R.K.D.F. UNIVERSITY, BHOPAL
B.E. (MECHANICAL ENGINEERING)
SECOND YEAR
Semester – III
Course Content & Grade

Branch	Subject Title	Subject Code
B.E. Common	**Engineering Mathematics-II**	**B.E.- 301**

Unit - I

Second Order linear differential equation with variable coefficents: Methods one integral is known, removal of first derivative, changing of independent variable and variation of parameter, Solution by Series Method

Unit - II

Vector Calculus: Differentiation of vectors, scalar and vector point function, geometrical meaning of Gradient, unit normal vector and directional derivative, physical interpretation of divergence and Curl. Line integral, surface integral and volume integral, Green's, Stoke's and Gauss divergence theorem

Unit - III

Linear and Non Linear partial differential equation of first order: Formulation of partial differential equations, solution of equation by direct integration, Lagrange's Linear equation, charpit's method. Linear partial differential equation of second and higher order: Linear homogeneous and Non homogeneous partial diff. equation of nth order with constant coefficients. Separation of variable method for the solution of wave and heat equations

Unit - IV

Fourier series: Introduction of Fourier series, Fourier series for Discontinuous functions, and Fourier series for even and odd function, Half range series Fourier Transform: Definition and properties of Fourier transform, Sine and Cosine transform.

Unit - V

Laplace Transform: Introduction of Laplace Transform, Laplace Transform of elementary functions, properties of Laplace Transform, Change of scale property, second shifting property, Laplace transform of the derivative, Inverse Laplace transform & its properties, Convolution theorem, Applications of L.T. to solve the ordinary differential equations

References
(i)   Advanced Engineering Mathematics by Erwin Kreyszig, Wiley India
(ii)   Higher Engineering Mathematics by BS Grewal, Khanna Publication
(iii)   Advance Engineering Mathematics by D.G.Guffy
(iv)   Mathematics for Engineers by S.Arumungam, SCITECH Publuication
(v)   Engineering Mathematics by S S Sastri. P.H.I.

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Branch	Subject Title	Subject Code
ME	**STRENGTH OF MATERIAL**	**ME - 302**

UNIT - I

STRESS AND STRAIN: Definition**,** Stress- strain, tensile & compressive stresses, shear stress-Elastic limit, Hooke's Law Poission' Ratio, modulus of elasticity, modulus of rigidity, bulk modulus, yield stress, ultimate stress, factor of safety, state of simple shear, relation between elastic constants, Volumetric Strain, Volumetric strain for tri-axial loading, Deformation of tapering members, Deformation due to self weight, bars of varying sections, composite sections, temperature. Stress Mechanical properties of materials: Ductility, malleability, hardness, toughness, fatigue, creep; behavior of materials under tension, compression, bending, shear; ductile and brittle materials, failure of MS and CI in tension and torsion

UNIT - II

COMPOUND STRESSES: introduction, 3.2 Stress components on inclined planes, 3.3 General two-dimensional stress system, 3.4 Principal planes and stresses, 3.5 Mohr's circle of stresses. 3.6 Thin cylinders subjected to pressure, change in length, diameter and volume, 3.7 Thick cylinders - Lame's equations (excluding compound cylinders).

UNIT - III

STRESSES IN BEAMS: Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance,bending stress distribution, Section moduli for different sections, beams for uniform strength, Flitched beams, Principle axes, Principle moment of inertiaDirect & Bending Stresses: Core of Section, Chimneys subjected to wind pressure SHEAR STRESS IN BEAMS: Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors

UNIT - IV

BENDING : pure bending, symmetric member, deformation and stress, bending of composite sections, eccentric axial loading, shear force and BM diagram, relationship among load, shear and BM, shear stresses in beams, strain energy in bending, deflection of beams, equation of elastic curve, Macaulay's method and Area moment method for deflection of beams.

UNIT - V

TORSION: Torsion of circular shafts- solid and hollow, stresses in shaft when transmitting power, shafts in sense and parallel. Torsion in shafts: stresses in a shaft, deformation in circular shaft, angle of twist, stepped-hollow, thin walled-hollow transmission shafts Leaf springs; helical springs, open and closed coil, stress in spring wire, deflection of helical spring, springs in series and parallel.

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Branch	Subject Title	Subject Code
ME	**MANUFACTURING PROCESS**	**ME - 303**

UNIT - I

Patterns and Pattern making Introduction to Foundry - Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern materials, color coding and storing of patterns Moulding methods and processes-materials, equipment, Moulding sand ingredients, essential requirements, sand preparation and control, testing, cores and core making. Design considerations in casting, gating and Riser - directional solidification in castings, Metallurgical aspects of Casting

UNIT - II

Casting Processes Sand castings, pressure die casting, permanent mould casting, centrifugal casting, precision investment casting, shell Moulding, Co2 Moulding, continuous casting-squeeze casting, electro slag casting, Fettling and finishing, defects in Castings, Casting of non-ferrous materials Melting, Pouring and Testing
Melting furnaces- -crucibles oil fired furnaces-electric furnaces-cupola, selection of furnace, calculation of cupola charges-Degasification, inoculation, pouring techniques casting defects and Inspection of castings.

UNIT - III

Basic Joining Processes Types of welding-gas welding, -arc welding,-shielded metal arc welding, GTAW, GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-atomic hydrogen arc welding-thermit welding, Flame cutting - Use of Oxyacetylene, modern cutting processes, arc cutting,

UNIT- IV

Special Welding Processes Soldering, brazing and braze welding and their application., welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys. Introduction to Electron beam and Laser welding.

UNIT - V

Design of Weldments: Welding symbols-Positions of welding-joint and groove design-weld stress-calculations-design of weld size, estimation of weld dilution, heat input, effect of welding parameters preheating, and post heating temperature: Selection of electrodes, flux etc. Weldments Testing and Metallurgy Inspection of welds – destructive and non-destructive testing methods, Defects in welding-causes and remedies, -effect of gases in welding-fatigue failure in Weldments.

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	**BASIC THERMODYNAMICS**	**ME - 304**

Unit - I

Basic concepts: Thermodynamics, Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, statement and significance, concept of an Ideal gas, Gas laws, Avogadro's hypothesis, Heat and work transfer. First law of thermodynamics- Statement of first law of thermodynamics, first law applied to closed system, first law applied to a closed system undergoing a cycle, processes analysis of closed system, flow process, flow energy, steady flow process, Relations for flow processes, limitations of first law of thermodynamics.

Unit - II

Second law of thermodynamics, heat engine, heat reservoir, Refrigerator, heat pump, COP, EPR, Available energy, Carnot's theorem, Carnot's cycle, efficiency of Carnot's cycle, statement of second law Reversible and irreversible processes, consequence of second law, Entropy, Entropy change for ideal gas, T-S diagrams, Availability and Irreversibility. Gibbs and Helmholtz functions

Unit - III

Real gas, Deviation with ideal gas, Vander-wall's equation, evaluation of its constants, limitations of the equation. The law of corresponding states Compressibility factor, Generalized compressibility chart, P-V-T surface of a Real gas, Thermodynamics relations, Maxwell relations and there applications.

Unit - IV

Pure Substance, Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, processes of vapor measurement of dryness fraction, Use of steam table and Mollier chart.

Unit - V

Air standard cycles, Carnot, Otto, Diesel, Dual cycles and there comparison, two stroke and four stroke engines, Brayton cycle, non reactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures, Enthalpy of gasmixtures.

References:
1.   P.K.Nag; Engineering Thermodynamics; TMH
2.   Van GJ; Thermodynamics; John Wylen
3.   Cengel Y; Thermodynamics; TMH
4.   Arora CP; Thermodynamics; TMH
5.   Thermal Engineering by R Yadav
6.   Engineering Thermodynamics by Omkar Singh New Age International.
7.   Engineering Thermodynamics by Ratha Krishanan PHI India Pvt. Ltd.

8.   Engineering Thermodynamics by M. Achuthan, PHI India.

List of Experiments (Pl. expand it):
1.   To find mechanical equivqlent of heat using Joules apparatus
2.   To study working of impulse and reaction steam turbine by models.\
3.   To study working of Gas turbines by models and to identify various processes of Brayton Cycle.
4.   To calculate COP of vapour compression refrigeration system and to plot on T-s, p-H diagrams.
5.   To plot specific fuel consumstion versus rpm diagrams for diesel and petrol engines
       Theory classes must be supplemented with laboratory classes.

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Branch	Subject Title	Subject Code
ME	**Value Education**	**ME - 305**

Chapter 1
Value Education
Concepts of Values-Definition and Types of values –The need for Education in values-Challenges for Value adoption-Character development-Vision of a better world

Chapter 2
Inculcation of values
Classification of values- Personal Values-Family Values-Social Values-Spiritual values-Benefits of value adoption

Chapter 3
Values for Professional excellence
Definition-Purpose-implementation-situations to adopt-reflection questions-quotable quotes of Active listening-Decision making-Determination-Perseverance-Discipline-Responsibility

Chapter 4
Business ethics
Ethics and Entrepreneurship- Professional Ethics –Ethical choices- Resolving Ethical Dilemmas-Leadership and Social Responsibility- Corporate Social Responsibility

Chapter 5
Quality of Life
Dealing with change-Trends, Organizations and the Individual-Self and the world-Quality from within-Relating to others-The dynamics of personal powers

Chapter 6
Exploring the self
True Identity-Anatomy of the self-The cyclic processes within the self-States of the awareness-Innate and Acquired qualities-Empowering the self

Chapter 7
Understanding Self-Esteem
Know self-esteem-Understanding the self-Components of self-esteem**-Association with self-esteem-Levels of self-esteem-Reflection exercises**

Chapter 8
Principles of living
Be introspective-Be an observer-Being optimistic-Appreciate differences-Don't compare yourself with others-Live at present

Chapter 9
Practical Meditation
Why meditate?-Soul consciousness-The supreme-Karma-Timeless dimension-The eight powers

Chapter 10

Exercises for Practice

Quiet reflection- Practice introversion-Being an observer-Stand back and observe -Self awareness (Soul consciousness)-Experiencing Body free stage-Reflect on original qualities-Visualize the Divine-Think attributes of the Supreme-Developing a living relationship-Surrender to God-Create Good wishes for all-Visualization in Meditation: Orbs of Light- The forest-The Balloon

Every chapter will have 1.Objectives 2.Introduction 9. Summary 10. Glossary and 11. Suggested Reading apart from the CONTENT as referred above

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Branch	Subject Title	Subject Code
ME	**COMPUTER AIDED DESIGN LAB**	**ME - 306**

Unit - I

Methods to solve engineering problems- analytical, numerical, experimental, their merits and comparison, discretization into smaller elements and effect of size/ shape on accuracy, importance of meshing, boundary conditions, Computer Aided Engineering (CAE) and design, chain-bumping-stages vs concurrent-collaborative design cycles, computer as enabler for concurrent design and Finite Element Method (FEM), degree of freedom (DOF), mechanical systems with mass, damper and spring, stiffness constant K for tensile, bending and torsion; Practical applications of FEA in new design, optimization/ cost-cutting and failure analysis,

Unit - II

Types of analysis in CAE, static (linear/ non linear), dynamic, buckling, thermal, fatigue, crash NVH and CFD, review of normal, shear, torsion, stress-strain; types of forces and moments, tri-axial stresses, moment of inertia, how to do meshing, 1-2-3-d elements and length of elements; force stiffness and displacement matrix, Rayleigh-Ritz and Galerkin FEM; analytical and FEM solution for single rod element and two rod assembly.

Unit - III

Two-dimension meshing and elements for sheet work and thin shells, effect of mesh density and biasing in critical region, comparison between tria and quad elements, quality checks, jacobian, distortion, stretch, free edge, duplicate node and shell normal.

Unit - IV

Three-dimension meshing and elements, only 3 DOF, algorithm for tria to tetra conversion, floating and fixed trias, quality checks for tetra meshing, brick meshing and quality checks, special elements and techniques, introduction to weld, bolt, bearing and shrink fit simulations, CAE and test data correlations, post processing techniques Unit 5 Review of linear optimization, process and product optimization, design for manufacturing (DFM) aspects in product development, use of morphing technique in FEA, classical design for infinite life and design for warranty life, warranty yard meetings and functional roles, climatic conditions and design abuses, case studies.

References:
1.   Gokhle Nitin; et al; Practical Finite Element Analysis; Finite to Infinite, 686 Budhwar Peth, Pune.
2.   Krishnamoorthy; Finite Element Analysis, theory and programming; TMH
3.   Buchanan; Finite Element Analysis; Schaum series; TMH
4.   Seshu P; Textbook of Finite Element Analysis; PHI.
5.   Desai Chandrakant S et al; Introduction to finite element Method ,

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Branch	Subject Title	Subject Code
B.E. Common	**Engineering Mathematics-III**	**BE - 401**

Unit - I

Difference Operators, Interpolation (Newton Forward & Backward Formulae, Central Interpolation Formulae, Lagrange's and divided difference formulae), Numerical Differentiation and Numerical Integration.

Unit - II

Errors & Approximations, Solution of Algebraic & Trancedental Equations (Regula Falsi ,Newton-Raphson, Iterative, Secant Method), Solution of simultaneous linear equatins by Gauss Elimination, Gauss Jordan, Crout's methods , Jacobi's and Gauss-Siedel Iterative methods

Unit - III

Functions of complex variables : Analytic functions, Harmonic Conjugate, Cauchy-Riemann Equations, Line Integral, Cauchy's Theorem, Cauchy's Integral Formula, Singular Points, Poles & Residues, Residue Theorem , Application of Residues theorem for evaluation of real integrals

Unit - IV

Solution of Ordinary Differential Equations(Taylor's Series, Picard's Method, Modified Euler's Method, Runge-Kutta Method, Milne's Predictor & Corrector method), Correlation and Regression, Curve Fitting (Method of Least Square).

Unit - V

Concept of Probability: Probability: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Testing of Hypothesis |: Students t-test, Fisher's z-test, Chi-Square Method

Reference:
(i)   Numerical Methods using Matlab by J.H.Mathews and K.D.Fink, P.H.I.
(ii)   Numerical Methods for Scientific and Engg. Computation by MKJain, Iyengar and RK Jain, New Age International Publication
(iii)   Mathematical Methods by KV Suryanarayan Rao, SCITECH Publuication
(iv)   Numerical Methods using Matlab by Yang,Wiley India
(v)   Pobability and Statistics by Ravichandran ,Wiley India
(vi)   Mathematical Statistics by George R., Springer

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Branch	Subject Title	Subject Code
ME	**KINEMATICS OF MACHINES**	**ME - 402**

UNIT - I

Introduction Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain Velocity in Mechanisms Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism

UNIT - II

Acceleration in Mechanisms Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank crank mechanism Mechanisms with Lower Pairs Pantograph, Exact straight line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms.

UNIT - III

FRICTION Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar frictionuniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive Brakes & Dynamometers Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamometers

UNIT - IV

CAMS Cams and Followers – Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower

UNIT - V

Gears & Gear Trains Classification & terminology, law of gearing, tooth forms &comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear.

Books and References:

1.   Theory of Machines – Thomas Bevan
2.   Theory of Machines and Mechanisms- Shigley
3.   Theory of Machines and Mechanisms-Ghosh & Mallik
4.   Theory of Machines and Mechanisms- Rao & Dukkipati
5.   Theory of Machines-S.S. Rattan
6.   Kinematics of Machines-Dr. Sadhu singh
7.   Mechanics of Machines – V. Ramamurti
8.   Theory of Machines – Khurmi & Gupta
9.   Theory of Machines – R. K. Bansal
10.   Theory of Machines – V. P. Singh
11.   Theory of Machines – Malhotra & Gupta

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Branch	Subject Title	Subject Code
ME	**POWER PLANT ENGG**	**ME - 403**

Unit - I

Introduction Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant

Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

Unit - II

Steam power plant General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit - III

Diesel power plant General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant

Unit - IV

Nuclear power plant Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. Hydro electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. Non Conventional Power Plants Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc.

Unit - V

Electrical system Generators and generator cooling, transformers and their cooling, bus bar, etc. Instrumentation Purpose, classification, selection and application, recorders and their use, listing of various control rooms. Pollution due to power generation

References

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi
3. "Power Plant Technology" El-Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

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SECOND YEAR
Semester – IV
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**MATERIAL SCIENCE & METTALURGY**	**ME - 404**

Unit - I

Engineering Materials: Classification of plain carbon steels; composition, properties & applications of low, medium & high carbon steels. Alloy steels: Free cutting steels; structural steel, spring steel, tool steel, high speed steels stainless steels. Effects of alloy element on properties of steels. Type of Cast irons: composition, properties & applications of each. Properties of aluminium; alloy of aluminium , (wrought & cast alloys), properties of copper, copper alloys (Brasses & Bronzes); Introduction and application to nano materials. Powder metallurgy- property and application.

Unit - II

Plastic Deformation of Metals: The tensile stress strain curve, Deformation by slip & by twinning, Dislocation theory, Theory of work hardening its effect on properties of metals, Recovery, Recrystallisation and grain growth; Hot and cold working of metals and their effect on mechanical properties, annealing, Introduction to creep, fracture and fatigue behavior of metals.

Unit - III

Crystal Structure: Mechanism of crystallization; unit cells, space lattice and lattice constants; Crystal systems, and Bravias Lattices; Body centered cubic, Face centered cubic and Hexagonal closed packed structure; Miller indices for planes and directions; Crystal imperfections; point defects, line defects and surface defects. Manufacturing and properties of refractory (acid, basic and natural).

Unit - IV

Heat Treatment of Steels: Definition, principle, and purpose of heat treatment. Description of heat treatment methods: Hardening, Annealing, Normalizing, Tempering and case hardening with microstructure changes. Mar-temping & Austempering, Hardenability and its determination. Precipitation Hardening. Isothermal Transformation of steel, Transformation on continuous cooling, Critical cooling rate, Heat treatment furnace.

UNIT - V

Phase Diagrams: Definition of phase, Equilibrium cooling of pure metals and binary alloys. Hume Rothery rule for solid solubility, Types of solid solution, Eutectic, Euteitoid and Peritectic reactions, Allotropy of iron, Iron-Iron carbon equilibrium diagram, relationship equilibrium diagram and properties of alloy.

List of Reference Books:
1. Introduction to physical Metallurgy by Sidney H. Avnen,.- Tata McGraw-Hill
2. Material Science & Metallurgy for Engineering by Dr.V.D. Kodgire.- Everest Pub. House, Pune.
3. Materials Science & Engineering by V. Raghavan.- Prentice Hall of India, New Delhi.
4. Heat Treatment principles & Technology by T.V. Rajan, O.P. sharma.-

5. Engineering Metallurgy Part –I by Raymond A. Higgins, ELBS.
6. Introduction to Engineering materials by B.K. Agrawal.-
7. Physical Metallurgy for Engineering by Donald S. Clark & Willbur R. Varney, EWP.
8. Engineering Material and Metallurgy by R.K. Rajput / S Chand
9. Material Science & Metallurgy for Engineering by O.P. Khanna, Dhanpat Rai

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SECOND YEAR
Semester – IV
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**MACHINE DRAWING**	**ME - 405**

Unit – I

Introduction: Principles of Drawing, Requirements of production drawing,Sectioning and conventional representation, Dimensioning, symbols of standard tolerances, Machining Symbols such as external and internal threads, slotted heads, square ends, and flat radial ribs, slotted shaft, splined shafts, bearings, springs, gears. Introduction to Compute Aided Drafting software for 2D and 3D Modeling.

Unit – II

Fasteners: Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints.

Unit - III

Assembly Machine Drawing: Basic concept, plotting technique, assembly and blow up of parts, bill of materials, product data; Cotter and Knuckle joints, pedestal and footstep bearings, crosshead, stuffing box, IC engines parts - piston and connecting rods; lath machine parts.

Unit - IV

Pipe and Pipe Fittings: flanged joints, spigot an socket joint, union joint, hydraulic an expansion joint. Couplings: Solid or Rigid Coupling, Protected Type Flange coupling, muff coupling, Oldham, universal coupling, cone friction clutch, free hand sketch of single plate friction clutch.

Suggested Readings / Books:
1. Ajit Singh, Machine Drawing (including Auto CAD), Tata McGraw Hill
2. N.D. Bhatt, Machine Drawing, Charotar publications
3. N. Sidheshwar, Machine Drawing, Tata McGraw Hill.
4. P.S. Gill, Machine Drawing, BD Kataria and Sons.
5. V Lakshmi Narayanan and Mathur, Text -book of Machine Drawing
6. Narayana and Reddy; Machine Drawing; New age, Delhi.
7. Dr. kk dewadi, Machine Drawing, Dhanpat Rai

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Branch	Subject Title	Subject Code
ME	**DOT. Net**	**ME - 406**

UNIT - I

Introduction .NET framework, features of .Net framework, architecture and component of .Net, elements of .Net.

UNIT - II

Basic Features Of C# Fundamentals, Classes and Objects, Inheritance and Polymorphism, Operator Overloading, Structures. **Advanced Features Of C#** Interfaces, Arrays, Indexers and Collections; Strings and Regular Expressions, Handling Exceptions, Delegates and Events.

UNIT - III

Installing ASP.NET framework, overview of the ASP .net framework, overview of CLR, class library, overview of ASP.net control, understanding HTML controls, study of standard controls, validations controls, rich controls. **Windows Forms:** All about windows form, MDI form, creating windows applications, adding controls to forms, handling Events, and using various Tolls

UNIT - IV

Understanding and handling controls events, **ADO.NET-** Component object model, ODBC, OLEDB, and SQL connected mode, disconnected mode, dataset, data-reader **Data base controls:** Overview of data access data control, using grid view controls, using details view and frame view controls, ado .net data readers, SQL data source control, object data source control, site map data source.

UNIT - V

XML: Introducing XML, Structure, and syntax of XML, document type definition (DTD), XML Schema, Document object model, Presenting and Handling XML. xml data source, using navigation controls, introduction of web parts, using java script, Web Services

References:
1.   C# for Programmers by Harvey Deitel, Paul Deitel, Pearson Education
2.   Balagurusamy; Programming in C#; TMH
3.   **Web** Commerce **Technology** Handbook by Daniel **Minoli**, Emma **Minoli** , TMH
4.   Web Programming by Chris Bates, Wiley
5.   XML Bible by Elliotte Rusty Harold ,
6.   ASP .Net Complete Reference by McDonald, TMH.
7.   ADO .Net Complete Reference by Odey, TMH

List of Experiments/ program (Pl. expand it):

1. Working with call backs and delegates in C#
2. Code access security with C#.
3. Creating a COM+ component with C#.
4. Creating a Windows Service with C#
5. Interacting with a Windows Service with C#
6. Using Reflection in C#
7. Sending Mail and SMTP Mail and C#
8. Perform String Manipulation with the String Builder and String Classes and C#:
9. Using the System .Net Web Client to Retrieve or Upload Data with C#
10. Reading and Writing XML Documents with the XML Text-Reader/-Writer Class and C#
11. Working with Page and forms using ASP .Net.

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THIRD YEAR
Semester – V
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**DYNAMICS OF MACHINERY**	**ME - 501**

UNIT - I

FORCE ANALYSIS –
Rigid body dynamics in general plane equation-Equations of motion-Dynamic force analysis-Inertia force and inertia torque-D'Alemberts principle-The principle of superposition-Dynamic analysis in reciprocating engines-Gas forces-Equivalent masses-Bearing loads-Crank shaft torque-Turning moment diagrams-Fly wheels-Engine shaking forces-Cam dynamics-Unbalance, Spring, Surge and Windup.

UNIT - II

MECHANISMS FOR CONTROL : Governors-Types-Centrifugal governors-Gravity controlled and spring controlled centrifugal governors-Characteristics-Effects of friction-Controlling force-Other governor machanisms. Gyroscopes-Gyroscopic forces and torques-Gyroscopic stabilization-Gyroscopic effects in automobiles, ships and airplanes.

UNIT - III

BALANCING- Static and dynamic balancing-Balancing of rotating masses-Balancing a single cylinder engine- Balancing multi- cylinder engines-Partial balancing in locomotive engines- Balancing linkages-Balancing machines.

UNIT - IV

FRICTION: Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria. Boundary and fluid film lubrication, friction in journal and thrust bearings, concept of friction circle and axis, rolling friction.
Clutches: Single plate and multi plate clutches, Cone clutches.

UNIT - V

BELT DRIVES: Velocity ratio, limiting ratio of tension; power transmitted; centrifugal effect on belts, maximum power transmitted by belt, initial tension, creep; chain and rope drives;
Brakes: Band brake, block brakes, Internal and external shoe brakes, braking of vehicles. Dynamometer: Different types and their applications.
Dynamic Analysis of Cams: Response of un-damped cam mechanism (analytical method), follower response analysis by phase-plane method, jump and cross-over shock.

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	**FLUID MECHANICS**	**ME - 502**

UNIT – I

BASIC CONCEPTS AND PROPERTIES Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

UNIT – II

FLIUD KINEMATICS AND FLUID DYNAMICS Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net – fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's ? theorem- applications - similarity laws and models.

UNIT – III

INCOMPRESSIBLE FLUID FLOW Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy - weisback's equation - pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

UNIT – IV

HYDRAULIC TURBINES Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction.
Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines.

UNIT – V

HYDRAULIC PUMPS Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps: working principles of gear and vane pumps

TEXT BOOKS
1.   Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
2.   Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi (7th edition), 1995.
3.   Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers, 1992.

References Book
1.   Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi publications (P) Ltd., New Delhi, 1995.
2.   White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
3.   Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 1998.
4.   Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd edition, 2004.

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	**GAS DYNAMICS**	**ME - 601**

UNIT - I

Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - General features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

UNIT - II

Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and density-stagnation, acoustic speed - critical speed of sound dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function. Steady one dimensional isentropic flow with area change-effect of area change on flow parameters chocking-convergent nozzle

UNIT - III

Simple frictional flow: adiabatic flow with friction in a constant area duct governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area ductgoverning equations - limiting conditions. Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy.

UNIT - IV

Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness – shock strength.

UNIT-V

Steam nozzles: isentropic flow of vapors, flow of steam through nozzles, condition for maximum discharge, effect of friction, super-saturated flow.

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Semester – VI
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**MACHINE COMPONENT DESIGN**	**ME - 602**

Unit – I

Introduction to basic design concepts, design process, stages/phases in design, flowchart, problem formulation, design considerations (strength, manufacturing, maintenance, environment, economics and safety); design for recycle and reuse, Design and safety factors for steady and variable loads, impact and fatigue considerations, reliability and optimization, standardization in design.

Unit – II

POWER TRANSMISSIONS SYSTEMS, PULLEYS: Transmission of power by Belt and Rope drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives, Materials, Chain drives.

SPUR & HELICAL& BEVEL GEAR DRIVES : Spur gears- Helical gears – Load concentration factor – Dynamic load factor. Surface compressive strength – Bending strength – Design analysis of spur gears – Estimation of centre distance, module and face width, check for plastic deformation. Check for dynamic and wear considerations. Design bevel gear and its application.

Unit – III

Springs: Design of helical compression and tension springs, leaf springs and torsion springs; fatigue loading of springs, surge in spring.

Shafts: Design of shaft under combined bending, twisting and axial loading; shock and fatigue factors, design for rigidity; Design of shaft subjected to dynamic load; Design of keys and shaft couplings.

Unit – IV

BEARINGS : Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, Bearing life.

Design of power screws: Design of screw, Square ACME, Buttress screws, design of nut, compound screw, differential screw, ball screw- possible failures.

Unit – V

Brakes & Clutches: Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk , plate clutches, cone & centrifugal clutches. Design of brakes: Rope, band & block brake, Internal expending brakes, Disk brakes

Engine Parts : Connecting Rod : Thrust in connecting rod – stress due to whipping action on connecting rod ends – Cranks and Crank shafts, strength and proportions of over hung and center cranks – Crank pins, Crank shafts.

References:

1. Shingley J.E; Machine Design; TMH
2. Machine Desine by R. S. Khurmi , S Chand
3. Sharma & Agrawal; Machine Design; Kataria & sons
4. Machine Design, V.Bandari Tmh Publishers
5. Machine Design, S MD Jalaludin, Anuradha Publishers
6. Sharma and Purohit; Design of Machine elements; PHI
7. Data Books : (I) P.S.G. College of Technology (ii) Mahadevan

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	HYDRAULLIC MACHINES	ME - 603

UNIT - I

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work don and efficiency, flow over radial vanes.

UNIT - II

Hydroelectric power stations: Elements of hydro electric power station-types-concept of pumped storage plants-storage requirements, mass curve (explanation only) estimation of power developed from a given catchment area; heads and efficiencies.

UNIT - III

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies , hydraulic design –draft tube-theory- functions and efficiency.

UNIT - IV

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT-V

Centrifugal pumps: classification, working, work done – manomertic head- losses and efficiencies-specific speed- pumps in series and parallel-performance characteristic curves, NPSH. **Reciprocating pumps:** Working, Discharge, slip, indicator diagrams

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	**MECHANICAL MEASUREMENT & METROLOGY**	**ME - 604**

Unit-I

Mechanical Measurements Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors. 4Sensors and Transducers: Types of sensors, types of transducers and their characteristics 2Signal transmission and processing: Devices and systems. 2Signal Display & Recording Devices.

Unit-II

Statistics: Least square regression analysis and data outlier detection; Normal distribution and concept of standard deviation of the mean in finite data set, Uncertainty Analysis: Measurement errors; error sources: calibration, data acquisition, data reduction; Design stage uncertainty analysis; combining elemental errors; Bias & Precision errors; Error propagation, Higher order uncertainty analysis.

Unit-III

METROLOGY: Metrology and Inspection: Standards of linear measurement, line and end standards .Limit fits and tolerances. Interchange ability and standardization. Linear and angular measurements devices and systems Comparators: Sigma, Johansson'sMicrokrator. Limit gauges classification, Taylor's Principle of Gauge Design.

Unit-IV

Measurement of geometric forms like straightness, flatness, roundness. Tool maker's microscope, profile project autocollimator. Interferometer: principle and use of interferometer, optical flat. Measurement of screw threads and gears. Surface texture : quantitative evaluation of surface roughness and its measurement.

Unit-V

Introduction: Concept of Automatic Controls – open loop & closed loop systems. Servomechanisms. Block diagrams, transfer functions. Applications of Laplace-Transform in control systems with simple examples / numerical. Controllers: Brief introduction to Pneumatic, hydraulic and electric controllers Modeling: Modeling of mechanical systems, modeling of electrical systems, signal flow graphs, modeling of fluid systems, liquid level systems, hydraulic systems, modeling of thermal systems.

References
1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems,Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonald and Co. 1963

5.   Gupta, I.C., "Engineering Metrology",Dhanpat Rai & Sons, New Delhi, 1994
6.   Sirohi, "Mechanical Measurement" New Age Publishers
7.   Jain, R.K., "Engineering Metrology" Khanna Publishers
8.   Jain, R.K., "Mechanical Measurement" Khanna Publishers 17sssssssssss
9.   Raven, "Automatic Control Theory", McGraw Hill Publishers.
10   Nagrath and Gopal, "Control System Engineering", New Age Publishers.

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Semester – VI
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**INTERNAL COMBUSTION ENGINE**	**ME - 605**

Unit – I

Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, cylinder arrangement, firing order, power balance for multi-cylinder engines, valve timing. Thermodynamic properties of fuel-air mixture before and after combustion, deviations of actual cycle from Ideal conditions.

Unit – II

Combustion in S.I. Engines: The Process of combustion, Effects of engine variables on ignition lag and flame propagation, abnormal combustion, knocking, effects and control of knock, Knock theory, effects of engine variable on knock, S.I. Engine fuel properties, Knock rating of fuel, octane number, additives, requirements of combustion chamber, Design Principles, Types of combustion chambers, merits.
Combustion in C.I. Engines: Combustion Process, Stages, diesel knock, effects of operating parameters on knock, knock Control, rating of C.I. engine fuels, Cetane number, types and requirements of the combustion chambers.
Emission and Control: SI and CI engine emissions, effects of pollutants on human health and biological sphere, Control of emissions from SI and CI Engines, Introduction to Noise Pollution & its Control.

Unit – III

Engine Operating Systems: Valves and valve gear, lubrication systems, and system components, lubricating oils, properties and rating, additives. Cooling systems, temperature gradients in engine parts, various methods of cooling, Power absorbed in cooling, Properties of coolants, additives. Fuel systems for SI and CI engines, F/A ratio requirements for different operating conditions, fuel transfer pump, fuel injection pump, injector, Modern carburetors, MPFI in SI engines. Conventional & Modern Ignition system, firing order.

Unit – IV

Engine Performance: Testing of Engines - their performance characteristics, Heat Balance sheet, Scavenging processes, Volumetric, charging and scavenging efficiencies, scavenging methods and systems of four stroke and two stroke engines.

Unit-V

Supercharging: Supercharging suitability for SI and CI engines and effect of attitude on mixture strength and output of S.I. engines, Types of supercharging, analysis and performance, low and high pressure super charging, exhaust, gas turbo-charging, supercharging of two stroke engines.

List of Reference Books:

1.   I.C. Engine by M.L. Mathur, R.P.Sharma; Dhatpat Rai Pub.
2.   I.C. Engine by V. Ganeshan ; Tata McGra Hill.
3   I.C. Engines by Anand V. Domkundwar, V.M. Domkundwar; Dhatpat Rai Pub

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	**ADVANCE WORKSHOP PRACTISE**	**ME - 606**

Unit - I

Lathe: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature

Unit - II

Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

Unit - III

Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.
Drilling & Broaching: Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

Unit - IV

Shapers: Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities.
Gear Cutting: Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

Unit - V

Mechatronics: Introduction to control systems, analog control, transfer function, procedure for writing transfer function, signal flow diagram, introduction to electronic components like switches, magnetic type, electromagnetic type, transducers and other sensors, servo motors, basics of CD-ROM players, PLC, applications, CNC machines.

References:
1.   Rao PN; Manufacturing Technology vol I and II; TMH
2.   Hazra Chadhary; Workshop Tech.II; Media Promoter and Pub
3.   Lindberg RA; Processes and Materials of Manufacturing; PHI.
4.   Raghuvanshi;BS; Work shop technology Vol-I, II; Dhanpat Rai Delhi
5.   Alciatori DG, Histand MB; Introduction to Mechatronics and Measurement system; TMH
6.   HMT; Production Processes; TMH

List of Experiment (Pl. expand it):
1. To make a job on lathe machine with all operations like turning, step turning, drilling, tapper turning, thread cutting and knurling.
2. Study of center less grinding machine/ tool and cutter type grinding machine.
3. Study of horizontal/ universal milling machine, diving head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. Study of radial drilling machine and preparing a job on it.
6. To study a sapping machine to learn about working of quick return mechanism.

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	HEAT AND MASS TRANSFER	ME - 701

UNIT-I

Introduction to Heat Transfer: Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2 Conduction : One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. Steady State one-dimensional Heat conduction : Composite Systems in rectangular, cylindrical and spherical oordinates withand without energygeneration; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation.

UNIT-II

Fins: Heat transfer from extended surfaces, Fins of uniform cross-sectional area Errors of measurement of temperature in thermometer wells. Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts

UNIT-III

Forced Convection: Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. Natural Convection : Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere ; Combined free and forced convection.

UNIT-IV

Thermal Radiation : Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.

UNIT-V

Heat Exchanger : Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. Condensation And Boiling : Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. Introduction To Mass Transfer : Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

Books:

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad

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Course Content & Grade

Branch	Subject Title	Subject Code
ME	**MECHANICAL SYSTEM DESIGN**	**ME - 702**

Note: PSG Design data book and/ or Mahadevan and Reddy's Mechanical design data book areto be provided/ permitted in exam hall (duly verified by authority)

Unit I

Design of Belt, Rope and Chain Drives: Methods of power transmission, selection and design of flat belt and pulley; Selection of V-belts and sheave design; Design of chain drives, roller chain and its selection; Rope drives, design of rope drives, hoist ropes.

Unit II

Spur and Helical Gears: Force analysis of gear tooth, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears.

Bevel Gears: Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

Unit III

Design of I.C. Engine Components: General design considerations in I C engines; design of cylinder; design of piston and piston-rings; design of connecting rod; design of crankshaft.

Unit IV

Design of Miscellaneous Components: design of Flanged coupling; Rigid coupling, Design of Pressure vessels subjects to internal pressure, external pressure, design of penetration, design of flanges, cone cylinder junctions ,Materials, Fabrication.

Unit V

Optimization: Basic concept of optimization, classification of optimization, optimization techniques, engineering applications of optimization. Classical optimization techniques: unconstrained optimization single-variable optimization, multivariable optimization, solution by direct search method, solution by Lagrange-multipliers method.

References:
1.   Shigley J.E.; Machine Design; TMH
2.   BhandariVB; Design of Machine Elments; TMH
3.   Sharma CS and Purohit K; Design of Machine Elements; PHI Learning.
4.   Hall and Somani; Machine Design; Schaum Series; TMH
5.   Wentzell TH; Machine Design; Cegage Learning
6.   Sharma & Agrawal; Machine Design; Katson
7.   Kulkarni SG; Machine Design; TMH

8.   Abdul Mubeen; Machine Design; Khanna Publishers
9.   Juvinall RC, Marshek KM; Fundamentals of Machine Component Design; Wiley
10.   Norton R; Design of Machinery; TMH

List of Experiment (Pl. expand it):
Designing and sketching of components contained in the syllabus

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FOURTH YEAR
Semester – VII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**MECHANICAL VIBRATION**	**ME - 703**

UNIT - I

Basic Concepts of Vibration : Vibration and oscillation, causes and effects of vibrations, Vibration parameters – spring, mass, damper, Damper models, Motion – periodic, non periodic, harmonic, non-harmonic, Degree of freedom, static equilibrium position, Vibration classification, Steps involved in vibration analysis. Free Undamped Single Degree of Freedom Vibration System : Longitudinal, transverse, tensioned system, Methods for formulation of differential equations by Newton, Energy, Lagrangian (Rayleigh's Method), Effect of springs mass and shaft inertia on natural frequency, Effect of flexible bearing on natural frequency.

UNIT - II

Free Damped Single Degree of Freedom Vibration System : Viscous damped system – under damped, critically damped, over damped; Logarithmic decrement; Coulomb's damping; Combined viscous and coulomb's damping. Equivalent Single Degree of Freedom Vibration System : Conversion of multi-springs, multi masses, multi – dampers into a single spring and damper with linear or rotational coordinate system

UNIT - III

Free Undamped Multi Degree of Freedom Vibration System : Eigen values and Eigen vectors for linear system and torsional two degree of freedom; Holzer method for linear and torsional unbranched system; Two rotors, Three rotors and geared system; Dunkerley and Rayleigh method for transverse vibratory system Forced Single Degree of Freedom Vibratory System : Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation (excluding elastic damper)

UNIT- IV

Vibration Measuring Instruments : Principle of seismic instruments, vibrometer, accelerometer–undamped, damped. Vibration Isolation : Force isolation, motion isolation, isolators. . Rotor Dynamics : Critical speed of single rotor, undamped and dampedCAM Dynamics : Cam Dynamics: Mathematical Model, Differential Equation, Response Follower Jump Phenomenon

UNIT - V

Balancing : Static and dynamic balancing of multi rotor system, Balancing of reciprocating masses In – line engines, V – engines (excluding radial engines)

Reference :
1. Mechanical Vibrations (S.S. Rao) Pearson Education (4th Edition).
2. Mechanical Vibrations (G.K. Grover).
3. Fundamentals of Mechanical Vibration (S. graham Kelly) Tata McGraw Hill.
4. Mechanical Vibration Analysis (P. srineevasan) Tata McGraw Hill.

5.	Mechanical Vibrations – Schaum's Ouline Series (S. Graham Kelly) McGraw Hill.
6.	Mechanical Vibrations– Schaum's Ouline Series (William W. Seto) McGraw Hill.
7.	Theory and Practice of Mechanical Vibrations (J.S. Rao, K. Gupta) New Age International

Publications.
1.	Mechanical Vibrations (Den, Chambil, Hinckle).
2.	Mechanical Vibrations (J.P. Den Hartog) McGraw Hill Book Company Inc.
3.	Introduction to Dynamics and Control (Leonard Meirovitch) Wiley – New york.
4.	Elements of Vibration Analysis (Leonard Meirovitch) McGraw Hill – New York..
5.	Dynamics and Control of Structures (Leonard Meirovitch) Wiley – New York.
6.	Matrices and Transformations (Antoy J. Pettofrezzo) Oxford University Pre

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FOURTH YEAR
ELECTIVE - I
Semester – VII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**RELIABILITY ENGINEERING**	**ME - 7101**

Unit -I

Reliability: Definition Probability Concept; Addition of Probabilities; Complimentary Events; Calculation of Reliability, Reliability analysis.

Unit -II

Failure Data Analysis: Introduction, Mean Failure Rate, Mean Time to Failure (MTTF), Mean Time between Failures (MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form.

Unit - III

Conditional Probability : Introduction, Hazard Rate as conditional probability, Principles of CBM, Pillars of condition monitoring, CBM implementation and benefits, visual monitoring, vibration monitoring, wear debris monitoring, corrosion monitoring, performance monitoring.

Unit - IV

General Maintenance & Management function : Breakdown, emergency, corrective, predictive, Objectives and evolution of TPM, Effects and Criticality analysis (FMECA), applications and benefits, risk evaluation, risk priority.

Unit - V

Maintainability and Availability: Introduction, Maintenance Planning & scheduling, Maintenance organization, Tools for better maintenance –preventive, shutdown and Scheduled maintenance.

Text Books:
1. Reliability Engineering, L.S. Srinath, Affiliated East-West Press, New Delhi.
2. Reliability Engineering, A.K.Govil, Tata Mc-Graw Hill, New Delhi.

Reference Books:
1. Reliability Engineering, L.Balagurusamy, Tata Mc-Graw Hill, New Delhi, 1984.
2. Reliability Based Design, S.Rao, Mc-Graw Hill, 1992.
3. Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, Wiley Publications.
4. Reliability Engineering, D.J. Smith, 1972, E.W. Publications.
5. Mishra R.C. Reliability and Maintenance Engineering New age International Publisher.
6. Naikan; Reliability engineering and life testing; PHI
7. Modarre M; Reliability and Risk Analysis, Marcel Dekker Inc CRC Press

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B.E. (MECHANICAL ENGINEERING)
FOURTH YEAR
Semester – VII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**TRIBOLOGY**	**ME - 7102**

UNIT - I

TRIBOLOGICAL ASPECTS OF ROLLING MOTION
Introduction to trobological systems and their characteristic features; analysis and assessment of surface; topography; deterministic and stochastic tribo-models for asperity contacts; techniques of surface examination; technological properties of surfaces. Quantitative laws of sliding friction, causes of friction, adhesion theory, laws of rolling friction, measurement of friction

UNIT - II

WEAR Introduction, mechanism of wear, types of wear, quantitative laws of wear, measurement of wear, wears resistance materials

UNIT - III

LUBRICANTS Introduction, dry friction, boundary lubrication, hydrodynamic, hydrostatic and elasto-hydrodynamic lubrication, functions of lubricants, types and properties, lubricant additives. Principles, application to rolling contact bearings, cams, Gears

UNIT - IV

BEARING DESIGN CONSIDERATION & CHARACTERISTICS Geometry and pressure equation of journal bearing, hydrostatic bearings, thrust bearings, porous bearings and hydrodynamic gas bearings. Journal bearings with specialized applications. General requirements and different types of bearing materials.

UNIT - V

SURFACE INTERACTIONS Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact.

REFERENCE BOOKS:
1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2. Hand Book of Tribology – WHILEY
3. Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.
4. Tribology in Industries by Sushil. K. Srivastava, S Chand & Publications.
5. Basic Lubrication theory by Alastair Cameron

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B.E. (MECHANICAL ENGINEERING)
FOURTH YEAR
Semester – VII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**MATERIAL HANDLING EQUIPMENT**	**ME - 7103**

UNIT – I

Types of intraplant transporting facility, principal groups of material handling equipments, choice of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications.

UNIT – II

Introduction to control of hoisting equipments.Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains hemp rope and steel wire rope, selection of ropes, fastening of chains and ropes , different types of load suspension appliances, fixed and movable pulleys, different types of pulley systems, multiple pulley systems . Chain and rope sheaves and sprockets.

UNIT – III

Load handling attachments, standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, electric lifting magnets, grabbing attachments for loose materials, crane attachments for handling liquid materials.

UNIT – IV

Arresting gear, ratchet type arresting gear, roller ratchet, shoe brakes and its different types like electromagnetic, double shoe type, thruster operated, controller brakes, shoe brakes, thermal calculations of shoe brakes and life of linings, safety handles, load operated constant force and variable force brakes general theory of band brakes, its types and construction.

UNIT – VI

Cranes with rotary pillar, cranes with a fixed post, jib cranes with trolley, cranes with luffing boom cantilever cranes, cage elevators safety devices of elevators belt and chain conveyors and their power calculations, vibrating and oscillating conveyors pneumatic and hydraulic conveyors, screw conveyors hoppers, gates and feeders. Introduction to AGV s as new material handling device, use of robot for material handling.

Refrence:
1.	Material Handling - Immer J. R. (McGraw Hill)
2.	Plant Layout & Material Handling - James Apple (John Wiley)
3.	Material Handling System Design - James Apple ((John Wiley)
4.	Material Handling Principles & Practice - Theodore H. Allegre Sr. (CBS Publishers & Distributors)
5.	Material Handling- John R. Immer- McGraw Hill Co. Ltd., New York

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FOURTH YEAR
Semester – VII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**AUTOMOBILE ENGINEERING**	**ME - 705**

UNIT - I

VEHICLE STRUCTURE AND ENGINES Types of automobiles , vehicle construction and different layouts ,chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine-their forms ,functions and materials

UNIT - II

ENGINE AUXILIARY SYSTEMS Electronically controlled gasoline injection system for SI engines., Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system, Turbo chargers, Engine emission control by three way catalytic converter system .

UNIT - III

TRANSMISSION SYSYTEMS Clutch-types and construction ,gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel –torque converter , propeller shaft, slip joints, universal joints ,Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT - IV

STEERING,BRAKES AND SUSPENSION SYSTEMS : Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems , Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control

UNIT-V

ELECTRICAL AND CONTROL SYSTEMS : Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers. importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.

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Semester – VIII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**REFRIGERATION & AIR CONDITIONING**	**ME - 801**

Unit-I

Introduction: Principles and methods of refrigeration, freezing; mixture cooling by gas reversible expansion, throttling, evaporation, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of performance, vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

Unit-II

Vapour compression system: Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system: removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system,.

Unit-III

(a) **Vapour absorption system**: Theoretical and practical systems such as aqua-ammonia, electrolux & other systems;
(b) **Steam jet refrigeration**: Principles and working, simple cycle of operation, description and working of simple system,
(c) **refrigerants:** nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties

Unit-IV

Psychrometric: Calculation of psychrometric properties of air by table and charts; psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body,

Unit-V

Air conditioning loads: calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems.

References:
1. Arora CP; Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI
3. Ananthanarayan; Basic Refrigeration and Air conditioning; TMH
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI
6. Pita ; Air conditioning Principles and systems: an energy approach; PHI
7. Stoecker W.F, Jones J; Refrigeration and Air conditioning; McGH, Singapore

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FOURTH YEAR
Semester – VIII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**I.E. & OPERATION RESEARCH**	**ME - 802**

Unit - I

Linear system and distribution models: Mathematical formulation of linear systems by LP, solution of LP for two variables only, special cases of transportation and assignment and its solution, Vogel's forward looking penalty method, cell evaluation degeneracy, use of SW Lindo, Tora, Excell.

Unit - II

Supply chain (SCM): Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

Unit - III

Inventory models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time (=WIP/ Throughput), JIT/ lean mfg; basic EOQ/ EPQ models for constant review Q-system(S,s); periodic review, base stock P-system; service level, lead time variance and safety stock;; ABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

Unit - IV

(a) **Waiting Line Models** Introduction, Input process, service mechanism, Queue discipline, single server (M/M/1) average length and times by Little's formula, optimum service rate; basic multiple server models (M/M/s)
(b) **Competitive strategy**: concept and terminology, assumptions, pure and mixed strategies, zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

Unit - V

(a) **Decision analysis**: decision under certainty, risk probability and uncertainty; Hurwicz criteria; AHP-assigning weight and consistency test of AHP
(b) **Meta-heuristics** Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search, Simulated Annealing and Genetic algorithms and solution of traveling salesman and non linear optimization problems.

References:
1.   Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2.   Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.

3.   Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4.   Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5.   Taha H; Operations research; PHI
6.   Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7.   Sharma JK; Operations Research; Macmillan
8.   Ravindran , Philips and Solberg; Operations research; Wiley India
9.   Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
10.   Bowersox DJ, Closs DJ, Cooper MB; Supply Chain Logisti Mgt; TMH
11.   Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH
12.   Bronson R ;Theory and problems of OR; Schaum Series; TMH

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B.E. (MECHANICAL ENGINEERING)
FOURTH YEAR
ELECTIVE - II
Semester – VIII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**ROBOTICS**	**ME - 8101**

Unit – I

Introduction: Automation and Robotics, CAD/CAM and Robotics - An over view of Robotics – present and future applications - classification by coordinate system and control system. Need an importance, basic concepts, structure and classification of industrial robots

Unit – III

Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom - Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

Unit – IV

Robot programming, languages and software packages, Piezoelectric sensors , linear position and displacement sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing. Image processing and object recognition.

Unit – II

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Unit – V

Safety and Economy of Robots: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots.

References:
1. Mittal RK, Nagrath IJ; Robotics and Control; TMH
2. Industrial Robotics / Groover M P /Pearson Edu
3. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
4. Yoshikava ; Foundations of Robotics- analysis and Control; PHI Learning;
5. Murphy ; Introduction to AI Robotics; PHI Learning
6. Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
7. Saha S; Introduction to Robotics; TMH

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FOURTH YEAR
Semester – VIII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**SIMULATION & MODELLING**	**ME - 8102**

Unit - I

Introduction to modeling and simulation: Modeling and simulation methodology, system modeling, concept of simulation; gaming; static, continuous and discrete event simulation.

Unit - II

Basic concept of probability, generation and characteristics of random variables, continuous and discrete variables and their distributions; mapping uniform random variables to other variable distributions; linear, nonlinear and stochastic models

Unit - III

Introduction to Queuing Theory: Characteristics of queuing system, Poisson's formula, birthdeath system, equilibrium of queuing system, analysis of M/M/1 queues. Introduction to multiple server Queue models M/M/c Application of queuing theory in manufacturing and computer system

Unit - IV

System Dynamics modeling: Identification of problem situation, preparation of causal loop diagrams and flow diagrams, equation writing, level and rate relationship, Simulation of system dynamics models.

Unit - V

Verification and validation: Design of simulation experiments, validation of experimental models, testing and analysis. Simulation languages comparison and selection, study of simulation software Arena, Promodel, SIMULA, DYNAMO, STELLA, POWERSIM.

References:
1.   Law AM and Kelton WD; Simulation Modeling and Analysis; TMH
2.   Gordon G., System simulation, PHI Learningl
3.   Banks J; Hand book of Simulation; John Wiley.
4.   Harrell C, Ghosh B, Bowden R; Simulation Using Promodel; MG Hill
5.   Seila, Ceric and Tadikmalla; Applied Simulation Modeling, Cengage
6.   Payer T., Introduction to system simulation, McGraw Hill.
7.   Sushil, System Dynamics, Wiley Eastern Ltd.
8.   Spriet JA; Computer Aided Modeling and Simulation, Academic Press INC; USA

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FOURTH YEAR
Semester – VIII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**SOLAR ENERGY UTILISATION**	**ME - 8103**

UNIT-I

Energy resources and their utilization: Indian and global energy sources, Energy exploited, Energy planning, Energy Parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.

UNIT-II

Solar radiations: Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT-III

Solar energy: Radiation, flat plate and concentrating collectors, fluid flow and heat transfer analysis, estimation of solar radiation, Active systems, solar pond, passive space conditioning, power generation, photovoltaic's. Principles and applications of wave energy, tidal energy, biomass energy, OTEC and Geothermal energy. MHD Engineering. Fuel Cells. Wind Energy potentials.

UNIT-IV

Solar Photovoltaic: Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes.

UNIT-V

Other Non- Conventional energy sources: Geothermal energy – Introduction, Types of geothermal resources, Methods of Harnessing. Energy from oceans – wave energy, energy conversion devices, tidal energy- Types of tidal power plants, ocean thermal energy – Introduction, open & closed systems.

References:
1. Solar Energy – S.P.Sukhatme, Tata mcgraw hill co.
2. Power Plant Engineering – P.K.Nag, Tata mcgraw hill publishing co.
3. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn
4. Solar Energy Fundamentals Design, Modelling and Applications by G.N. Tiwari, Nwrosh.
5. Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.

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B.E. (MECHANICAL ENGINEERING)
FOURTH YEAR
Semester – VIII
Course Content & Grade

Branch	Subject Title	Subject Code
ME	**QUALITY MANAGEMENT & CONTROL**	**ME - 8104**

UNIT - I

ITRODUCTION: Basic concepts, definitions and history of quality control. Quality function and concept of quality cycle. Quality policy and objectives. Economics of quality and measurement of the cost of quality. Quality considerations in design. Process control: Machine and process capability analysis.Use of control charts and process engineering techniques for implementing the quality plan. Acceptance Sampling: single, double and multiple sampling, lot quality protection, features and types of acceptance sampling tables.

UNIT-II

MANAGEMENTDURATION AND CONTROL: Importance and options to accelerate project completion; timecost tradeoff; fixed variable and total costs; use of floats and cost optimization; project performance measures; project monitoring info and reports; project control process; Gant chart and control chart cost-schedule S-graph; planned cost of work schedule (PV), budgeted/ earned cost of work (EV) and actual cost of work completed (AC).

UNIT-III

QUALITY ORGANIZATION, CULTURE AND LEADERSHIP: projects within functional organization; dedicated project/ task-force teams; staff, matrix and network organization;; Organization culture; ten characteristics; cultural dimensions supportive to projects; social network and management by wandering around (MBWA);; five stage team development model; shared vision; conflicts; rewards; rejuvenating project teams; project stakeholders; concept of project partnering.

UNIT-IV

STRATEGIC PLANNING AND PROJECT APPRAISAL: Capital allocation key criteria; Porters competitive strategy model; BCG matrix; Strategic Position Action Evaluation (SPACE); time value of money; cash flows; payback period; IRR; cost of capital; NPV; social cost benefit analysis; UNIDO approach; project risks and financing.

UNIT-V

DEFECT DIAGNOSIS AND PREVENTION : Basic causes of failure, curve/control of failure. **MTBF.** Maintainability, Condition monitoring and dignostic techniques. different traits of a manager and leader; managing project teams, choosing appropriate project organization.

References:
1.   Prasana Chandra: Projects: planning Implementation control; TMH.
2.   Gray Clifford F And Larson EW; Project The managerial Process; TMH
3.   Panneerselven and Serthil kumar; Project management, PHI
4.   Burke ; Project Management-Planning and control technics; Wiley India
5.   Kamaraju R; Essentials of Project Management; PHI Learning