essential requirements of steam power station design, selection of site for steam power station, capacity of steam power plants, choice of steam conditions. Coal handling systems, fluidized bed combustion, ash handling, dust collection, disposal and applications of fly ash, chimney draught. Classification of steam turbines, energy losses in steam turbines, governing and control.

Unit-3: Power Plants:
Nuclear: Atomic structure, Nuclear reaction, Nuclear stability and energy of binding , radioactive decay and half life, heat transfer and fluid flow in nuclear reactors, types of reactors, metals for nuclear energy, advantages of nuclear power plants, site selection, safety measures, India's nuclear power program;
Hydro-electric: classification, advantages and disadvantages, selection of site, hydrologic cycle, essential elements of hydroelectric power plant, hydraulic turbines: classification, Pelton wheel, Francis turbine, Propeller and Kaplan turbines, comparison of turbines, cavitations, performance of turbines, governing, safety measures, comparison of hydro power station with thermal power station.
Diesel Engine Power Plant: application, advantages and disadvantages, typed of Diesel plants, essential components of Diesel engine power plants, layout,
Gas Turbines Power Plant: applications, advantages and disadvantages, site selection, layout, classification, components of gas turbines plant, gas turbine fuels, Gas Turbine materials.

Unit-4: Environmental Impact of Power Plant Operation:
Pollution from thermal power plants, Thermal pollution: sources, side effects, measurement, control. Air pollution: sources, effects on health, effects on material, gaseous emission and its control, particulate emission and its control, green house effect, acid rain, acid snow, photochemical smog, dry acidic deposition, flue gas desulfurization system. Pollution from nuclear power plants: nuclear power and environment, storage and disposal of radioactive waste.

Unit-5: Energy Storage:
Pumped Hydro, Compressed Air Energy Storage (CAES), Flywheel Energy storage, Electrochemical Energy Storage, Magnetic Energy Storage, Thermal Energy Storage, Chemical Energy Storage, Hydrogen Energy

Text Books

1. P K Nag, “Power Plant Engineering”, Tata McGraw Hill
2. R K Rajput, “Power Plant Engineering”, Laxmi Publications (P) Ltd.
3. Arora and Domkundwar,”A Course in Power Plant Engineering”, Dhanpat Rai & Co., Delhi

Reference Books

1. M. M. El Wakil, “ Power plant technology”, Tata McGraw Hill
2. S M Khopkar, “ Environmental Pollution : Monitoring and Control”, New Age International Publishers,

3. Dr B B Parulekar, " Energy Technology", Khanna Publishers, Delhi
4. A K Raja, "Power Plant Engineering", New Age International Publishers, Delhi

ME 362: INDUSTRIAL ORGANIZATION AND MANAGEMENT

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. Students are able to understand the concepts of difference between management, administration and organization and its levels of management
2. Students are able to understand concepts of different types of industrial ownerships and rules and regulation of acts related to industrial ownership
3. Understand the function of management like, planning, forecasting, decision making and industrial safety
4. Able to improve different types of costing and depreciation
5. Able to understand concepts of replacement equipment, machineries with economical justification

Course Outcomes

1. Capable to plan and administrate the organization
2. Capable to understand the types of industrial ownership and methods of fund generation for industries establishment
3. Capable to understand the different functions of management
4. Capable to calculate the cost, price and value of product and depreciation
5. Capable to decide reasons for replacement and affects of replacement of machine, equipments in terms of profit/loan

Unit –1: Theories of Management

Scientific Management (Taylor and the Scientific Management Movement), Classical Theory (Fayol, Urwick, Gulick and others) Bureaucratic Theory (Weber and his critics). Ideas of Mary Parker Follett and C.I. Barnard; Human Relations School (Elton Mayo and others). Behavioral Approach, Systems approach.

Unit-2: Administrative Behavior

Decision making with special reference to H. Simon, communication and control, leadership theories. Theories of motivation (Maslow and Herzberg)

Unit-3: Organisation

Hierarchy, Principles of organization- Unity of command, Span of control, Authority and Responsibility, Co-ordination, Centralization and Decentralization, Delegation, Supervision, Types of organizations, structures

Unit–4: Personnel Administration

Position classification, Recruitment, Training, Promotion, Pay and Service conditions, Administrative Ethics

Unit-5: Administrative Systems

Comparative management features of USA, Great Britain, France and Japan (Riggs concept)

Text Books

1. O. P. Khanna, "Industrial Organization and Management, Khanna Publications
2. D. Ravindra Prasad and V. S. Prasad, Admistrative Thinkers, Sterling Publishers, New Delhi

Reference Books

(1) Paul Hersey, Management of organisation behavior, Pearson Prentice Hall
(2) D. Gvishiyani, Organisation and Management, Progress Publishers, Moscow

ME 363: INTRODUCTION TO FINITE ELEMENT METHOD

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. Understand how and why finite element techniques work.
2. Learn how the finite element method is implemented.
3. Develop finite element formulations of engineering problems from a variety of application areas including structural mechanics, Heat transfer and fluid mechanics.
4. Understand how to use finite element analysis in design.

Course Outcomes

1. Understand the general steps of finite element methods.
2. Identify mathematical model for solution of common engineering problems.
3. Understand the basic finite element formulation techniques.
4. Formulate simple problems into finite elements.
5. Be able to derive equations in finite element methods for 1D, 2D and 3D problems
6. Be able to formulate and solve basic problems in heat transfer, solid mechanics and fluid mechanics.
7. Students will learn the mathematical formulation of the finite element method and how to apply it to basic (linear) ordinary and partial differential equations.

Unit – 1: Introduction

Basic concept, Historical background, engineering applications, general description, comparison with other methods, Need for weighted – integral forms, relevant mathematical concepts and formulae, displacement transformation matrix, stiffness matrix, weak formulation of boundary value problems, variational methods, Rayleigh –Ritz method and weighted residual approach

Unit – 2: Finite Element Techniques

Model boundary value problem, finite element discretization, element shapes, sizes, and node locations, interpolation functions, shape functions, derivation of element equations, connectivity, boundary conditions, principal of potential energy, FEM solution, convergence criteria

Unit – 3: Applications to solid and structural mechanics problems
External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, strain displacement relations, boundary conditions compatibility equations

Unit – 4: Application to heat transfer problem
Variation approach, Galerkin approach, one-dimensional steady state problems for conduction, convection and radiation

Unit – 5: Application to fluid mechanics problems
In viscid incompressible flow, potential-function and stream-function formulation, incompressible viscous flow, solution of incompressible fluid film lubrication.

Text Books
1. Reddy J.N., "An Introduction to Finite Element Method", (2005), TMH, New Delhi
2. Seshu P., "Finite Element Analysis", (2006), PHI, New Delhi
3. T R Chandrupatla, A D Belegundu, "Finite Elements in Engineering", PHI learning Pvt Ltd.

Reference Books
1. Desai C S, Kundu T, "Introductory Finite Element Method", CRC Press, Taylor and Francis, FL
2. Zienkiewicz O C, Taylor R L, "The Finite Element Method", Volume 2, Butterworh – Heinemann publication 2002
3. Manicka Selvam V.K., "Finite Element Primer", Dhanpat Rai Publ., New Delhi
4. Daryl L Logan, "Finite Element Method", Cengage Learning, US.
5. S. Rajasekaran, "Finite Element Analysis", S Chand Publications.

ME 364: RENEWABLE ENERGY ENGINEERING

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives
1. Introduction to solar energy collection and utilization systems
2. Introduction to wind turbine configurations, functioning and performances evaluation.
3. Understand various photovoltaic systems and components
4. Introduction to biomass.
5. Introduction to various applications of renewable energy.

Course Outcomes
1. Students will understand the basics of solar energy, its applications and collection.

2. Students will learn the basics of wind energy, wind turbines used, and its applications.
3. Students will get the knowledge of photovoltaic systems, semiconductors, photodiode.
4. Use of biomass as fuel, its composition and production.
5. Students will get the knowledge of various applications of solar, wind, biomass and hydroelectric systems.

Unit –1: Solar Energy

The nature of the solar radiation, Insulation, Generalities, Insulation on a Sun-Tracking surface, Insulation on a Stationary surface, Horizontal surface, Solar Collection: Solar Architecture, Exposure Control, Heat Storage, Circulation, Insulation, Flat collection, Evacuated tubes, Concentrators, High temperature solar heat Engine: Solar Chimney, Solar ponds, Solar Refrigeration, Solar Desalination.

Unit-2: Wind

History: Wind Turbine Configurations, Drag Type wind Turbine, Lift type wind Turbine, Magnus effect wind machines, vertex wind machines, Availability of wind energy, Wind Turbine characteristics. Principles of Aerodynamics: Flux, Power in the wind, Dynamic pressure, Wind pressure, available power, Efficiency of a wind Turbine, Airfoils, Reynolds Number, Aspect Ratio, Wind Turbine Analysis: Aspect Ratio (of a wind turbine),Centrifugal force performance calculation, Magnus Effect

Unit-3: Photovoltaic Systems

Introduction: Basic semi conductor Physics, The band gap energy, The Solar spectrum, Band
Gap Impact on photovoltaic Efficiency, The P-N junction, The P-N junction Diode, The simplest Equivalent circuit for PV cell, From cells to modules to a Arrays From cells to a module, From modules to a Arrays, Impacts of Temperature and Insulation on I-V curves, Crystalline silicon Technologies, Single crystal czochralski (CZ) silicon, Ribbon silicon Technologies, Cast multi crystalline silicon, Crystalline silicon modules, Thin- film photovoltaic, Amorphous silicon, Gallium Arsenide & Indium phosphate, Cadmium Telluride
Copper Indium Diselenide (CIS), Theoretical Efficiency, Carrier multiplication, Thermo photovoltaic cells: The Ideal AND practical, The Photodiode, The reverse saturation, Practical Efficiency

Unit-4: Biomass

Introduction: The Composition of Biomass, A little bit of organic chemistry, Hydrocarbons,
Oxidation Stages of Hydrocarbons, Esters, Carbohydrates, Biomass as fuel: Wood Gasifies, Ethanol, Ethanol production, Fermentation, An aerobic Digestion, Photosynthesis

Unit-5: Renewable Energy Applications

Biomass sources: Energy forming, Bio-fuel production, processes, Gasification, Bio power Generation routes, Basic thermodynamic cycles in bio power generation, Biomass based steam power plant, Biomass based cogeneration plant, Fuel cell cycle, Engine power using Bio diesel, Biogas for power generation, The solar resource: Solar – power satellite, Stand alone PV system, Estimating the load, The Inverter and the system voltage, Batteries, Sizing the PV array, Hybrid PV systems, Wind Energy Resources: Component of wind energy conversion system, Wind Turbine Generation Hydroelectric system: Essential component of hydroelectric system, system efficiency, Advantages and Disadvantages of Hydroelectric system, Hydraulic machines, Status of Hydro power system.

Text Books

1. G. D. Rai, "Non Conventional Energy Sources", Standard Publishers Distributors.
2. R. K. Rajput, "Non Conventional Energy Sources and Utilisation", S. Chand Publications
3. Sukhatme, "Solar Energy: Principles of thermal collection and storage", TMH Publication

Reference Books

1. S. Rao, Dr B. B. Parulekar, "Energy Technology", Khanna Publishers.
2. G. N. Tiwari, R. K. Mishra, "Advanced Renewable Energy sources", RSC Publishing
3. Garg and Prakash, H. P. Garg, "Solar energy: Fundamentals and Applications", TMH Publication

ME 365: MATERIAL HANDLING

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. Students get the knowledge of different types of material handling equipment according to types of layout
2. Student should get the knowledge of material handling trucks and its arrangements
3. Student should get the knowledge of different types of conveyors and its arrangement
4. Students should get knowledge of online material handling equipment like AVG, elevators etc
5. Student should get the knowledge of different types of material handling cranes, robots and material stocking methods and dispatch

Course Outcomes

1. Introduction to material handling equipments
2. Understand the applications of material handling equipments for restricted and unrestricted areas
3. Introduction to trolley, tractor, AVGs and elevators
4. Utilization of jibs, cranes, industrial robots

Unit – 1:

Materials handling: General introduction, definition of terms i.e. batched goods, charged pallet ratio, general cargo, handling, integrated transport, line load etc. Engineering and economic factors,

relationship to plant layout; Selection of material handling equipment; Types of equipments and their maintenance

Unit – 2:
Unrestricted Equipment: General information, counterbalancing of trucks, powered stokers, order pickers, side loader and forwarding trucks, straddle carriers and mobile lifting frame, hand pallet trucks and stokers, air cushion handling frames, carts and trolleys

Unit – 3:
Area restricted: General information on line restricted material handling equipment; Different type of conveyers like roller, wheel, belt, slat, chain, overhead rail etc

Unit – 4:
Rail mounted trolleys, trolley and tractors, automatically guided vehicles, lift, elevators, other equipment, sorting installations

Unit – 5:
Position restricted: Jib cranes and other fixed industrial robots. Auxiliary equipment: Load carriers (Pallets, Stillage etc.) warehouse layouts, goods reception and dispatch equipment, equipment for assembling and securing loads.

Text Books
1. James M Apple, "Material Handling System Design", Ronald Press Co
2. John M. Hill, "Industrial Engineering", Mc Graw Hill publications

Reference Books
1. James Tomkines & John, "Facilities Planning" John wiely and sons, New York
2. G. Saliendy, "Hand Book of Industrial Engineering"' John Wiely and sons, New York

ME 366: MECHANICAL VIBRATIONS AND NOISE CONTROL

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks
Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives
1. To understand the basic concepts and behavior of vibrations in machines
2. To understand the determination of frequencies and other parameters in single degree and two degree vibration systems
3. To understand to determine the critical speeds of rotating shafts
4. To understand how to apply the different measures for controlling the machine vibrations and noise

Course Outcomes

1. Ability enhancement in analyzing the machine vibrations in various degree of freedom systems
2. Ability enhancement in determining the various causes of machine vibrations and noise and in applying the perfect compensatory system to control them
3. Ability enhancement in practically using the different vibrations and noise measuring instruments to find the basic causes of machine failures

Unit-1: Single Degree of Freedom Systems-Free Vibrations
Introduction to vibration, definitions and basic concepts, degree of freedom, types of vibrations, S.H.M., Fourier analysis. Undamped free vibrations, spring mass system, equivalent stiffness of spring combinations, longitudinal vibrations, transverse vibrations, torsional vibrations; illustrative examples; Damped free vibrations, types of damping, free vibrations with viscous damping, logarithmic decrement, dry friction or coulomb damping, illustrative examples.

Unit-2: Single Degree of Freedom Systems-Forced Vibrations
Forced vibrations with constant harmonic excitation, magnification factor, vibrations with rotating & reciprocating unbalance, vibrations due to excitation of the support, vibrations with coulomb damping, illustrative examples.

Unit-3: Two Degree of Freedom Systems
Introduction, principle modes of vibration, spring mass coupled systems, double pendulum, torsional systems; combined rectilinear & angular modes, systems with damping, illustrative examples. Critical speed of a light shaft having a single disc without and with damping, illustrative examples

Unit-4: Vibration Control
Vibration isolation and transmissibility, force transmissibility, motion transmissibility, vibration absorbers, measurement of vibration, vibration measuring instruments, real time frequency processing, vibration control, vibration control for noise reduction, vibration dampers and vibration isolators, illustrative examples.

Unit-5: Noise Control
Sound, human response to sound, the Decibel scale, octave band analysis, noise, effects of noise, standards and limits, sources of noise, noise measuring instruments, noise control, industrial noise control strategies, noise control at source, noise control along path, noise control at receiver, acoustic barriers, illustrative examples.

Text Books

1. G. K. Grover," Mechanical Vibrations", Nem chand Publication, New Delhi
2. A. G. Ambekar, "Mechanical Vibrations and Noise Engineering, PHI, New Delhi
3. J. D. Irwin & E. R. Graf, Industrial Noise and Vibration Control, PHI, New Delhi

Reference Books:

1. Den Hartog, "Mechanical Vibrations", Dover Publication, New York
2. Hand Book of Noise and Vibration Control, Trade and Technical Press Ltd., England
3. L. L. Faulkhar, "Industrial Noise Control", Industrial Press Inc., New York

ME 367: MACHINE TOOL DESIGN

Teaching Scheme:
Lectures: 3 hrs / week

Examination Scheme:
Class Test: 20 Marks

Teachers Assessment: 20 Marks
End Sem. Exam: 60 Marks

Course Objectives

1. To gain the knowledge of different drives and mechanisms used in machine tools
2. To gain the knowledge of design of gear boxes & feed boxes used in machine tools
3. To gain the knowledge of design of structures, guideways, spindles of machine tools
4. To gain the knowledge of various control systems used in machine tools

Course Outcomes

1. Ability enhancement for the design of various components of structures, guideways, spindles of machine tools
2. Ability enhancement to adopt & implement the recent trends required as per the applications

Unit 1: Machine Tool Drives & Mechanisms

Working & auxiliary motions, defining parameters, machine tool drives, hydraulic transmission & its elements, mechanical transmission & its elements, technico-economical prerequisites, general requirements, engineering design process

Unit 2: Regulation of Speed & Feed Rates

Definition, stepped regulation of speed, various laws of stepped regulation, design of speed box, selection of range ratio, structural diagrams, speed chart, design of feed box, machine tool drives using multiple speed motors, determination of number of teeth of gears, stepless regulation of speed & feed rates, hydraulic, electrical, mechanical stepless regulation

Unit 3: Design of Machine Tool Structures

Functions of machine tool structures & requirements, materials, static & dynamic stiffness, profiles of machine tool structures, basic design procedure, design of beds, design of columns, design of housings, design of bases and tables, design of cross rails, arms, saddles, carriages, rams, model techniques

Unit 4: Design of Guide ways, Power Screws & Spindles

Types of guide ways, functions, design of slide ways, design criteria, design of aerostatic slide ways, design of antifriction guide ways, protecting devices for slide ways, design of power screws, functions of spindle unit, materials of spindles, effect of machine tool compliance on machine accuracy, antifriction bearings, sliding bearings

Unit 5: Control Systems in Machine Tools

Functions, requirements & classification, control systems for changing speeds & feeds, control systems for forming & auxiliary motions, automatic control systems, adaptive control systems, numerical control systems, distributed numerical control (DNC-1), computer numerical control, direct numerical control(DNC-2) systems, recent trends in machine tools

Text Books

1. Mehta N. K., “Machine Tool Design”, Tata McGraw Hill
2. Pal D. K. and Basu S. K., “Design of Machine Tools”, 4th Revised Edition, Oxford-IBH

3. Bhattacharya A., Sen G. C., “Principles of Machine Tools”, New Central Book Agency, Calcutta

Reference Books

1. Acherkan N. S., “Machine Tool”, Vol. I to Vol. II, MIR publications
2. Kundra T, Rao P.M., Tiwari N. K., “Numerical Control and Computer Aided Manufacturing”, Tata McGraw Hill
3. Martin S. J., “NC Machine Tools”, ELBS publication