DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME & SYLLABUS
2012-2013 BATCH

BMS COLLEGE OF ENGINEERING
Bull Temple Road, Bangalore - 560 019
Vision of the Department

To become a center of excellence in educating students to become successful Mechanical Engineers.

Mission of the Department

• To empower the students with the fundamentals for a successful career in the field of mechanical engineering.
• To continue their education through post-graduation, Research & Development.
• To provide service to the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

• PEO1 - Graduates shall have successful careers as Mechanical Engineers, lead & manage teams.
• PEO2 - Graduates shall be professional in engineering practice and socially responsible
• PEO3 - Graduates shall be pursuing advanced education, research and engage in the process of life-long learning.
**Program Outcomes (PO)**

<table>
<thead>
<tr>
<th></th>
<th>Ability to apply knowledge of mathematics, science, and Mechanical engineering fundamentals to solve complex problems in engineering</th>
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<tbody>
<tr>
<td>2</td>
<td>Ability to analyze mechanical engineering problems, interpret data and arrive at meaningful conclusions involving mathematical inferences</td>
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<tr>
<td>3</td>
<td>Ability to design a mechanical system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations.</td>
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<td>4</td>
<td>Ability to understand and solve complex mechanical engineering problems by conducting experimental investigations.</td>
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<td>5</td>
<td>Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex mechanical engineering activities.</td>
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<td>6</td>
<td>Ability to understand the effect of mechanical engineering solutions on legal, cultural, social and public health and safety aspects.</td>
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<tr>
<td>7</td>
<td>Ability to develop sustainable solutions and understand their effect on society and environment</td>
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<td>8</td>
<td>Ability to apply ethical principles to engineering practices and professional responsibilities.</td>
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<td>9</td>
<td>Ability to work as a member of a team, to plan and to integrate knowledge of various engineering disciplines and to lead teams in multidisciplinary settings.</td>
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<tr>
<td>10</td>
<td>Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means</td>
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<tr>
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<td>Ability to lead and manage multidisciplinary teams by applying engineering and management principles.</td>
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<td>Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning</td>
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### III SEM

<table>
<thead>
<tr>
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### Elective Courses

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### VI SEM

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<td>12 ME 6DESOE</td>
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### VII SEM

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<td>12 ME 7DE FRM</td>
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<td>12 ME7 DE PDM</td>
<td>Product Design &amp; Manufacturing</td>
<td>12 ME 7DE IEE</td>
<td>Industrial Engineering &amp; Ergonomics</td>
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<td>12 ME7 DE CIM</td>
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<td>12 ME 7DE CMT</td>
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## VIII SEM

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Total: 22
III SEMESTER : MECHANICAL ENGINEERING

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Prerequisites
1. Engineering Physics

Course Outcomes
Co1: Express given functions to form Fourier series.
Co2: Demonstrate an understanding of Fourier transforms techniques
Co3: Employ analytical techniques to solve partial differential equations with appropriate boundary conditions
Co4: Compute interpolating polynomials, derivatives, integrals for a given function from a given data.
Co5: Apply Z-transforms techniques to solve difference equations
Co6: Use calculus of variations to find the extremal of a functional

UNIT - 1

Structure of crystalline solids: Concepts of unit cell, space lattice, Unit cells for cubic crystals (Simple cubic, BCC & FCC) and HCP structure and calculations of radius, Coordination Number and Atomic Packing Factor.
Crystal imperfections: Point, line, surface defects and volume defects.
Diffusion in solids: Diffusion Mechanism, Fick's laws of diffusion, Factors affecting diffusion. 07hrs

UNIT - 2

Mechanical behavior: Stress strain diagram for ductile and brittle materials, linear and non-linear elastic properties, properties in plastic range, engineering stress-strain, true stress & strain.
Plastic deformation: Slip & twinning, critically resolved shear stress, strain hardening, strain ageing and recovery, recrystallisation and grain growth
Fracture: Brittle, Ductile facture, Griffith's criterion. 08 hrs
Creep: Creep curve, creep mechanism, effect of temperature and stress on creep and creep test.

**Fatigue**: Fatigue cycles, Fatigue test, S-N curves, Fatigue mechanism, Factors affecting fatigue life. 07 hrs

**UNIT - 3**

**Solid solutions**: Types of solid solutions, Rules for governing the formation of solid solutions and intermediate phases

Cooling curves and phase diagrams: Construction of phase diagrams, Gibbs phase rule and Lever rule, Phase diagrams of Isomorphous & Eutectic systems and problems on Eutectic systems.

**Iron carbon equilibrium Diagram**: Equilibrium phases, Invariant reactions, critical temperatures, Slow cooling of steels (hypo, hyper and eutectoid steels). 08 hrs

**UNIT - 4**

**TTT diagram**: Construction of TTT diagram, Non-equilibrium phases, continuous cooling curves, TTT diagram for hypo and hyper eutectoid steels, Effect of alloying elements on steels.

**Heat treatment processes**: Annealing and its types, normalizing, hardening, tempering, martempering, austempering, dispersion hardening, surface heat treatment methods and heat treatment of Non-ferrous materials. 10hrs

Ferrous materials: Types, Composition, Properties and applications of plain carbon steels alloy steels and Cast irons and designation of steels.

Non-ferrous materials: Aluminum and its alloys, Copper and its alloys, Magnesium alloys. 05hrs

**UNIT - 5**

**Composite Materials**: Definition, classifications, properties and applications of FRP composites, MMCs and Ceramic composites.

Production methods of FRP Composites (Pultrusion, filament winding, hand lay-up process)
and Spray forming processes) and MMCs (Powder metallurgy, Stir casting, Squeeze casting and In-situ methods) 07hrs

Text Books:

Reference Books:

Scheme of Examination:
Answer five full questions selecting one from each unit. To set one question each from units 1, 3 and 5 and two questions each from units 2 and 4.
Prerequisites

1. Engineering Mechanics

Course Outcomes

CO1: Understand the basic concepts stress and strain
CO2: Design various structural members subjected to different loading conditions
CO3: Design cylindrical shafts subjected to torsional loads
CO4: Design cylindrical pressure vessels under various loadings

Assessments

1. CIE – 50 Marks
2. SEE – 100 Marks

UNIT – 1

Simple stress and strain: Introduction, stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation – behavior in Tension for Mild steel and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Principle of super position. Elongation due to self weight for constant cross section, simple shear stress, shears strain, elastic constants and their relations. Stress in composite section subjected to external loads and temperature change, volumetric strain.  

Compound stresses: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

10 Hrs

04 Hrs
UNIT – 2

Bending moment and Shear force in beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, uniformly varying load and couple for different types of beams. 06 Hrs

UNIT -3

Bending and shear stresses in beams: Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses, radius of curvature and bending moment, moment carrying capacity of a section, shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections (composite / fletched beams not included).

Deflection of beams: Introduction, differential equation for deflection, equations for deflections, slope and moments, double integration method for cantilever and simply supported beams for point loads, UDL, UVL and Couple, Macaulay's method. 06 Hrs

UNIT - 4

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. 04 Hrs

UNIT - 5

Thick and thin cylinders: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame’s equation), (compound cylinders not included), No Numerical

Columns and Struts: Introduction, Euler's formula for critical load of columns for different end conditions, limitations of Euler's theory, Rankine's formula, Simple Numerical. 06 Hrs

Text Books:


Reference Books:

Scheme of Examination: Two questions to be set from Unit 1 and 3 each and one question from unit 2, 4, 5. Answer five full questions of 20 marks.
III SEMESTER : MECHANICAL ENGINEERING

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**Prerequisites**
1. Elements of Mechanical Engineering

**Course Outcomes**
CO1: Understand fundamentals of foundry
CO2: Understand sand molding process and use foundry machines and equipments.
CO3: Identify various melting Furnaces and understand their operation principles and inspection methods. Of moulds
CO4: Understand the fundamentals of welding and techniques of welding, brazing and soldering.

**Assessments**
1. CIE – 50 Marks
2. SEE – 100 Marks


**Patterns:** Definition, functions, materials used for pattern, various pattern allowances and their importance, classification of patterns. **Binder:** Definition, Types of binder used in moulding sand. **Additives:** Need, type of additives used.

**UNIT - 2**

**Sand Moulding and special moulding process** :Types of base sand, requirement of base sand. Types of sand moulds. **Sandmoulds:** Moulding sand mixture ingredients (base sand, binder & additives) for different sand mixtures. Method used for sand moulding.

**Cores:** Definition, Need, Types. Method of making cores, Binders used. Concept of Gating &Risering. Principle involved and types. Fettling and cleaning of castings. Basic steps involved. Casting defects causes, features and remedies. 6 Hrs.
Moulding Machines: Jolt type, squeeze type, Jolt & Squeeze type and Sand slinger.

Special Moulding Process: Study of important moulding processes Green sand, Core sand, Dry sand, Sweep mould, CO2 sand, Shell mould, Investment mould & Full mould.

Metal moulds: Gravity die-casting, centrifugal casting, Squeeze Casting, Slush casting, Thixocasting and continuous casting processes.  

UNIT – 3


Inspection methods: Methods used for inspection of casting & welding, visual, magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy Current, Holography methods of inspection.

UNIT – 4


Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes. (AHW)

Gas Welding: Principle, Oxy – Acetylene welding, Reaction in Gas welding, Flame characteristics, Gas torch construction & working. Forward and backward welding.


UNIT – 5


Text Books:

Reference Books:

Scheme of examination: Answer five full questions, Units 1, 3, 5 are compulsory, and answer one question each from Unit 2 & 4.
III SEMESTER : MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>Subject</th>
<th>BASIC THERMODYNAMICS</th>
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<td>L-T-P</td>
<td>3-2-0</td>
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</table>

Prerequisites

1. Calculus
2. Engineering Physics and Engineering Chemistry

Course Outcomes

CO1: Understand the fundamentals of Thermodynamics.
CO2: Understand the concept of property, state, process and cycle.
CO3: Understand and analyze the conversion of work and heat within the limits of first and second law.
CO4: Understand the concept of entropy
CO5: Understand the properties of real and ideal gases and pure substances.

Assessments

1. CIE – 50 Marks
2. SEE – 100 Marks

PART-A

UNIT - 1


c) Work & Heat: Work transfer, pdV-work or displacement work, other types of work transfer, Free expansion with Zero Work transfer, Net work done by a system, Heat transfer, Heat transfer-A path function, Specific heat and Latent heat, Point to remember regarding heat, Transfer and work transfer.  

14 hrs.
UNIT - 2

a) **First Law of Thermodynamics** : First Law for a closed system undergoing a cycle, First Law for a closed system undergoing a change of state, Open system (Control volume), Steady flow energy equation (SFEE) Energy-A property of the system, Different forms of Stored Energy, Specific Heat at Constant volume, Enthalpy, Specific Heat and constant pressure, Energy of an Isolated system, Perpetual Motion machine of the First Kind (PMM1), Limitations of the First Law.  

**10 hrs.**

UNIT - 3


**12 hrs.**

PART-B

UNIT - 4

a) **Real and ideal gases** : Introduction; Vander Waal's Equation Van der Waal's constants in terms of critical properties, law of corresponding states, compressibility factor; compressibility chart. Ideal gas; equation of state, internal energy and enthalpy as functions of temperature only, universal and
particular gas constants, specific heats, perfect and semi-perfect gases. Evaluation of heat, work, change in internal energy, enthalpy and entropy in various quasi-static processes. Ideal gas mixture; Dalton's law of additive pressures, Amagat’s law of additive volumes, evaluation of properties. Analysis of various processes.

UNIT - 5

a) Pure substances: P-T and P-V diagrams, triple point and critical points. Subcooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapour states of a pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness factor (quality), T-S and H-S diagrams, representation of various processes on these diagrams, Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.

Text Books:

Reference Books:

Scheme of Examination: One Question from each unit and internal choice must be given in unit 1 & 3.
III SEMESTER : MECHANICAL ENGINEERING

<table>
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<tr>
<th>Subject</th>
<th>COMPUTER AIDED MACHINE DRAWING</th>
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</table>

Prerequisites

1. Engineering Drawing

Course Outcomes

CO1: Construct auxiliary and sectional views of simple solids.
CO2: Construct into 2-D drawings from pictorial view of simple machine components and sectional views.
CO3: Model the 3-D geometric information of machine components and construct 2-D production drawings.
CO4: Understand the fundamentals of threaded fasteners, their representation and uses.
CO5: To construct assembly drawings of various joints and couplings from part drawings.

Assessments

1. CIE – 50 Marks
2. SEE – 100 Marks

UNIT – 1

Chapter 1 - Sections of Solids: Sectioning, Sectional view, Representation of section plane, Hatching, Sectioning of engineering objects when the axis is inclined to one plane of projection & parallel to the other like: Square, Pentagonal, Hexagonal prisms, Square, Pentagonal, Hexagonal pyramids, Cylinder, Cone and Tetrahedron. 10Hrs

Chapter 2 - 3D Modelling from Orthographic views: Given the 2 or 3 views of a machine component, Generation of the object in 3D environment using software. (Demo only) 04Hrs

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), Proportions for square and hexagonal headed bolts & nuts, simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw. 04 Hrs

UNIT – 2

Chapter 4 - Joints: Assembly of Socket and Spigot cotter joint, Pin or Knuckle joint, protected type flanged coupling, Universal coupling. 10Hrs

UNIT – 3

Chapter 5 – Assembly Drawings: Screw jack, Machine vice, Plummer block, Tail stock, Steam stop valve, Ram's bottom safety valve, Petrol engine connecting rod, simple eccentric. 24 Hrs

Text books:

Reference Book:
2. ”Auto CAD 2006, for engineers and designers”. Sham Tickoo. Dream tech 2005

Scheme of evaluation:
CIE:
  · CIE 1 (Manual Drafting) - 15 marks Questions to be set from Chapter 1
  · CIE 2 (Manual Drafting, No Memory drawing) – 15 marks- Questions to be set from Chapter 4
  · Drawing Sheets – 20 marks
SEE : 100 Marks by Manual Drafting
NOTE: Examination duration: 04 hours

One question from Chapter 1 : 15 marks.
One question from Chapter 4 (Disassembled parts must be given) : 20 marks
One question from Unit 3 : 65 marks.

TOTAL : 100 marks
Prerequisites
1. Workshop practice

Course Outcomes
CO1: Determine various properties of sand.
CO2: Evaluate composition of moulding sand mixture.
CO3: Demonstrate ability to prepare sand moulds based on different patterns.

PART – A
1. Testing of Moulding sand and Core sand
Preparation of sand specimens and conduction of the following tests:
1 Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2 Permeability test
3 Core hardness &Mould hardness tests.
4 Sieve Analysis to find Grain Fineness number of Base Sand
5 Clay content determination in Base Sand

PART – B
2. Foundry Practice
Use of foundry tools and other equipments.
Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes).
Preparation of one casting (Aluminum or cast iron-Demonstration only)

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<tr>
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<tr>
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III SEMESTER : MECHANICAL ENGINEERING

Prerequisites
1. Strength of Materials

Course Outcomes
CO1: Determine mechanical properties of materials related to tensile, compression, torsion, impact, bending & hardness.
CO2: Identify & evaluate microstructures of different materials.
CO3: Understand heat treatment and non-destructive testing concepts.

PART – A

2. Torsion tests, Bending Test on metallic specimen.
3. Izod test on various specimen.
4. Brinell and Vickers’s Hardness test on various specimens.

PART – B

3. Demo on Non-destructive test experiments like,
   (a). Magnetic crack detection
   (b). Dye penetration testing, to study the defects of Casted and Welded specimens

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Credits
STRENGTH OF MATERIALS LABORATORY
Sub. Code
L-T-P
12ME3DL SOM

01
0-0-2
IV SEMESTER : MECHANICAL ENGINEERING

Course Outcomes
CO1: Estimate the relation between two variables and perform regression analysis
CO2: Apply the basic principles of probability and probability distributions.
CO3: Compute joint probabilities of two random variables
CO4: Calculate transition probabilities using Markov chain
CO5: Construct analytic functions and evaluate real and complex integrals
CO6: Discuss series solution of ordinary differential equations

UNIT-1

STATISTICS [10 hours]
Curve fitting – Fitting a straight line, fitting of a parabola, fitting of curves of the form \( y = a b^x \), \( y = a x^b \), \( y = ae^{bx} \)

PROBABILITY 1
Probability of an event, axiomatic definition, addition theorem, conditional probability, multiplication theorem, Bayes' theorem.

UNIT-2

PROBABILITY 2 [10 hours]
Probability distributions: Random variables, Discrete probability distributions, continuous probability distributions, Some standard distributions: Binomial distribution, Poisson distribution, exponential distribution, normal distribution.

UNIT-3

COMPLEX ANALYSIS 1 [10 hours]

Transformations \( w = z^2 \), \( w = e^z \) and \( w = z + \frac{a^2}{z} \) \( (z \neq 0) \) Bilinear transformations.
UNIT-4

COMPLEX ANALYSIS 2  [12 hours]
Complex integration-Cauchy’s theorem, Cauchy's integral formula, Taylor's and Laurent's series, Singular points, poles, residues, the residue theorem.  (5L+2T)

SERIES SOLUTION OF DIFFERENTIAL EQUATIONS
Series solution-Frobenius method, series solution of Bessel's differential equation leading to Bessel function of first kind, equations reducible to Bessel's differential equation, series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula.  (4L+1T)

UNIT-5

ROBABILITY 3  [10 hours]
Joint Probability distributions: Case of discrete random variables, mathematical expectation, correlation, covariance.
Markov Chain: Probability vectors, stochastic matrices, fixed points, regular stochastic matrices. Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.  (7L+3T)

Text Books

Reference Books:

Question Paper Pattern
1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. Internal Choice in Unit 2 and Unit 4
Course Prerequisites
1. Basic Thermodynamics
2. Calculus

Course Outcomes
CO1: Understand the concept of energy and irreversibility.
CO2: Understand different thermodynamic cycles, compare them and solve problems
CO3: Analyze problems of practical relevance pertaining to concepts of refrigeration and psychrometrics.
CO4: Analyze the concepts and functioning of reciprocating compressors
CO5: Analyze the parameters affecting the performance of IC engines

Assessment
CIE – 50 Marks
SEE – 50 Marks

UNIT - 1
a) Exergy & Irreversibility: Available Energy, Available Energy referred to a Cycle, Quality of Energy, Maximum work in reversible process, Reversible work by an Open system, Exchanging Heat only with the surroundings, Useful work, Dead state, Availability, Availability in Chemical reactions, Irreversibility

UNIT - 2
b) Vapour Power cycles: Simple steam power cycle, Rankine Cycle, Actual Vapour Cycle processes, Comparison of Rankine and Carnot cycles, Mean temperature of heat addition, Reheat cycle, Ideal Regenerative cycle, Regenerative cycle, Feedwater Heaters,
UNIT - 3

a) **Refrigerations**: Refrigeration by Non- cyclic processes, Reversed Heat engine cycle, Vapour Compression refrigeration cycle, Absorption refrigeration cycle, Heat pump system, Gas cycle refrigeration.

b) **Psychometrics**: Atmospheric air and psychometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative humidities and the relation between the two Enthalpy and adiabatic saturation temperature. Construction and Use of psychometric chart. Analysis of various processes; heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Summer and winter air - conditioning.

**13 Hrs**

UNIT - 4


**07 Hrs**

UNIT - 5

a) **I.C.Engines**: Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation. Testing of two-stroke and four-stroke SI and CI engines for performance, related numerical problems, heat balance, Morse test.

**08 Hrs**
Text Books:

Reference Books:
4. An Introduction to Thermo Dynamics by Y.V.C. Rao, Wiley Eastern Ltd.,
5. Thermodynamics by Radhakrishnan.
6. Thermodynamics for Engineers by Michel Sadd.

Scheme of Examination:
One Question from each unit and internal choice must be given in unit 2 & 3.
IV SEMESTER : MECHANICAL ENGINEERING

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Perquisites
1. Calculus and Vector Calculus
2. Engineering Physics
3. Engineering Mechanics

Course Outcomes
CO1: Understand the fundamentals of kinematics and common mechanisms.
CO2: Analyse velocity and acceleration in various four bar mechanisms.
CO3: Understand the fundamentals of gear profiles and compute various parameters of gear teeth.
CO4: Design gear trains for power transmission.
CO5: Understand the fundamentals of cam profiles and design cam profiles for different applications.

Assessment
CIE – 50 Marks
SEE – 50 Marks

UNIT - 1

INTRODUCTION: DEFINITIONS: Link or element, kinematic pairs, degrees of freedom, Grubler’s criterion (without derivation), Kinematic chain, Mechanism, structure, Mobility of Mechanism, Inversion, Machine Gashoff’s criteria.

KINEMATIC CHAINS AND INVERSIONS: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

MECHANISMS: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms
--Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms
--Geneva mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph,
Davis & Ackerman steering gear mechanism.

UNIT - 2
VELOCITY & ACCELERATION ANALYSIS OF MECHANISMS (GRAPHICAL METHODS)
Velocity and acceleration analysis of Four Bar mechanism and slider crank mechanism by
vector polygons: Relative velocity and acceleration of particles in a common link, relative
velocity and accelerations of coincident Particles on separate links- Coriolis component of
acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

UNIT – 3
VELOCITY ANALYSIS BY INSTANTANEOUS CENTER METHOD: Definition, Kennedy's
Theorm, Determination of linear and angular velocity using instantaneous center method
KLEIN’S CONSTRUCTION: Analysis of velocity and acceleration of single slider crank
mechanism.
SPUR GEARS: Gear terminology, law of gearing, Characteristics of involute action, Path of
contact, Arc of contact, Contact ratio, Interference in involute gears, Methods of avoiding:
interference, Back lash, Comparison of involute and cycloidal teeth.

UNIT - 4
GEAR TRAINS: Simple gear trains, Compound gear trains for large speed reduction,
Epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic
gear trains. Tooth load and torque calculations in epicyclic gear trains.

UNIT – 5
CAMs: Types of cams, Types of followers, Displacement, Velocity and Acceleration time
curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-faced follower, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

**Text Books:**


**Reference books:**


**Scheme of Examination:**

2 questions each from Unit 1 & 2, one question each from Units 3, 4 & 5.
Perquisites
1. Engineering Mechanics
2. Strength of Materials
3. Calculus

Course Outcomes
CO1: Apply concepts of mechanics of materials to estimate the stresses in a machine element and predict failure of components based on theories of failure.
CO2: Understand fatigue failure in machine elements and factors affecting it.
CO3: Design shafts, keys, splines and couplings for power transmission.
CO4: Design cotter, riveted & welded joints.
CO5: Design power screws and threaded fasteners.

Assessment
CIE – 50 Marks
SEE – 50 Marks

UNIT 1:

Introduction: Definitions: normal, shear, biaxial and tri axial stresses, Stress tensor, Principal Stresses. Engineering Materials and their Mechanical properties, Stress-Strain diagrams, Stress Analysis, Design considerations: Codes and Standards. 5 Hrs

Design for Static & Impact Strength: Static loads and factor of safety, Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory; Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of Stress concentration factor. Impact Strength: Introduction, Impact stresses due to axial loading. 7 Hrs
UNIT 2:
**Design for Fatigue Strength**: Introduction - S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Endurance limit modifying factors: size effect, surface effect, Stress concentration effects; Fluctuating stresses, Goodman's and Soderberg's relationship; stresses due to combined loading. **8 Hrs**

UNIT 3:
**Design of Shafts**: Torsion of shafts, design for strength and rigidity with steady loading, ASME & BIS codes for power transmission shafting, shafts under fluctuating loads and combined loads. **7 Hrs**


**Couplings**: Rigid and flexible couplings: Flange coupling, Bush and Pin type coupling **7 Hrs**

UNIT 4

**Riveted and Welded Joints** - Types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints, Tank and Structural Joints, Riveted Brackets. Welded Joints - Types, Strength of butt and fillet welds. **7 Hrs**

UNIT 5:

**Threaded Fasteners**: Stresses in threaded fasteners, Effect of initial tension, Design of threaded fasteners under static, dynamic and impact loads. **6 Hrs**

**Power Screws**: Mechanics of power screw, Stresses in power screws, efficiency and self-locking, Design of Power Screw. **5 Hrs**
DESIGN DATA HAND BOOKS:
2. Design Data Hand Book by K. Mahadevan and Balaveera Reddy, CBS Publication
4. PSG design data handbook by PSG College of Technology, Coimbatore

TEXT BOOKS

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit.
To set One question each from Unit 2, 4 & 5 and two questions each from Units 1 & 3.
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

IV SEMESTER : MECHANICAL ENGINEERING

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<th>MANUFACTURING PROCESS-II</th>
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Perquisites
1. Elements of Mechanical Engineering
2. Engineering Physics

Course Outcomes
CO1: Understand the fundamentals of metal cutting and properties & selection of cutting tool materials.
CO2: Explain the constructional features & working of various machine tools.
CO3: Understand the basic and super finishing operations.
CO4: Compute machining time and metal removal rate for various machining operations.
CO5: Understand the principles and operations of nonconventional machining processes.
CO6: Produce simple components using various machine tools.

Assessment
CIE – 50 Marks
SEE – 50 Marks

Unit – 1

Theory of Metal Cutting: Single point cutting tool nomenclature, Merchants circle diagram and analysis and simple problems., shear angle relationship, tool wear and tool failure, tool life, effects of cutting parameters on tool life, tool failure criteria, Taylor's tool life equation, problems on tool life evaluation. 7 Hrs.

Unit-2

**Production Lathe:** Classification of Lathes, Specification, Engine lathe, Capstan & Turret lathes-Constructional features, tool layout, tool & work holding devices and attachments. Lathe operations. Calculation of machining time. 6 Hrs

**Shaping, Slotting and planning machines:** Classification, constructional features of shaping m/c, slotting m/c, planning m/c. driving mechanisms of shaping, slotting and planning machines. Operations done on shaping machine, slotting machine and planning machine. Difference between shaping and planning operations. 7 Hrs.

Unit – 3

**Drilling machines:** Classification, constructional features, drilling & related operations, types of drill & drill bit nomenclature, drill materials. Calculation of machining time

**Milling machines:** Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Calculation of machining time.

**Indexing:** Simple, compound, differential and angular indexing calculations. Simple numerical on indexing. 9 Hrs.

Unit – 4

**Broaching machines:** Classification, Construction and principle of operations

**Grinding, Lapping and Honing machines:** Types of abrasives, bonding process, classification, constructional features (cylindrical and surface grinding, centre less grinding), selection of grinding wheel. Mounting and balancing of grinding wheel., **Lapping and Honing:** Principles of operation, construction, applications. 9 Hrs.

Unit – 5

**Non-traditional machining processes:** Principle, need, equipment, operation and LBM, plasma arc machining, Electro chemical machining, ultrasonic machining, abrasive let machining, EDM. 8 Hrs.
Text Books:
4. Manufacturing process by Dr.K.Radhakrishna

Reference Books:
3. All about machine tools by Heinrich Gerling

Scheme of examination:
Answer any Five of 20 marks each. Two questions each from Units 1 & 2.
One question each from Units 3, 4, 5.
IV SEMESTER : MECHANICAL ENGINEERING

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Perquisites
1. Vector Calculus
2. Engineering Mathematics 1 and 2
3. Engineering Mechanics

Course Outcomes
CO1: Understand fundamentals of fluid mechanics and properties of fluids
CO2: Understand and apply the principles of pressure, buoyancy and floatation.
CO3: Understand and apply the principles of fluid kinematics and dynamics.
CO4: Explain the concepts of different types of fluid flow measuring devices.
CO5: Understand the losses in fluid flow and apply dimensional analysis.

Assessment
CIE – 50 Marks
SEE – 50 Marks

PART-A

Unit - 1
Introduction to Properties of Fluids: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Concept of continuum, types of fluids. 08Hrs

Unit – 2
Fluid Statics: Pascal's law, pressure variation in a static fluid in 2D, Absolute, gauge, atmospheric and vacuum pressures. Manometers. 07Hrs

Total pressure and center of pressure for horizontal plane, vertical plane surface and inclined plane surface submerged in static fluid. Buoyancy, center of buoyancy, meta center and meta centric height, stability of floating bodies. 07Hrs
Unit - 3
**Fluid Kinematics and Dynamics:** Classification of fluid flow, continuity equation in 2D & 3D (Cartesian co-ordinate system only), velocity potential function and stream function. Forces acting on fluid in motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids.  

Unit - 4
**Fluid flow measurements:** Introduction, venturimeter, orifice meter, Pitot tube. Major & Minor losses - Darcy Equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, Bend losses and Change of section losses. Hagen poiseulle's equation.

Unit - 5
**Laminar flow and viscous flow, Dimensional Analysis:** Drag, Lift, expression for lift and drag, pressure drag and friction drag, boundary layer concept, Velocity of sound in a fluid, Mach number.

**Dimensional Analysis - Rayleigh's method, Buckingham \( \Pi \) theorem, dimensionless numbers.**

**Text Books:**

**Reference books:**

**Answer any Five Questions of 20 marks each, choosing one from each unit.**
**Two questions to be set from Units 2 & 5 and One question each from Units 1, 3 & 4.**
Course Outcomes

CO1: Demonstrate preparation of models involving various types of turning operations on lathe.

CO2: Demonstrate preparation of models involving various milling & shaping operations.

PART – A
Preparation of two models on lathe involving Plain turning, Taper turning (by offset methods compound rest method) Step turning, Facing, Convex shape turning External Thread cutting -V thread and Square thread.

34 Hours

PART – B
Cutting of V Groove using a shaper,
Cutting of Spur Gear Teeth Helical Gear using Milling Machine.

14 Hours

Scheme of Examination:

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IV SEMESTER : MECHANICAL ENGINEERING

Prerequisites
Basic and Applied Thermodynamics

Course Outcomes

PART - A
1. Determination of Flash point and Fire point of lubricating oil using AbelPensky and Martin (closed) / eavland (Open Cup) Apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels.
5. Determination of area by planimeter

Total: 21 Hours

PART - B
1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for
   (a) Four stroke Diesel Engine
   (b) Four stroke Petrol Engine
   (c) Morse test for multi Cylinder Diesel/Petrol Engine
   (d) Two stroke Petrol Engine
   (e) Variable Compression Ratio I.C. Engine.

Total: 21 Hours

Scheme for Examination:

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V SEMESTER : MECHANICAL ENGINEERING

Course Outcomes
CO1: Understand the concepts of management and planning and apply them for decision making.
CO2: Apply the principles of organizing and staffing.
CO3: Demonstrate ability to lead, co-ordinate and direct a team.
CO4: Understand concepts of entrepreneurship and develop an enterprise.
CO5: Identify the role & significance of small scale industries and assistances available for establishing a small scale industry.

Assessments
1. CIE – 50 Marks
2. SEE – 50 Marks

Unit – 1


Unit – 2

Subject | MANAGEMENT & ENTREPRENEURSHIP | Sub. Code | 12 ME 5DC MAE
--- | --- | --- | ---
Credits | 04 | L-T-P | 4-0-0
Unit – 3


8 hours

Unit – 4


8 hours

Unit – 5


8 hours

Institutional Support
Different Schemes, TECKSOK, KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI, NSIC, SIDBI, KSFC.

7 hours

Text Books:
1. Principles of Management – P.C. Tripathi, P.N. Reddy, Tata McGraw Hill, (Chapters 1,2,3,4,5,14,15,16,17)
2. Dynamics of Entrepreneurial Development & Management – Vasant Desai – Himalaya Publishing House (Chapters 1,2,4,6,8,9,10,13,15,16,17,18,19,20,21,22, 42,46,47)
REFERENCE BOOKS:
2. **Entrepreneurship Development** – SS Khanka – S Chand & Co. (Chap 1, 2, 5, 11, 12, 13, 16, 18, 20)

Scheme of Examination: Answer five full questions selecting one from each unit. To set One question each from Unit 2, 3 & 4 and two questions each from units 1 & 5.
V SEMESTER : MECHANICAL ENGINEERING

<table>
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<th>Subject</th>
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Prerequisites

- Engineering Mechanics, Strength of Materials, Design of Machine elements 1

Course Outcomes

CO1: Determine the stresses in curved beams, analyze and design springs under static and dynamic axial loads.

CO2: Analyze and design various types of brakes and clutches and check for heat generation and dissipation.

CO3: Design gears based on strength, dynamic and wear loads.

CO4: Understand the fundamentals of bearings & lubrication mechanisms and design of sliding bearings.

CO5: Design and select power transmission elements

Assessments

1. CIE – 50 Marks
2. SEE – 50 Marks

UNIT 1

Curved Beams: Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps. Closed rings and links (only numericals).


UNIT 2

Clutches & Brakes: Design of Clutches: Single plate, multi plate and cone clutches.

6 Hours
UNIT 3

Spur & Helical Gears: Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load. Helical Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.

Bevel and Worm Gears: Bevel Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads. Worm Gears: Definitions, Design based on strength, dynamic, wear loads and efficiency of worm gear drives.

UNIT 4


UNIT 5

Belts Ropes and Chains: Flat belts: Length & cross section, Selection of V-belts, ropes and chains for different applications.

Design Data Hand Books:
2. Design Data Hand Book by K. Mahadevan and K. Balaveera Reddy, CBS Publication

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set One question each from Unit 2, 4 & 5 and two questions each from Units 1 & 3.
Prerequisites
- Engineering Physics

Course Outcomes
CO1: Understand the various Standards of measurements and usage of different measuring devices.
CO2: Understand the system of limits, fits, tolerances and gauging.
CO3: Understand the principles of interferometry.
CO4: Understand the characteristics and elements of measurement systems.
CO5: Understand the principles and measurement of various phenomena like force, torque, pressure, temperature and strain.
CO6: Demonstrate calibration and usage of various measuring instruments for measurement of various physical parameters and phenomena.

Assessments
1. CIE – 50 Marks
2. SEE – 50 Marks

UNIT - 1
Standards of measurement: Definition and Objectives of metrology, Standards of length - International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, Slip gauges, Wringing phenomena, Indian Standards (M-81, M-112), Numerical problems on building of slip gauges.


4 Hrs
UNIT - 2

**System of limits, Fits, Tolerances and gauging:** Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919 -1963), geometrical tolerances, positional tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges -Taylor's principles, Design of 'Go' and 'No Go' gauges, Wear allowance on gauges. Types of gauges -plain plug gauge, ring gauge, snap gauge, limit gauge, gauge materials.

**8 Hrs**

UNIT - 3

**Angular measurements**, Bevel Protractor, Sine Principle and use of Sine bar, Sine center, use of angle gauges, numericals on building of angles.

**Principles of Interferometry:** Interferometer, autocollimator, Optical flats.

**4 Hrs**

**Screw thread & gear measurement** Terminology of screw threads, measurement of major diameter, minor diameter pitch, angle. Measurement of effective diameter by 2-wire and 3-wire methods, Best size wire. Toolmakers microscope, gear terminology, use of gear tooth Vernier caliper.

**3 Hrs**

UNIT - 4

**Measurements and Measurement systems:** Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in Measurements, Classification of Errors.

**4 Hrs**
**B.M.S COLLEGE OF ENGINEERING, BANGALORE-19**  
(Autonomous College under VTU)

**Transducers, Intermediate modifying and terminating devices:** Transfer efficiency, Primary and Secondary transducers, electrical, Mechanical, electronic transducers, advantages of each type transducers. Mechanical systems, inherent problems, Electrical intermediate modifying devices. Terminating devices, Mechanical Oscillographs, X-Y Plotters.  

**UNIT – 5**

**Measurement of Force, Torque & Pressure:** Principle, platform balance, proving ring, Torque measurement, Prony brake, hydraulic dynamometers. Pressure Measurements- Principle, use of elastic members, McLeod gauge, Pirani Gauge. Bridgeman gauge.  

**Temperature and strain measurement:** Resistance thermometers, thermo-couple, laws of thermocouple materials used for construction, pyrometer, Optical Pyrometer. Strain Measurements- Strain gauge, gauge factor, methods of strain measurement.  

**UNIT - 6**

**PART-A: MECHANICAL MEASUREMENTS**

1. Calibration of Pressure Gauge  
2. Calibration of Thermocouple  
3. Calibration of LVDT  
4. Calibration of Load cell  
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.  

**PART-B: METROLOGY**

7. Measurements of angle using Sine Center / Sine bar / bevel protractor  
8. Measurements of alignment using Autocollimator. (Demo)
9. Measurements of cutting tool forces using
   a) Lathe tool Dynamometer
   b) Drill tool Dynamometer.

10. Measurements of Screw thread Parameters using two wire or three-wire method. (Demo)


12. Measurements of gear tooth profile using gear tooth vernier.

13. Calibration of micrometer using slip gauges

   **12 Hrs.**

Text Books:

Reference Books:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 3&5 and two questions each from Units 2 & 4.
V SEMESTER : MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>Subject</th>
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<th>DYNAMICS OF MACHINES</th>
<th>Sub. Code</th>
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<td>Prerequisites</td>
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<tr>
<td>Engineering Mechanics, Kinematics of Machinery, Calculus</td>
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<td>Course Outcomes</td>
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<tr>
<td>CO1: Understand and analyze static equilibrium of simple mechanisms subjected to force and design a flywheel</td>
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<td>CO2: Understand the operation of Bearings and belt drives and design them for power transmission.</td>
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<td>CO3: Understand the concept of static and dynamic balancing and analyze rotating and reciprocating masses in engine for balancing.</td>
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<td>CO4: Understand the concept of gyroscopic action and analyze the stability of ships, planes, two wheeled and four wheeled automobiles</td>
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<td>1. CIE – 50 Marks</td>
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UNIT 1

Static Force Analysis: Introduction, Static equilibrium, Equilibrium of two and three force members. Member with two forces and torque, Free-body diagrams, Static force analysis of simple mechanisms. Principle of virtual work. 7 Hours

Turning moment diagram: Turning moment diagram and flywheels, Fluctuation of Energy. Determination of size of a flywheel. 6 Hours

UNIT 2

Friction and Belt Drives: Definitions; Types of friction, laws of friction, Friction in pivot and collar bearings. Flat belt drive, ratio of belt tensions, centrifugal tension, power transmitted. Belt thickness and width calculations. 5 Hours
Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power

UNIT 3
Balancing of Rotating Masses: Static and dynamic balancing, Balancing of single rotating and many rotating masses by another mass in one plane. Effect of transferring rotating mass from one plane to another. Balancing of several rotating masses by balancing masses in different plane.

UNIT 4
Balancing of Reciprocating Masses: Inertia effect of crank and connecting rod, single cylinder engine, balancing in multi cylinder-inline engine (primary & Secondary forces), V-type engine; Radial engine – Direct and reverse crank method.

UNIT 5
Gyroscope: Vectorial representation of angular motion, Gyroscopic couple. Effect of gyroscopic couple on the movement of a Naval ship, plane disc, aeroplane, stability of a two wheeler and four wheeler taking a turn

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set One question each from Unit 3, 4 & 5 and two questions each from Units 1 & 2.
V SEMESTER : MECHANICAL ENGINEERING

<table>
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Prerequisites
- Fluid Mechanics, Basic and Applied Thermodynamics
- Calculus

Course Outcomes
CO1: Understand typical designs of turbo machines, their working principles and applications
CO2: Explain the working principle of various types of compressors, pumps and hydro turbines and their application range
CO3: Evaluate the performance parameters of pumps, compressors, turbines on a 1-D basis with the use of velocity triangles
CO4: Design Turbomachinery for multistage operation.

Assessments
1. CIE – 50 Marks
2. SEE – 100 Marks

UNIT - 1

INTRODUCTION: Definition of a Turbomachine; parts of a Turbomachine; Comparison with positive displacement machine; Classification: Application of First and Second Laws to Turbomachines, Efficiencies. Dimensionless parameters and their physical significance; Effect of Reynolds number; Specific speed.

THERMODYNAMIC ANALYSIS OF COMPRESSION AND EXPANSION PROCESSES:
Stagnation and static properties and their relations; Compression process – Overall isentropic efficiency of compression; Stage efficiency; Comparison and relation between overall efficiency and stage efficiency; Polytropic efficiency; Preheat factor; Expansion Process – Overall isentropic efficiency for a turbine; Stage efficiency for a turbine; Comparison and relation between stage efficiency and overall efficiency for expansion process; polytropic efficiency; Reheat factor.  

7 Hours
UNIT - 2

ENERGY TRANSFER IN TURBO MACHINES: Euler Turbine equation; Alternate form of Euler turbine equation – components of energy transfer; Degree of reaction; General analysis of a Turbo machine – effect of blade discharge angle on energy transfer and degree of reaction; General analysis of centrifugal pumps and compressors – Effect of blade discharge angle on performance; Theoretical head – capacity relationship.

GENERAL ANALYSIS OF PUMPS AND COMPRESSORS: Axial flow compressors and pumps – general expression for degree of reaction; velocity triangles for different values of degree of reaction; General analysis of axial and radial flow turbines – Utilization factor; Vane efficiency; Relation between utilization factor and degree of reaction; condition for maximum utilization factor – optimum blade speed ratio for different types of turbines.

12 Hours

UNIT - 3

CENTRIFUGAL COMPRESSORS: Classification; Expression for overall pressure ratio developed; Blade angles at impeller eye root and eye tip; Slip factor and power input factor; width of the impeller channel; Compressibility effect – need for pre-whirl vanes; Diffuser design: Flow in the vaneless space, determination of diffuser inlet vane angle, width and length of the diffuser passages; Surging of centrifugal compressors.

AXIAL FLOW COMPRESSORS: Classification; Expression for Pressure ratio developed per stage – work done factor, radial equilibrium conditions.

6 Hours

UNIT - 4

CENTRIFUGAL PUMPS: Definition of terms used in the design of centrifugal pumps like manometric head, suction head, delivery head, pressure rise, manometric efficiency, hydraulic efficiency, volumetric efficiency, overall efficiency, multistage centrifugal pumps, minimum starting speed, slip, priming, cavitation, NPSH.

5 Hours
UNIT - 5

STEAM TURBINES: Classification, Single stage impulse turbine; Condition for maximum blade efficiency, stage efficiency. Compounding – Need for compounding, method of compounding. Impulse Staging – Condition for maximum utilization factor for multi stage turbine with equiangular blades; effect of blades and nozzle losses. Reaction turbine; Parson’s reaction turbine, condition for maximum blade efficiency, reaction staging.

HYDRAULIC TURBINES: Classification: Pelton Turbine-velocity triangles, Design parameters, turbine efficiency, volumetric efficiency; Francis turbine–velocity triangles, runner shapes for different blade speeds, Design of Francis turbine; Function of a Draft tube, types of draft tubes; Kaplan and Propeller turbines – Velocity triangles and design parameters.

TEXT BOOKS:
1. An Introduction to energy conversion, Volume III – Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers (P) Ltd.

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set One question each from Unit 1, 3 & 4 and two questions each from Units 2 & 5.
Course Outcomes

CO1: Determine coefficient of discharge for various flow measuring devices
CO2: Determine the forces developed due to impact of jets on vanes
CO3: Determine the performance parameters of pumps, blowers, compressors, turbines

PART - A

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Determination of force developed by impact of jets on vanes.
4. Calibration of flow measuring devices
   a. Orifice Plate meter
   b. Nozzle
   c. Venturimeter
   d. V-notch

   18 Hours

PART - B

5. Performance testing of Turbines
   a. Pelton wheel
   b. Francis Turbine
   c. Kaplan Turbines

   6. Performance testing of Pumps
      a. Single stage / Multi stage centrifugal pumps
b. Reciprocating pump
7. Performance test of a two stage Reciprocating Air Compressor
8. Performance test on an Air Blower

24 Hours

TEXT BOOKS:

REFERENCE BOOKS:

Scheme for Examination:

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<td>One Question from part B</td>
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</table>
UNIT - 1

Introduction: Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions.  

UNIT - 2

Strain at a point, Compatibility Equations, Principal Strains, Generalised Hooke's law, Methods of Solution of Elasticity Problems –Plane Stress & Plane Strain Problems. 

Uniqueness theorem, Principle of super position, reciprocal theorem, Saint Venant principle.
UNIT 3

TWO DIMENSIONAL PROBLEMS: Cartesian co-ordinates – Airy’s stress functions – Investigation of Airy’s Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load.  

UNIT - 4

GENERAL EQUATIONS IN CYLINDRICAL CO-ORDINATES: Thick cylinder under uniform internal and / or external pressure, shrink and force fit, Stresses in an infinite plate with a circular hole subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders. 

UNIT – 5

TORSION OF CIRCULAR, ELLIPTICAL AND TRIANGULAR BARS: membrane analogy, torsion of thin open sections and thin tubes.

TEXT BOOKS:

REFERENCES BOOKS:
1. Theory of Elasticity: Dr. Sadhu Singh, Khanna Publications, 1988
2. Elasticity, Theory, Applications & Numericals: Martin H Sadd, Elsevier. 2005
3. Applied Elasticity, Seetharamu&Govindaraju, Interline Publishing

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1 3 & 5 and two questions each from Units 2 & 4.
UNIT - 1

THERMODYNAMIC CYCLE ANALYSIS: Deviation from ideal processes. Effect of chemical equilibrium and variable specific heats. Effect of air fuel ratio and exhaust gas dilution. Calculation of combustion temperatures. Use of combustion charts. Simple numerical problems. 7 Hours

UNIT - 2


UNIT - 3


UNIT - 4

FUELS: Hydro carbons - chemical structure-influence of chemical structure on knock alternative fuels; Alcohols; vegetable oils; Bio gas as Diesel engine fuels.


UNIT - 5

EMISSION REGULATION AND CONTROL SYSTEMS: Mechanism of pollutant formation. Total emission control package thermal reactor package; catalytic converter package; control of NOx-Exhaust gas recirculation-Water injection.

MODERN DEVELOPMENTS: Turbo charging and super charging of I.C.engines, Stratified charge engines (Lean burned SI engine) Multi fuel engines, Rotary piston engine, Two injector engines Pilot ignition engine, all ceramic swirl chamber engines

TEXT BOOKS:


REFERENCE BOOKS:


Scheme of Examination: Answer Five full questions selecting one from each unit.
To set one question each from Unit 1, 3 & 5 and Two questions each from Units 2 & 4.
UNIT - 1
INTRODUCTION: The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

UNIT - 2
MODELING PROCESS QUALITY: Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, Finding the Z score, Central limit theorem.

UNIT - 3
CONTROL CHARTS FOR VARIABLES: Control Charts for X-Bar and R-Charts, Statistical basis of the charts, Development and use of X bar and R charts, Interpretation of charts. Type I and Type II errors, the probability of Type II error. Numerical Problems

UNIT - 4
PROCESS CAPABILITY: The foundation of process capability, Natural Tolerance limits, $c_p$ - process capability index, $c_{pk}$, $P_o$ - process performance index, summary of process measures. Numerical problems
UNIT 5:
Control Charts For Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non conformities per unit. Numerical problems

LOT-BY-LOT ACCEPTANCE SAMPLING FOR ATTRIBUTES: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans. Numerical problems

TEXT BOOKS:
2. Statistical Quality Control, RC Gupta, Khanna Publishers, New Delhi, 2005

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 3 & 4 and two questions each from Units 2 & 5.
UNIT - 1

METHODS OF REFRIGERATION: Introduction to Refrigeration, Methods of Refrigeration: Ice refrigeration, evaporative refrigeration, air refrigeration, vapour refrigeration, dry ice refrigeration, thermo electric refrigeration, pulse tube refrigeration, thermoacoustic refrigeration.

REFRIGERANTS: Types of Refrigerants, Comparative study of Ethane and Methane derivatives, selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-isotropic mixtures.

UNIT – 2

GAS CYCLE REFRIGERATION: Introduction, reverse Carnot cycle, Bell Coleman cycle, advantages & dis-advantages of gas refrigeration system. Applications to aircraft refrigeration, Analysis of gas refrigeration and Numericals.

TRANSMISSION AND DISTRIBUTION OF AIR: Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system.

UNIT – 3

MULTI PRESSURE VAPOUR COMPRESSION SYSTEMS: Multi stage compression, Multi evaporator systems, Cascade systems, production of solid carbon dioxide, System practices for multistage numericals system.

EQUIPMENTS USED IN VAPOUR COMPRESSION REFRIGERATION SYSTEM: Compressors: Principle, types of compressors, capacity control. Condensers: Types and

14 Hours

UNIT - 4


7 Hours

UNIT - 5

DESIGN CONDITIONS: Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.

LOAD CALCULATIONS AND APPLIED PSYCHOMETRICS: Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor, Bypass factor, cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning apparatus for cooling and dehumidification, evaporative cooling.

CONTROLS IN REFRIGERATION AND AIR CONDITIONING EQUIPMENTS: High pressure and low pressure cut out, thermostats, pilot operated solenoid valve, motor controls, bypass control-Damper motor. VAV controls.  

15 Hours

TEXT BOOKS:


REFERENCE BOOKS:
4. *Refrigeration and Air-Conditioning* by Manoharprasad
5. *Refrigeration and Air-Conditioning* by S C Arora & S Domkundwar, DhanpatRai Publication

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 4 and Two questions each from Units 3 & 5.
UNIT - 1


OPERATIONS DECISION MAKING: Introduction, Characteristics of decisions, framework for Decision Making, Decision methodology, Decision supports systems, Economic models, Statistical models. 10 Hours

UNIT - 2

SYSTEM DESIGN & CAPACITY PLANNING: Design capacity, System capacity, and Determination of Equipment requirement. Facility Location and Facility Layout, Location Planning for Goods and Services, Foreign locations and facility layout. 7 Hours

UNIT - 3

FORECASTING: Forecasting Objectives and Uses, Forecasting Variables, Opinion and Judgmental methods, Time Series methods, Exponential smoothing, Regression and Correlation methods, Application and Control of Forecasts. 8 Hours

AGGREGATE PLANNING AND MASTER SCHEDULING: Introduction, Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods. 7 Hours
UNIT - 4

INVENTORY CONTROL AND MATERIALS MANAGEMENT:
Definition and Need, Components Inventory, inventory control. Scope of Materials Management, Material handling, storage and retrieval, purpose of inventories, Dependent and Independent demand, Inventory cost and Order quantities, Inventory classification and counting  

UNIT - 5

MATERIAL AND CAPACITY REQUIREMENTS PLANNING:

PURCHASING & SUPPLY MANAGEMENT: Purchase and supply chain management- Approaches to purchase and supply chain management, make or buy decision, e-Procurement, Vender development, rating, and certification. 

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit.
To set one question each from Unit 1, 2 & 4 and two questions each from Units 3 & 5.
DEPARTMENT OF MECHANICAL ENGINEERING

<table>
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<th>Sub. Code</th>
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Prerequisites: - Elements of Mechanical Engineering, Manufacturing process

Course Outcomes

Course Outcomes

Co1: Understand the need of Non Traditional Machining and working of ultrasonic machining.

CO2: Compute material removal rate for abrasive jet machining and abrasive water jet machining

CO3: Understand the Process parameters affecting the functioning of various Non-Traditional Machines.

Co4: Understand the advantages, limitations & applications of different Non-Traditional Machines

Assessments

1. CIE – 50 Marks

SEE – 50 Marks

UNIT-1

INTRODUCTION - History, need, classification, comparison between conventional and non-conventional machining process and selection.

ULTRASONIC MACHINING (USM) - Introduction, equipment details, cutting tool system design, mechanism of metal removal, effect of parameters, USM process characteristics, applications, advantages & disadvantages of USM. 7 Hours

UNIT-2

ABRASIVE JET MACHINING (AJM) - Introduction, equipment details, variables in AJM, nozzle design, shape of cut, mechanism of metal removal, process characteristics, applications, advantages & disadvantages of AJM.

ABRASIVE WATER JET MACHINING (AWJM) - Principal, equipment, operation, mechanism of metal removal, application, advantages and limitations. 8 Hours
UNIT-3

**ELECTROCHEMICAL MACHINING (ECM)**- Introduction, study of ECM machine, elements of ECM process, mechanism of metal removal, process characteristics, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, handling of slug, economics of ECM, Applications such as Electrochemical Grinding, Electrochemical Honing, Electrochemical deburring, advantages, limitations and applications.

**CHEMICAL MACHINING (CHM)**- Introduction, elements of process, mechanism of metal removal, chemical blanking process: Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining), Process steps – masking, Etching, process characteristics of CHM, hydrogen embrittlement, advantages, limitations & application of CHM.

UNIT-4

**ELECTRICAL DISCHARGE MACHINING (EDM)**- Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing, synchronized with electrode movement, EDM process characteristics, machine tool selection, advantages, limitations & application of EDM, EDM accessories / applications, electrical discharge grinding, models for material removal rates (MRR), Traveling wire EDM.

**PLASMA ARC MACHINING AND LASER BEAM MACHINING**: Introduction, equipment, mechanism of metal removal, process parameters, process characteristics, advantages, limitations & applications.
UNIT-5

ELECTRON BEAM MACHINING AND ION BEAM MACHINING:  Introduction, equipment, mechanism of metal removal, process parameters, process characteristics, advantages, imitations & applications

ION BEAM MACHINING : Introduction, equipment, mechanism of metal removal, advantages, limitations & applications.

7 Hours

TEXT BOOKS:

REFERENCE BOOKS:
3. Advanced methods of Machining, J.A. McGeough, Chapman and Hall, 1988

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 5 and two questions each from Units 3 & 4.
INSTRUCTION: USE OF DISCRETE COMPOUNDING INTEREST FACTORS TABLE IS PERMITTED IN EXAMS

UNIT – 1


UNIT – 2


EQUIVALENT ANNUAL-WORTH COMPARISONS: Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of sinking fund method, Annuity contract for guaranteed income, Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Exercises, Problems.

Assessments
1. CIE – 50 Marks
2. SEE – 50 Marks
UNIT – 3

**Estimating and Costing:** Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.
Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, corporate income tax.

08 Hours

UNIT – 4

**INTRODUCTION, SCOPE OF FINANCE, FINANCE FUNCTIONS:** Introduction
Simple Numericals.

08 Hours

UNIT – 5

**FINANCIAL RATIO ANALYSIS:** Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm’s earning power.
Comparative statements analysis. Simple Numericals

07 Hours

**FINANCIAL AND PROFIT PLANNING:** Introduction, Financial planning, Profit planning,
Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting.
Introduction to Bench Marking of Manufacturing Operation.

07 Hours

TEXT BOOKS:
REFERENCE BOOKS:
2. Financial Management, Prasanna Chandra, TMH, 2004

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 3 & 4 and two questions each from Unit 2 & 5.
UNIT - 1

STEAM POWER PLANT: Different Types of Fuels used for steam generation, Equipment for burning coal in lump form, strokers, different types, Oil burners, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures.

HIGH PRESSURE BOILERS: Benson, Velox and schmidtstam generators. Chimneys: Natural, forced, induced and balanced draft, Calculations and numericals involving height of chimney to produce a given draft. Cooling towers and Ponds. Accessories for the Steam generators such as Superheaters, Desuperheater, control of superheaters, Economizers, Air pre-heaters and re-heaters. Co-generation concept.  

UNIT - 2

HYDRO-ELECTRIC PLANTS: Hydrographs, flow duration and mass curves, unit hydrograph and numericals. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves. General layout of hydel power plants.

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Prerequisites
1. Basic and Applied Thermodynamics
2. Turbomachinery

Assessments
1. CIE – 50 Marks
2. SEE – 50 Marks
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19  
(Autonomous College under VTU )

UNIT - 3

**Nuclear Power Plant:** Principles of release of nuclear energy; Fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor; moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shieldings, Radio active waste disposal.

8 Hours

UNIT - 4

**SOLAR ENERGY:** Solar Extra terrestrial radiation and radiation at the earth surface, radiation-measuring instruments, working principles of solar flat plate collectors, solar pond and photovoltaic conversion [Numerical Examples].

**WIND ENERGY:** Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, coefficient of performance of a wind mill rotor [Numerical Examples].

**TIDAL POWER:** Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.

**OCEAN THERMAL ENERGY CONVERSION:** Principle of working, Rankine cycle, problems associated with OTEC.

**GEOTHERMAL ENERGY CONVERSION:** Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy.

15 Hours
UNIT - 5

ENERGY FROM BIO MASS: Photosynthesis, photosynthetic oxygen production, energy plantation.

BIO CHEMICAL ROUTE: Biogas production from organic wastes by anaerobic fermentation, classification of bio gas plants, factors affecting bio gas generation.

THERMO CHEMICAL ROUTE: Thermo chemical conversion on bio mass, types of gasifiers. 7 Hours

TEXT BOOKS:
2. Power Plant Engineering, Domakundawar, Dhanpath Rai sons. 2003

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit.
To set one question each from Unit 2, 4 & 5 and two questions each from Unit 1 & 3.
UNIT - 1
Digital logic families and comparison – MSI logic – multiplexers, decoders, adders, subtractors, JK flip flops and counters D to A convertors, counter type and successive approximation type A to D convertors. 06 Hrs.

UNIT - 2
Power control – SCR and Triac. Principles of convertor, Inverter and choffer, block diagrams of DC motor and induction motor control. 06 Hrs.

UNIT - 3
Introduction, Classification of Microprocessor and applications. Organization: Organization of 8085 processor interrupts and addressing modes available. 8085 programming – Instruction set, assembler directives, assembly language programming examples. 11Hrs.

UNIT - 4
Interfacing – Modes of data transfer, memory and I/o interfacing introduction to interfacing data convertors, I/O and timer, 8279 keyboard and display interface, 8255A interfacing, DMA and 8237 DMA controller, serial I/O data communication. Applications: Introduction to stepper motor and data acquisition system. 11Hrs.
UNIT - 5
Introduction to Microcontrollers – Classification, Components of a typical full featured microcontroller, the PIC16F84 microcontroller, PIC16F84 pin out and required external components.

UNIT - 6
Lab. Experiments: $13 \times 2 = 26$ Hrs.
- Truth table verification of basic gates
- Functional verification of JK flip flop using NAND gates only
- Functional verification of Half-adder and Full-adder
- Functional verification of 4 – 16 line decoder
- Functional verification of 4 : 1 MUX using chip configuration and using NAND gates only
- Data transfer between memory and register and vice versa
- 8 and 16 bit addition and subtraction using and without using accumulator
- 8 bit multiplication by repeated addition and shift and add method
- Interface of 8255 – generation of square wave
- Interfacing of stepper motor

Text Books:
2. Thyristors and its applications, K.K. Sugandhi and R.K. Sugandhi
3. Digital Fundamentals, Floyd.

Reference Books:
1. An introduction to Mechatronics, David G. Alciatore and Michale B. Histand

Scheme of Examination: Answer Five full questions selecting one from each unit.
To set One question each from Unit 1, 2, and 5 and two questions each from Units 3 & 4.
VI SEMESTER : MECHANICAL ENGINEERING

Perquisites
1. Elementary calculus and Vector Calculus
2. Basic Thermodynamics
3. Fluid Mechanics
4. Numerical Methods

Course Outcomes
CO1: Understand the different modes of heat transfer.
CO2: Understand the conduction mode of heat transfer under steady, lumped and transient phenomenon.
CO3: Understand the basic velocity, thermal boundary layers and apply the convective heat transfer equations for natural, forced convection and heat exchangers.
CO4: Understand the basic laws that governs the radiation heat transfer and analyze the black body and grey body radiation heat transfer phenomenon.
CO5: Understand the modes of mass transfer phenomenon and governing laws.

Assessment
CIE – 50 Marks
SEE – 100 Marks

UNIT - 1
CONDUCTION: Modes of heat transfer: Basic laws governing conduction; Thermal conductivity. Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations for plane, cylinder and spheres. Overall heat transfer coefficient, Thermal conductive resistance and Numericals. Derivation for heat flow and temperature distribution in a plane for variable thermal conductivity case, Critical thickness of insulation and numericals.

TRANSIENT CONDUCTION: Lumped parameter analysis, Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere; Numerical Problems.  

UNIT - 2

BOUNDARY LAYERS: Flow over a body: Velocity boundary layer, Thermal Boundary layer, drag co-efficient and heat transfer coefficient.

Flow inside a duct: Velocity boundary layer, Thermal Boundary layer, hydrodynamic entrance region and hydro dynamically developed flow; Thermal entrance region and thermally fully developed flow.

Physical significance of Reynold number, Prandtl number and Nusselt number for both inside and outside flow (discussion only).

NATURAL CONVECTION: Introduction, Laminar flow momentum and energy equations for vertical flat plate; Application of dimensional analysis for free convection, physical significance of Grashoff number, use of correlations for free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.

FORCED CONVECTION: Introduction, Momentum and Energy equations for hydrodynamic and thermal boundary layer over a flat plate, Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. 

16 Hours
UNIT - 3

RADIATION HEAT TRANSFER: Basic laws governing radiation heat transfer; Thermal radiation; definitions of various terms; Stefan-Boltzman law, Kirchoff's law, Planck's law, Wein's displacement law, Intensity of radiation and Lambert's cosine law. Radiation heat exchange between two parallel infinite black surfaces, two parallel infinite gray surfaces and shape factor algebra; Infinite long concentric cylinders, small body in a large enclosure.  

07 Hours

UNIT – 4

HEAT EXCHANGERS: Classification of heat exchangers, overall heat transfer coefficient, fouling and fouling factor, LMTD, Effectiveness-NTU methods of analysis of heat exchangers.  

06 Hours

UNIT - 5

MASS TRANSFER: Mass transfer definition and its modes, concentration, velocities and fluxes; Fick's law of diffusion with numericals. General mass diffusion equation in stationary media, steady state diffusion through a plain membrane, steady state equimolar counter diffusion, isothermal evaporation of water into air from a surface, convective mass transfer and correlations.  

07 Hours

TEXT BOOKS:

REFERENCE BOOKS:
1. Heat transfer, a practical approach, Yunus A- Cengel Tata Mc Graw Hill
2. Principles of heat transfer, Kreith Thomas Learning 2001

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 3, 4 & 5 and two questions each from Units 1 & 2..
VI SEMESTER: MECHANICAL ENGINEERING

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**Prerequisites**
1. Engineering Mechanics
2. Engineering Physics
3. Engineering Mathematics (ODE and PDE)

**Course Outcomes**

**CO1**: Understand the basic principles of vibratory systems and apply them to solve simple problems.

**CO2**: Understand and analyze undamped and damped free vibrations and forced vibrations in multiple systems and air-conditioning systems.

**CO3**: Understand the working of vibration measuring instruments and concept of critical speeds in whirling shafts.

**CO4**: Solve vibration problems pertaining to multiple degree of freedom systems.

**Assessment**
1. CIE – 50 Marks
2. SEE – 100 Marks

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**UNIT 1**

**Introduction:**
Types of vibrations, SHM, principle of superposition applied to Simple Harmonic Motions (simple problems).

**Continuous systems**: Introduction, longitudinal vibration of rods with fixed-free end and free-free condition

**Undamped free vibrations**:
Single degree of freedom systems. Undamped free vibration-natural frequency of free vibration, stiffness of spring elements, effect of mass of spring.

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**UNIT 2**

**Damped free vibrations**: Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.
UNIT rover, Nemchand & Bros, Roorkee -19963

**Forced Vibration:** Single degree freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, Reciprocating and rotating unbalance, vibration isolation, transmissibility ratio - harmonic excitation and support motion.  

8 Hours

**Vibration measuring instruments & Whirling of Shafts:**
Vibrometer meter and accelerometer. Whirling of shafts with and without damping. Discussion of speeds above and below critical speeds.  

6 Hours

**UNIT 4**


10 Hours

**UNIT 5**


6 Hours

**TEXT BOOKS:**
2. **Mechanical Vibrations:** G.K. G
REFERENCE BOOKS:


**Scheme of Examination**: Answer Five full questions selecting one from each unit. To set One question each from Unit 2, 4 & 5 and two questions each from Units 1 & 3.
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19  
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VI SEMESTER : MECHANICAL ENGINEERING

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Prerequisites
1. Strength of Materials
2. Engineering Mathematics 1,2 and 3

Course Outcomes
CO1: Understand basics of Theory of Elasticity and apply them to continuum problems.
CO2: Formulate governing equations for linear static structural analysis.
CO3: Formulate basic equations related to 2D and axisymmetric finite elements and solve simple problems.
CO4: Develop finite elements equations and analyse heat transfer problems.

Assessment
1. CIE – 50 Marks
2. SEE – 100 Marks

UNIT - 1


Potential energy and equilibrium, Rayleigh-Ritz method and Galerkin method-applied to simple problems on axially loaded members, cantilever, simply supported beams, with point loads and distributed loads. Gauss elimination method and Gaussian quadrature-1pt, 2pt and 3 pt formula.

06 Hrs

Introduction to FEM, basic concept, historical background, general applicability, engineering applications, general description, comparison with other methods of analysis, commercial packages-preprocessor, solver and post processor.

08 Hrs

3 Hrs
UNIT – 2

One dimensional problems  Introduction;  Finite Element Modeling – Element Division; Numbering Scheme; Coordinate and Shape Functions;  The Potential Energy Approach; Galerkin approach, Assembly of Global Stiffness Matrix and Load Vector;  Treatment of Boundary Conditions; Temperature Effects; Numericals. Stiffness matrix of bar element by direct method, Properties of stiffness matrix.  

UNIT -3


UNIT -4

Formulation of triangular and quadrilateral elements.Introduction to axis symmetric –formulation of axis symmetric triangular elements. 

Convergence criteria-requirements of convergence of a displacement model, Displacement models and shape functions for i. tetrahedral and hexahedral elements(Pascal pyramid) and  ii.Higher order elements in bar, triangular ,quadrilateral elements (no formulations).Lagrangian and serendipity elements . Iso parametric, sub parametric and super parametric elements. 

UNIT - 5

HEAT TRANSFER PROBLEMS: Steady state heat transfer, 1D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1D heat transfer in thin fins. Numericals. 

08 Hrs.
TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 2, 3 & 5 and Two questions each from Units 1 & 4.
VI SEMESTER : MECHANICAL ENGINEERING

**Prerequisites**
1. Fluid Mechanics
2. Calculus

**Course Outcomes**
CO1: Understand the operating principle, performance and selection procedure of hydraulic elements and machines
CO2: Understand the working principle of actuators and evaluate actuator performance and justify selection of actuators for various applications
CO3: Identify different types of control valves and understand their working principle and application.
CO4: Design and analyse hydraulic circuits
CO5: Understand the working of pneumatic and electro-pneumatic systems and their control.

**Assessment**
1. CIE – 50 Marks
2. SEE – 100 Marks

**UNIT - 1**
**INTRODUCTION TO HYDRAULIC POWER:** Pascal's law and problems on Pascal's Law, continuity equations. Structure of fluid power system. Symbolic representation of hydraulic elements, Hydraulic Pumps: Pumping theory, Pump classification, Gear pumps (external and internal), Vane pumps (balanced and unbalanced), Piston pumps (radial, bent axis and swash plate), Pump performance, Pump selection and problems. **8 Hours**

**UNIT - 2**
**HYDRAULIC ACTUATORS AND MOTORS:** Linear Hydraulic Actuators (cylinders): classification, constructional details of cylinder, telescopic cylinder, mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators: Classification, Gear motors, vane motors, piston motors, Hydraulic motor performance and problems. **8 Hours**
UNIT - 3

**FLUID CONTROL VALVES:** Classification, **Pressure control valves:** relief valve (direct and pilot operated types), sequence valve, pressure reducing valve (direct and pilot operated types), unloading valve, counterbalance valve. **Flow control valves:** needle valve, globe valve and pressure and temperature compensated valve, check valve. **Directional Control Valves:** Constructional features, sliding and rotary types.

8 Hours

UNIT - 4

**HYDRAULIC ACCESSORIES:** Accumulators (mechanical and hydro-pneumatic types), filters (disc and cartridge types), reservoir system, pressure switches, sealing devices, heaters and heat exchangers, hydraulic oils- desirable properties and type of fluids.

**MAINTENANCE OF HYDRAULIC SYSTEMS:** Problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.

6 Hours

**HYDRAULIC CIRCUIT DESIGN AND ANALYSIS:** Control of single and double acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application, hydraulic cylinder sequencing circuit, locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors and accumulator circuits.

9 Hours

UNIT - 5


6 Hours

TEXT BOOKS:

REFERENCE BOOKS:
3. Industrial Hydraulics, Pippenger, Hicks, McGraw Hill, New York

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 3 and two questions each from Units 4 & 5.
Course Outcomes

1. Every student individually or in a group (group size is of 4 students. However, if project complexity demands a maximum group size of 5 students, the committee should be convinced about such complexity and scope of the work.) Shall take a project in the beginning of the sixth semester in consultation with the guide and the project must be completed by the end of sixth semester.

2. The project proposal must be submitted in the institute in the beginning of the (B.E. first Term) sixth semester. While submitting project proposal care is to be taken that project will be completed within the available time of two term i.e. 6 Hrs per week in sixth semester (total time become 12*6 = 72 Hrs per project partner).

3. Project title should be precise and clear. Selection and approval of topic: Topic should be related to real life application in the field of MECHANICAL, OR Investigation of the latest development in a specific field of MECHANICAL OR Software development project related to MECHANICAL OR Interdisciplinary. Interdisciplinary projects should be encouraged.

4. The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by guide.

5. The project work along with project report should be submitted as part of term work in sixth semester on or before the last day of the semester.

6. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

7. One guide will be assigned at the most two project groups.

8. The guides should regularly monitor the progress of the project work.

9. Assessment of the project for award of CIE marks shall be done by the guide and a departmental committee (consisting of minimum two Associate/Assistant Professors with experience more than three years) as per the guidelines given. The guide should be internal examiner for oral examination.

10. The evaluation at SEE examination should be done jointly by the internal and external (other than guide) examiners.

11. The external examiner should be from the related area of the concerned project. He should have minimum of five years of teaching experience at degree level / industry.
VI SEMESTER : MECHANICAL ENGINEERING

Course Outcomes

PART - A

1. Determination of Thermal Conductivity of a Metal Rod.


3. Determination of Effectiveness on a Metallic fin.


Total: 21 Hours
7. Determination of Stefan Boltzman Constant.

8. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers

9. Experiments on Boiling of Liquid and Condensation of Vapour


11. Performance Test on a Vapour Compression Air - Conditioner

12. Experiment on Transient Conduction Heat Transfer.  

Total: 21 Hours
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19  
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VI SEMESTER : MECHANICAL ENGINEERING
ELECTIVE : GROUP - 2

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Course Outcomes
CO1: Understand the basic concepts of solid mechanics
CO2: Understand concept of bi-harmonic equations of theory of elasticity using Airy function.
CO3: Evaluate stresses and displacements in pressurized cylinders, shrink fitted cylinders, rotating disc, shaft and plate with hole.
CO4: Analyze torsion of non-circular shafts and thin tubes.
CO5: Apply principles of continuum mechanics to design a structure or component and develop them under realistic constraints.

UNIT - 1
FUNDAMENTAL OF ELASTICITY: Concept of stress, spherical and deviator stress tensors, octahedral stresses. Invariants, representative stress. Strain tensor, spherical and deviator strain, octahedral strain and representative strain, cubical dilation, true stress and strain:, Generalized Hooke's law, elastic strain energy problems. 8 Hours

UNIT - 2
YIELD CRITERIA: Introduction, yield or plasticity conditions, Von Mises and Tresca criteria, Geometrical representation, yield surface, yield locus (two dimensional stress space), experimental evidence for yield criteria, energy required to change the shape with basic principle, problems. 7 Hours

UNIT - 3
BENDING OF BEAMS: Analysis for stresses, Non linear stress strain curve, shear stress distribution, residual stresses in plastic bending, problems. 5 Hours

TORSION OF BARS: Introduction, plastic torsion of a circular bar, elastic perfectly plastic material, elastic work hardening of material, residual stresses and problems. 5 Hours
UNIT - 4
STRESS STRAIN RELATIONS: Introduction, types of materials, empirical equations, theories of plastic flow, experimental verification of St.Venant's theory of plastic flow, the concept of plastic potential.  
6 Hours

UNIT 5
PLASTIC DEFORMATION OF METALS: Crystalline structure in metals, mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, recovery, recrystallization and grain growth, flow figures or luder’s cubes.  
6 Hours

8 Hours

TEXT BOOKS:
1. Theory of Plasticity, Sadhu Singh, Khanna publisher

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2& 4 and two questions each from Units 3& 5.
Study of a FEA package and modeling stress analysis of

a. Trusses  
6 Hours

b. Bars of constant cross section area, tapered cross section area and stepped bar
6 Hours

c. Beams -Simply supported, cantilever, beams with UDL, beams with varying load etc
6 Hours

PART-B

a) Stress analysis of a rectangular plate with a circular hole, axis symmetric problems  
6 Hours

b) Dynamic Analysis
1) Fixed -fixed beam for natural frequency determination
2) Bar subjected to forcing function
3) Fixed -fixed beam subjected to forcing function  
6 Hours

c) Thermal Analysis -2D problem with conduction and convection boundary conditions  
6 Hours

d) Fluid flow Analysis -Potential distribution in the 2 -D bodies  
3 Hours

REFERENCE BOOKS:


2. Practical Finite Element Analysis, Nitin S. Gokhale, Sanjay S. Despande, Dr. Anand N. Thite, Finit To Infinte, ISBN 978-81-906195-0-9 E-mail: finite@vsnl.com, Website: www.finitetoinfinite.com

**WEB REFERENCE:**
1. www.ansys.com
2. [www.mece.ualberta.ca/tutorials/ansys](http://www.mece.ualberta.ca/tutorials/ansys)
3. [http://mae.uta.edu/~lawrence/](http://mae.uta.edu/~lawrence/)

**Scheme of Examination:**
- One question from Part A - 20 Marks (05 Write up +15)
- One question from Part B - 20 Marks (05 Write up +15)
- Viva - Voce - 10 Marks

**Total:** 50 Marks
UNIT - 1


UNIT - 2

SOLAR RADIATION GEOMETRY: Sun earth angles- latitude, declination, hour angle, zenith, solar altitude angle, surface azimuth angle, solar azimuth angle, Local apparent time, solar time, apparent motion of sun, day length, numerical examples.

SOLAR THERMAL RADIATION DEVICES: Liquid flat plate collectors, solar air heaters, concentrating collectors like cylindrical, parabolic, evacuated tubular collectors.

UNIT - 3

UNIT - 4
PERFORMANCE ANALYSIS OF LIQUID FLAT PLATE COLLECTORS: General description, collector geometry, selective surface (qualitative discussion), basic energy balance equation, stagnation temperature, transmissivity of the cover system, transmissivity- absorptivity product, numerical examples. The overall loss coefficient, correlation for the top loss coefficient, bottom and side loss- coefficient, problems (all correlations to be provided)

TEMPERATURE DISTRIBUTION: Temperature distribution between the collectors tubes, collector heat removal factor, collector efficiency factor and collector flow factor, mean plate temperature, instantaneous efficiency (all expression to be provided). Effect of various parameters on the collector performance: Collector orientation, selective surface, fluid inlet temperature, number of covers, dust.
Solar Concentrators: Introduction, characteristic parameters: Aperture area, Acceptance angle, absorber area, geometric concentration ratio. Local concentration ratio or brightness concentration ratio, intercept factor, optical efficiency, thermal efficiency, Concentration ratio.

UNIT - 5
STORAGE DEVICES: Sensible heat storage, latent heat storage. Application of solar energy: water heating, space heating, solar power plant, space cooling, active and passive cooling systems. Various power generation methods; Solar furnace, Refrigeration, Distillation, Solar ponds; theory, working principle, operational problems (Sketches, principle of working).


TEXT BOOKS:

REFERENCE BOOKS:
2. Solar Energy Utilization – G.D.Rai

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 3 & 5 and two questions each from Units 2 & 4.
UNIT - 1

AGILE MANUFACTURING: Definition, business need, conceptual frame work, characteristics, generic features.  
06 Hours

DEVELOPING AGILE MANUFACTURING: Enterprise, Strategies, integration of organization, workforce and technology, reference models, examples.  
07 Hours

UNIT - 2

INTEGRATION OF PRODUCT /PROCESS DEVELOPMENT: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in Agile organization, Approaches.  
06 Hours

APPLICATION OF IT/IS CONCEPTS IN AGILE MANUFACTURING: Strategies, Management of complexities and information. flow, approaches, applications of multimedia to improve agility in manufacturing, system concepts.  
07 Hours

UNIT - 3

07 Hours

UNIT - 4

COMPUTER CONTROL OF AGILE MANUFACTURING: CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing, Cellular manufacturing, concepts, examples.  
07 Hours
UNIT - 5

CORPORATE KNOWLEDGE MANAGEMENT IN AGILE MANUFACTURING: Strategies, strategic options in Agile manufacturing, Role of standards.  06 Hours

DESIGN OF SKILL & KNOWLEDGE: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, decision support for selection of cutting parameters, design enhancements, parametric approach only.  06 Hours

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 3, 4 & 5 and two questions each from Units 1 & 2.
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
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DEPARTMENT OF MECHANICAL ENGINEERING

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Prerequisites

1. Engineering Mechanics
2. Linear Algebra
3. Kinematics of Machinery
4. Dynamics of Machinery

Course Outcomes

1. Understand the structure of a robot, its applications and its kinematics
2. Understand the mathematical transformations in robot mechanisms
3. Formulate the equations of dynamics of robot.
4. Plan trajectory for robotic motions and their control
5. Understand the working of actuators and sensors used in robots

Assessments

1. CIE – 50 Marks
2. SEE – 100 Marks

UNIT I

Introduction: History of robotics, Applications, Structure of a robot manipulator

2 Hours

Spatial descriptions and Transformations: Rotation matrix, transformation matrix, Compound transformations, operators, euler angles

5 Hours

Forward Kinematics: Link description, link connection description, Denavit-Hartenberg parameters, Forward kinematics

5 Hours

Inverse Kinematics: Solvability, algebraic and geometric approach, algebraic solution by reduction to polynomial, Repeatability and accuracy

4 Hours

UNIT II

Velocities and Static Forces: Linear and angular velocity, Cross product operator, velocity propagation, static forces, Jacobians, singularities, Jacobians in the force domain

6 Hours
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU )

UNIT III
Dynamics: Linear and angular acceleration, linear and angular momentum, Inertia tensor, Newton's equation, euler's equation, iterative newton euler dynamic formulation

8 Hours

UNIT IV
Trajectory Planning: Joint space schemes: cubic polynomial, cubic polynomial for a path with via points, linear function with parabolic blends, Cartesian space schemes: Cartesian straight line motion, geometric problems with Cartesian paths

3 Hours

Control: Linear control- Feedback control, second order linear system response, PD control, disturbance rejection and steady state error, PID control, modeling and control of a single joint, architecture of PUMa 560 robot controller

7 Hours

UNIT V
Actuators: Types, Characteristics of actuating systems, Overview of hydraulic and pneumatic actuators, Electric actuators : PMDC servo motor, Pulse width modulation, Direction control with H-bridge, Brushles DC motor, stepper motor, modern actuators

7 Hours

Sensors: Sensor characteristics, position sensors, velocity sensors, acceleration sensors, force and pressure sensors, torque sensors, touch and tactile sensors, proximity sensors

7 Hours

Texts books:
1. Introduction to robotics:mechanics and control, Craig J J,3/E,Pearson Education India,2008
References:
2. Robotic Engineering, Klaffer, R D, PHI, 2003

Scheme of Examination: Answer five full questions selecting one from each unit. To set one question each from Unit 2, 3&4 and two questions each from Units 1&5.
UNIT - 1

INTRODUCTION: Philosophy of Computational Fluid Dynamics, CFD as a research and design tool, Impact of CFD, Advantages and dis-advantages, Applications, Future of CFD.

CFD SOLUTION PROCEDURE: Elements of CFD code: Problem set up-pre-process, numerical solution – CFD solver, Result report and visualization-post-process. 6 Hours

UNIT - 2

GOVERNING EQUATIONS FOR CFD: Introduction, models of flow, the substantial derivative and divergence of velocity field- its physical meaning, the continuity equation, the momentum equation, the energy equation, Navier-Stokes equations and Euler equations.

PARTIAL DIFFERENTIAL EQUATIONS: Introduction, Physical and Mathematical classification of PDE, Hyperbolic, Parabolic and Elliptic equations. The mathematical and physical behavior of PDE equations. 10 Hours
UNIT - 3

CFD SOLUTION TECHNIQUES:

I. Steady State Heat Conduction:

Finite Difference Method (FDM): Introduction to finite differences, Difference equations, Explicit and Implicit approaches, Errors and analysis of stability. FDM applied to one dimensional, two and three dimensional steady state heat conduction. Numericals on 1D and 2D steady state conduction.


UNIT - 4

II. Transient Heat Conduction:

FDM and FVM: 1D analysis using explicit, Crank-Nicolson, Fully implicit schemes and Numericals.

III. FVM for convection-diffusion problems: Introduction, steady state one dimensional convection and diffusion, properties of discretization schemes, Central, Upwind, Hybrid and QUICK schemes, and numericals.

UNIT - 5

Introduction to Turbulence: Transition from laminar to turbulent flow, effect of turbulence on time-averaged Navier –stokes equations, generic form, Characteristics of simple turbulent flow, free turbulent and boundary layers near solid walls(Only discussion).

TEXT BOOKS:


REFERENCE BOOKS:
1. Introduction to Computational Fluid Dynamics, Anil W. Date, Cambridge University press, 2007.

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 5 and two questions each from Units 3 & 4.
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>Subject</th>
<th>FOUNDRY TECHNOLOGY</th>
<th>Sub. Code</th>
<th>12 ME 6DE FOT</th>
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<td>Credits</td>
<td>04</td>
<td>L-T-P</td>
<td>4-0-0</td>
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**UNIT – 1**

Foundry Metallurgy: Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid and metals.  

**UNIT – 2**

Solidification of castings: Crystallization and development of cast structure - nucleation, growth and dendritic growth. Structure of castings - significance and practical

Prerequisites

1. Material science, Manufacturing Process 1 and 2
2. Elements of Mechanical engineering and vector calculus

Course Outcomes

1. Identify melting and molding techniques and to design casting for minimal casting defects
2. Understand and analyze mechanism of solidification of advanced alloys and design gating and risering systems
3. Apply improvised foundry techniques for production complex castings.
4. Develop grey cast, ductile and malleable iron castings.
5. Develop non-ferrous alloy castings and understand the need for modernization of Foundry techniques

Assessments

1. CIE – 50 Marks
2. SEE – 100 Marks
control cast structure, grain shape and orientation, grain size, refinement and modification of cast structure. Concept of progressive and direction solidification, solidification time and derivation of Chvorinov’s equation, influence on mold characteristics and cast metal

UNIT – 3

Risering and Gating: The reason for risering, requirement of a riser, riser size and directional solidification, riser location and directional solidification, atmospheric pressure and risering, insulation, moldable exothermic sleeves, exothermic riser compounds, internal chills and chaplets, external chills, molding materials of different chill capacities, padding, riser shape, size and contact area, side and blind risers, location of risers, general considerations of risering, riser size, riser treatment, riser feeding distance, risering of alloys, Gating system, theoretical considerations of gating, turbulence in the gating system, velocity calculations, the tapered sprue, velocity calculations in real gating systems, problems.

UNIT – 4

Modern Moulding & Melting practices: Modern moulding process like vacuum moulding, flaskless moulding, nobake moulding. Cupola: Developments in cupola melting like, hot blast cupola, water cooled cupola, cupola charge calculations, Vacuum melting. Induction furnace & electric arc melting.

Foundry refractories: Introduction, classification of refractories, refractory raw materials, forms of refractories and refractory materials, structure of refractories, general considerations of acid refractories, fireclay and other alumina-silica refractories, silica refractories, general considerations of basic and neutral refractories, refractories in the acid cupola, refractories in the basic cupola, ladle refractories for iron and steel, refractories in the non-ferrous foundry.

UNIT – 5

Ferrous Foundry and Non Ferrous foundry: Manufacturing of steel ingots, casting, Structure, properties, production and application of Grey cast iron, malleable iron and spheroidal graphite iron. Production of aluminium, copper & magnesium alloy casting. Steps involved in melting treatment process etc.
MODERNIZATION & MECHANIZATION OF FOUNDRY: Need for modernization area mechanization, moulding and core making, melting, pouring, shake out equipment and fettling dust and fume control, material handling equipments for sand moulds and cores, molten metal and castings, reclamation of sands.  

TEXT BOOKS:

REFERENCES:
1. Foundry Technology, R.K. Jain
2. Foundry Technology P.N. Rao

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 3 and two questions each from Units 4 & 5.
VII SEMESTER: MECHANICAL ENGINEERING

<table>
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<td>Credits</td>
<td>04</td>
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PREREQUISITES

1. SOLUTIONS OF ODE AND PDE
2. LINEAR ALGEBRA

Course Outcomes

CO1: Understand the feedback control systems and develop linear model for single-input single-output systems using transfer functions, signal flow graphs and block diagram manipulations.

CO2: Apply Laplace transforms and develop transfer function for linear, time-invariant electrical, mechanical and electromechanical systems.

CO3: Understand and apply polar, Nyquist, Bode plot and Root locus methods for evaluating system stability.

CO4: Develop state models analyze the controllability and observability of a system.

ASSESSMENT

1. CIE – 50 MARKS
2. SEE -100 MARKS

UNIT - 1

INTRODUCTION TO CONTROL SYSTEMS: Background, Definition of control system, plant, controller, input, output, disturbances. Classification of control systems. Open and Closed loop control systems. Advantages and disadvantages of OLCS and CLCS. Real time applications of OLCS and CLCS. Requirements of an ideal control system. 4 Hours

MATHEMATICAL MODELS: Concept of transfer function, models of mechanical systems (translational and rotational), Electrical Systems, Models of DC and AC motors, Analogous systems: Force-voltage. 6 Hours
UNIT - 2

**BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS**: block representation of control system elements, Reduction of block diagrams, Signal flow graphs: Mason's gain formula.

6 Hours

**TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS**: Transient response specifications, Types of standard test Signals (inputs), Analysis of first order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. Concept of stability: Routh's-Hurwitz Criterion.

6 Hours

UNIT - 3

**ROOT LOCUS PLOTS**: Definition of root loci, general rules for constructing root loci, Analysis using root locus plots.

8 Hours

UNIT - 4

**FREQUENCY RESPONSE ANALYSIS**: Polar and Nyquist plots, Stability Analysis using Nyquist plots.

8 Hours

**BODE PLOTS**: Introduction, Bode Magnitude and Phase angle plot. Stability Analysis using Bode plots.

6 Hours

UNIT - 5

**STATE VARIABLE ANALYSIS**: Introduction, Advantages of state space approach, Definitions of State, state variable, state vector and state space, State diagram representation of standard state models, state models from differential equations, from transfer function. Derivation of transfer function from state model.

4 Hours

Concept of controllability and observability, Kalman's test for controllability. Simple problems.

4 Hours

TEXT BOOKS:
REFERENCE BOOKS:


Scheme of SEE:

- Students to answer five full questions selecting one from each unit.
- To set one question each from Unit 1, 3 & 5 and two questions each from Units 2&4.
UNIT - 1


EFFECTS OF PARAMETERS: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, Residual stresses in wrought products.  

UNIT - 2

FORGING: Classification of forging processes. Forging machines & equipment. Expressions for forging pressures & load in open die forging and closed die

UNIT - 3


POWDER METALLURGY: Production of components using powder metallurgy technique. Advantages limitations and applications.

UNIT - 4


HIGH ENERGY RATE FORMING METHODS: Principles, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming.

UNIT - 5


TEXT BOOKS:

REFERENCE BOOKS:
2. Principles of Industrial metal working process - G.W. Rowe, CBSpub. 2002
4. Theory of plasticity, Dr. Sadhu Sing, Khanna Publishers.

Scheme of Examination: Answer Five full questions selecting one from each unit.
To set One question each from Unit 2,3, & 4 and two questions each from Units 1 & 5.
UNIT - 1

INTRODUCTION: What is designing, Man as a designer: Design by evolution, inadequacies of traditional design method: System approach of engineering problems: Need models: design history of large scale existing system.

MORPHOLOGY OF DESIGN: The three phases of design projects, the structure of design process, decision making and iteration. 8 Hours

UNIT - 2


MAN-MACHINE INTERACTION: Designing for use and maintenance, Man-Machine Cycle, Design of displays and controls. Factors influencing displays and controls. 8 Hours

UNIT - 3

ORIGINATION OF DESIGN CONCEPT: Process of idealization, mental fixity, and some design methods like morphological analysis, AIDA, brain storming etc. 7 Hours

PRELIMINARY DESIGN: Mathematical modeling for functional design: concept of sensitivity, compatibility and stability analysis. 8 Hours

UNIT - 4

EVALUATION OF ALTERNATIVES AND DESIGN DECISIONS: Physical realizability, DESIGN TREE: Quality of design, Concept of utility, multi criteria decisions, decisions under uncertainty and risk (Numerical) 8 Hours

UNIT - 5

Reliability Considerations in Design: Bath tub curve, exponential reliability function, system reliability concept. (Numerical) 7 Hours
ECONOMICS AND OPTIMIZATION IN ENGINEERING DESIGN: Economics in Engineering Design, Fixed and variable costs, break-even analysis. (Numerical)

OPTIMIZATION: Introduction to LPP.  

6 Hours

TEXT BOOKS:

REFERENCE BOOKS:
2. Introduction to Design by M.A. Asimov-Prentice Hall. 1996

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 4 and two questions each from Units 3 & 5.
DEPARTMENT OF MECHANICAL ENGINEERING

<table>
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<tr>
<th>Subject</th>
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<td>04</td>
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<td>4-0-0</td>
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PREREQUISITES

COURSE OUTCOMES

- CO1: Understand the characteristics of successful product development
- CO2: Identify customer needs
- CO3: Understand concept generation, selection and testing
- CO4: Understand design for manufacturing
- CO5: Understand managing of projects

ASSESSMENT

1. CIE – 50 MARKS
2. SEE – 100 MARKS

UNIT-1

INTRODUCTION: Characteristics of successful product development who Designs and develops products, duration and cost of product development, the challenges of product development.  

DEVELOPMENT PROCESSES AND ORGANIZATIONS: A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization.

PRODUCT PLANNING: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

IDENTIFYING CUSTOMER NEEDS: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.
UNIT-2
PRODUCT SPECIFICATIONS: What are specifications, when are specifications established, establishing target specifications setting the final specifications.
4 Hrs
CONCEPT GENERATION: The activity of concept generation clarify the problem search externally, search internally, explore systematically, reflect on the results and the process.
4 Hrs

UNIT-3
CONCEPT SELECTION: Overview of methodology, concept screening, concept scoring, caveats.
2 Hrs
CONCEPT TESTING: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.
3 Hrs
PRODUCT ARCHITECTURE: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.
5 Hrs
INDUSTRIAL DESIGN: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, is assessing the quality of industrial design.
5 Hrs

UNIT-4
DESIGN FOR MANUFACTURING: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.
5 Hrs
PROTOTYPING: Prototyping basics, principles of prototyping, technologies, planning for prototypes.
4 Hrs

UNIT-5
PRODUCT DEVELOPMENT ECONOMICS: Elements of economic analysis, base case financial mode, Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.
3 Hrs
MANAGING PROJECTS: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

3 Hrs

TEXT BOOK:

REFERENCE BOOKS:
1. Product Design and Manufacturing: A C Chitale and R C Gupta, PH1

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 2, 4 & 5 and two questions each from Units 1 & 3.
UNIT - 1


5 Hours

UNIT - 2


5 Hours

UNIT - 3

ANALYSIS OF AUTOMATED FLOW LINE & LINE BALANCING: General terminology and analysis, Analysis of Transfer Line without storage upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with simple problem, Partial automation-with numerical problems, flow lines with more than two stages, Manual Assembly lines, line balancing problem.

5 Hours


6 Hours

UNIT - 4

AUTOMATED ASSEMBLY SYSTEMS: Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feed back, escapement and placement analysis of Multistation Assembly Machine analysis of single station assembly.
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(Autonomous College under VTU)

6 Hours

COMPUTERIZED MANUFACTURING PLANNING SYSTEM: Introduction, Computer Aided Process Planning, Retrieval types of process planning, Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning.
5 Hours

UNIT - 5

CNC MACHINING CENTERS: Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning.
5 Hours

ROBOTICS: Introduction to Robot configuration, Robot motion, programming of Robots end effectors, Robot sensors and Robot applications.
5 Hours

TEXT BOOKS:

REFERENCE BOOKS:
2. CAD/CAM by Zeid, Tata McGraw Hill.

Scheme of Examination: Answer Five full questions selecting one from each unit.
To set One question each from Unit 1, 2 &5 and Two questions each from Units 3 & 4.
UNIT - 1

**The Information Age:** An Overview: The purpose, data, information, and information systems and their types, ethical and societal issues, information systems in business functions, web empowered enterprises. **05 Hours**

**Strategic Uses of Information Systems:** Strategies and Strategic moves, Achieving a competitive advantage, creating and maintaining strategic information systems, Business Functions and Supply Chains – effectiveness and efficiency, accounting, finance, engineering, supply chain management, Human resource management, Enterprise resource planning. **05 Hours**

UNIT - 2

**Information Technology:** Business Hardware – components, classification of computers, output devices, storage media, and purchasing, Business Software – programming languages and software development tools, language translation, compilers and interpreters, system software, open source software, software licensing, ethical issues. **08 Hours**

UNIT - 3

**Business Networks and Telecommunication:** Telecommunication in Business and Daily Use, Bandwidths and Media, networks, protocols, internet networking services, Telecommuting – pros and cons, Future of Networking Technologies. **08 Hours**

**Web Enabled Commerce:** Web enabled enterprises – web business and technologies, web enabled business, Challenges of Global Information Systems – Multinational organizations, international commerce, ethical issues. **07 hours**
UNIT - 4

**Decision Support and Business intelligence:** Decision support and expert systems – decision support and decision making process, structured and unstructured problems, decision support systems, expert systems, geographical systems, Business Intelligence and Knowledge Management – Date Mining and online analysis, knowledge management.  

**06 Hours**

**Planning, Acquisition, and Control:** Systems Planning and Development – Planning Information systems, systems development life cycle, agile methods, systems integration, ethical issues – IS professionals certification.  

**07 Hours**

UNIT - 5

**Choices in Systems Acquisition:** Options and Priorities, outsourcing, licensing applications, software as a service, user application development, ethical issues– computer use policies for employees.  

**06 Hours**

**TEXT BOOK**


**REFERENCE BOOKS:**


**Scheme of Examination:** Answer Five full questions selecting one from each unit. To set one question each from Unit 2, 4 &5 and two questions each from Units 1 & 3.
UNIT - 1
INTRODUCTION: Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies 05 Hours

MANUFACTURING OPERATIONS: Manufacturing Operations, Product/Production Relationship, Production concepts and Mathematical Models & Costs of Manufacturing Operations 07 Hours

UNIT - 2
INDUSTRIAL CONTROL SYSTEM: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control. 07 Hours

AUTOMATED MANUFACTURING SYSTEMS: Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells. 07 Hours

UNIT - 3
GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues. 08 Hours

UNIT - 4
QUALITY CONTROL SYSTEMS: Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering. Introduction to SQC Tools. 04 Hours
INSPECTION TECHNOLOGIES: Automated Inspection, Coordinate Measuring Machines

UNIT - 5

TEXT BOOKS:
2. Principles of CIM, Vajpayee, PHI.

REFERENCE BOOKS:
3. Computer Based Industrial Control, Krishna Kant, EEE PHI

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 3 & 5 and two questions each from Units 2 & 4.
UNIT - 1
QUALITY, TOTAL QUALITY, TQM: Introduction-Definition, Basic Approach, TQM framework, Historical Review, Benefits of TQM.

UNIT - 2
LEADERSHIP AND QUALITY COSTS: Characteristics of quality leaders, Quality statement, strategic planning, Introduction to quality costs, prevention costs, Appraisal costs, failure costs, Management of quality costs, economics total of quality costs and its reduction.
CONTINUOUS IMPROVEMENT:
a. Improvement as problem solving process W-V Model of CI, process control
b. Reactive Improvement Standard steps & 7 tools of quality, seven steps, management diagnosis of seven steps, reactive improvement.  c. Proactive Improvement.
UNIT - 3

Statistical Process Control: Pareto diagram, process flow diagram, cause-and-effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams.  

08 Hours

TOOLS AND TECHNIQUES IN TQM: Kaizen, Re-engineering, Six Sigma, Benchmarking Definition, Process of benchmarking, 5S, 3M

06 Hours

UNIT - 4

QUALITY FUNCTION DEPLOYMENT AND FAILURE MODES EFFECTS ANALYSIS: Introduction to QFD and QFD process, Quality by design, Rationale for implementation of quality by design, FMEA, Design FMEA and process FMEA.

06 Hours

UNIT - 5

QUALITY MANAGEMENT SYSTEMS: Introduction to different standards Quality management systems, Bureau of Indian standards (BIS), Institute of Standards Engineers (SEI), ISO-9000 series of standards, Overview of ISO-14000, Overview of TS 16959.

6 Hours

PRODUCT ACCEPTANCE CONTROL: Product acceptance control through IS 2500 part 1 and part 2

4 Hours

TEXT BOOKS:


REFERENCE BOOKS:


3. Organizational Excellence through TQM, H. Lal, New age pub, 2008

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 4 &5 and two questions each from Units 2 & 3.
UNIT 1
INTRODUCTION TO PROJECT MANAGEMENT: Concepts & Categories of projects, Selection of projects, Phases of project life cycle, Roles and responsibilities of Project Manager, tools and techniques of project management. 8 Hours

UNIT 2
PROJECT PLANNING AND ESTIMATING: Feasibility report, Phased Planning, Project planning steps, Objectives and goals of the project, preparation of cost estimation. 7 Hours
ORGANIZING AND STAFFING: The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types, Accountability in project execution, controls, tendering and selection of contractors. 8 Hours

UNIT 3
PROJECT SCHEDULING: Project implementation scheduling, different scheduling techniques—Bar (GANTT) charts, Bar charts for combined activities. Project Evaluation and Review Techniques (PERT) planning, Simple numericals. 8 Hours
CO-ORDINATION AND CONTROL: Project direction co-ordination; and communication in a project, Role of MIS in project control, performance control, schedule control, Cost control examples. 7 Hours

PREREQUISITES
COURSE OUTCOMES
1. CO1: Classify projects and identify the phases of the life cycle of project.
2. CO2: Plan a project, identify and estimate the resources required for its completion.
3. CO3: Create scheduling charts for projects.
4. CO4: Assess and appraise the project with the aid of statistical tools.

ASSESSMENT
1. CIE – 50 MARKS
2. SEE – 100 MARKS

Subject | PROJECT MANAGEMENT | Sub. Code | 12 ME 7DE POM
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Credits | 04 | L-T-P | 4-0-0

135
UNIT 4
PROJECT EVALUATION & FOLLOW UP: Introduction, objectives, follow up techniques, channels for follow up, scope of follow up, Evaluation types, objectives & requirements, methodology, techniques for evaluation. 7 Hours

UNIT 5
ECONOMIC PROJECT APPRAISAL: Introduction, evaluation, rate of return, net present value, benefit cost ratio, internal rate of return & simple numericals. 7 Hours

TEXT BOOK:
2. Project Management, A systems approach to planning scheduling and controlling by Harold kerzner, CBS publication.

REFERENCE:
1. Project Management Refer, Pennington Lawrence, McGraw hill

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 4 & 5 and Two questions each from Units 2 & 3.
UNIT 1
Fracture Mechanics Principles: Introduction, Mechanisms of fracture, a crack in a structure, the Griffith's theorem, modern design, strength, stiffness and toughness. Stress intensity approach. 6 Hrs.

Stress Analysis for Members with Cracks: Linear elastic fracture mechanics, crack tip stress and deformations, relation between stress intensity factor and fracture toughness, stress intensity based solutions. Crack tip elastic zone estimation, plane stress and plane strain concepts. The Dugdale approach, the thickness effect. 7 Hrs.
UNIT 2

UNIT 3
Dynamic and Crack Arrest: Introduction, the dynamic stress intensity and elastic energy release rate, crack branching, the principles of crack arrest, the dynamic fracture toughness. 7 Hrs.
Fatigue and fatigue crack growth rate: Fatigue loading, various stages of crack propagation, the load spectrum, approximation of the stress spectrum, the crack growth integration, fatigue crack growth laws. 6 Hrs.

UNIT 4
Fracture toughness testing of metals: Specimen size requirements, various test procedures, effects of temperature, loading rate and plate thickness on fracture toughness, fracture testing in shear modes, fatigue testing, NDT methods. 6 Hrs.

UNIT 5
Fracture resistance of materials: Fracture criteria, fatigue cracking criteria, effect of alloying and second phase particles, effect of processing and anisotropy, effect of temperature, closure. 6 Hrs.

TEXT BOOKS:
REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 2, 4 & 5 and two questions each from Units 1& 3.
UNIT - 1

Scan Conversion and Clipping Representation of points, lines, Line Drawing Algorithms: DDA algorithm, Bresenham's integer line algorithm, Bresenham's circle algorithm, mid point line and circle, Polygon filling algorithms: scan conversion, seed filling, scan line algorithm. Viewing transformation, Clipping –points, lines, text, polygon, Cohen-Sutherland line clipping, Sutherland-Hodgmen algorithm. 07 Hours

Two Dimensional Transformations Representation of points, Transformations: Rotation, Reflection, Scaling, Combined Transformations, Translations and Homogeneous Coordinates, A geometric interpretation of homogeneous coordinates, Over all scaling, Points at infinity, rotation about an arbitrary point, Reflection through an arbitrary line. 06 Hours

UNIT - 2

Three Dimensional Transformations and Projections 3D Transformation matrix: general matrix, Translation, scaling, Shearing, Rotation, Reflection, Multiple transformations, Rotation about an axis parallel to coordinate axis, Rotation about an arbitrary axis in space, Reflection through an arbitrary plane, Orthographic, Parallel projection Transformations, one, Perspective projections- one point, two point and three point. 06 Hours

Plane and Space Curves Curve representation, Nonparametric curves, parametric curves, parametric representation and generation of line, circle, ellipse, parabola, hyperbola, generation of circle, ellipse, parabola, hyperbola, Cubic spline, normalized cubic splines, Bezier curves: blending function, properties, generation, B-spline curves-Cox-deBoor recursive formula, properties, open uniform basis functions, Non-uniform basis functions, periodic B-spline curve. 07 Hours
UNIT - 1

INTRODUCTION: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.

STereo Lithography systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. 6 Hours

UNIT - 2

Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.

Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications. 6 Hours


UNIT - 3

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer. GenisysXs printer HP system 5, object Quadra systems. 6 Hours

Laser Engineered Net Shaping (LENS): Process details, Materials, applications. 4 Hours

UNIT - 4

RAPID TOOLING: Indirect Rapid tooling, Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc. Direct Rapid Tooling Direct. AIM. 6 Hours

RAPID TOOLING: Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling. 6 Hours
UNIT - 5

SOFTWARE FOR RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools. 6 Hours

RAPID MANUFACTURING PROCESS OPTIMIZATION: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation. 6 Hours

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 3 & 5 and two questions each from Units 2 & 4.
UNIT-1

TOOL MATERIALS: Requirements, properties, types of materials like high carbon steel, HSS, coated HSS, ceramics, carbides, coated carbides, CBN, diamond tools, UCON, Water, air and oil hardened steels.

FORCE AND POWER REQUIREMENT: Force and power requirement in turning, drilling and milling processes. 6 Hours

UNIT-2

DESIGN OF SINGLE POINT CUTTING TOOLS: Types of single point tools, design of shank dimensions based on strength and rigidity, numerical problems on shank dimensions, tool signature (ASA), selection of tool geometry, influence of tool geometry on tool life, inserts and chip breakers. 6 hours

UNIT-3

DESIGN OF DRILL: Types of drills, tool angles, design of twist drill, numerical problems on design of twist drill, influence of tool geometry on tool life.

DESIGN OF MILLING CUTTER: Types of milling cutters, tool angles, design of plain milling cutter, numerical problems on design of plain milling cutter, influence of tool geometry on tool life. 8 Hours

UNIT - 4

JIGS AND FIXTURES: Functions, advantages in mass production, differences between jigs and fixtures, Design principles, Economic analysis, Principles of location: 3-2-1 and 4-1-1 types of location, types of locators, redundant location, Clamping: clamping principles, types of clamps, devices - mechanical, hydraulic, vacuum and magnetic. 8 Hours

Design of drill jigs - template, plate, channel, diameter, leaf, box, pot, local, angular, turnover, indexing jigs. Drill bushes, turning and milling fixtures. 8 Hours
UNIT - 5
PRESS TOOLS: Classification, components of simple die press tool operations, die accessories, difference between mechanical and hydraulic press tools, centre of pressure. 8 Hours

DESIGN: Computation of capacities, tonnage requirements for blanking, bending, forming and drawing operations, scrap strip layout, Design of Component, Combination, progressive, drawing and bending dies. 8 Hours

TEXT BOOKS:

REFERENCE BOOKS:
1. Metal cutting theory and Tool Design - Arshinav MIR Publications

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 3 and two questions each from Units 4 & 5.
Course Outcomes

CO1: Describe engineering significance of tribology, regimes of lubrication and understand the principle of viscosity measurement

CO2: Apply the Reynolds 2D equation for full journal bearing and slider bearings operating under hydrodynamic condition and estimate design parameters

CO3: Understand principle of EHL contacts and the contact mechanics

CO4: Estimate the design parameters of Hydrostatic bearings

CO5: Understand the working principle of Magnetic bearings and develop design solutions.

ASSESSMENT

1. CIE – 50 MARKS
2. SEE – 100 MARKS

UNIT 1


UNIT 2

Concept of lightly loaded bearings, Petroff's equation, Numerical problems. Pressure development mechanism. Converging and diverging films and pressure induced flow. Reynolds's 2D equation with assumptions. 08 Hours

UNIT 3

Hydrodynamic Bearings: Introduction to idealized slide bearing with fixed shoe and pivoted shoes. Expression for load carrying capacity. Location of center of pressure. Numerical problems. 08 Hours
Journal Bearings: Introduction to idealized full journal bearings. Load carrying capacity of idealized full journal bearings, Sommerfeld number and its significance. Comparison between lightly loaded and heavily loaded bearings, Numerical problems. 08 Hours

UNIT 4

EHL Contacts: Introduction to Elasto - hydrodynamic lubricated bearings. Introduction to 'EHL' constant. Grubin type solution. 06 Hours

Hydrostatic Bearings: Types of hydrostatic Lubrication systems Expression for discharge, load carrying capacity, Flow rate, Condition for minimum power loss. Torque calculations. Numerical problems. 06 Hours

UNIT 5

Magnetic Bearings: Introduction to magnetic bearings, Active magnetic bearings. Differential equations used in magnetic bearings and working principal, Advantages and disadvantages of magnetic bearings, Electrical analogy, Magneto-hydrodynamic bearings. 06 Hours

TEXT BOOKS:
2. Tribology in industry Susheel Kumar Srivasthava, S.Chand and Co.

REFERENCE BOOKS:
2. Principles and applications of Tribology, Moore, Pergamon press.
3. Theory of Hydrodynamic Lubrication, Pinkus '0' Stemitch.

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 5 and two questions each from Units 3 & 4.
UNIT - 1

PRODUCTIVITY & WORK STUDY: Definition of productivity, factors affecting productivity, definition, objective & scope of work study, human factors in work study, work study & management, work study & supervisor, work study & worker.

06 Hours

METHOD STUDY: Definition, objective & scope, charts to record movements in shop, process charts, flow process charts, Multiple activity charts, two handed process charts, SIMO chart, principles of motion economy.

08 Hours

UNIT - 2

WORK MEASUREMENT: Definition, objectives, techniques of work measurement, work sampling, need of confidence levels, sample size determination, random observation with simple problems.

06 Hours

TIME STUDY: Definition, time study equipments, selection of jobs, steps in time study, breaking jobs into elements, recording information, rating, standard performance, scales of rating, factors affecting rate of working, allowances, standard time determination.

06 Hours

UNIT - 3

INTRODUCTION TO INDUSTRIAL DESIGN: elements of design structure for industrial design in engineering application in modern manufacturing systems.

Ergonomics and Industrial Design: Introduction, general approach to the man-machine relationship, workstation design-working position.

08 Hours

UNIT - 4

VISUAL EFFECTS OF LINE AND FORM: The mechanics of seeing-psychology of seeing general influences of line and form.

06 Hours

COLOR MODELS: RGB, CMY, HSV, Color and light, color and objects-color and the eye-color consistency-color terms reactions to color and color continuation-color on engineering equipments.

06 Hours
UNIT - 5

AESTHETIC CONCEPTS: Concept of unity-concept of order with variety-concept of purpose style and environment –Aesthetic expressions. Style –components of style house style, observation style in capital goods, case study. 06 Hours

TEXT BOOKS:

REFERENCE BOOKS:
4. Work Study & Ergonomics, Suresh Dalela&Saurabh, standard publishers & distributors,1999

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 2 & 3 and two questions each from Units 4& 5.
UNIT - 1
INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. Applications, future potential of composites. 06 Hours

FIBER REINFORCED PLASTIC PROCESSING: Lay up and curing, fabricating process, open and closed mould process, hand lay up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding. 09 Hours

UNIT - 2

UNIT – 3
Macro Mechanics of a Lamina: Hooke’s law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems. 08 Hours
Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems. 06 Hours

UNIT – 4
Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) ,Special cases of laminates, Numerical problems. 07 Hours

UNIT - 5
FABRICATION PROCESS FOR MMC'S: Powder metallurgy technique, liquid metallurgy technique, diffusion bonding, squeeze technique and secondary processing.

TEXT BOOKS:

REFERENCE BOOKS:
1. Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker, Inc

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 2, 4 & 5 and Two questions each from unit 1 & 3.
DEPARTMENT OF MECHANICAL ENGINEERING

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</table>

COURSE OUTCOMES

- CO1: Determine parametric values pertaining to vibration systems.
- CO2: Determine fringe constant of Photoelastic material for different conditions.
- CO3: Determine stress concentration for various components using Photoelasticity.
- CO4: Demonstrate experimental analysis of governors, bearings & gyroscope.
- CO5: Determine stresses & strains using strain rosettes and strain gauges.

PART - A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Determination of Frequencies and mode shapes of cantilever beam
3. Determination of Fringe constant of Photoelastic material using.
   a) Circular disc subjected to diametral compression.
   b) Pure bending specimen (four point bending)
4. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

PART - B

1. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proel/Hartnel Governor.
3. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
4. Determination of stresses in Curved beam using strain gauge.
5. Experiments on Gyroscope.
DEPARTMENT OF MECHANICAL ENGINEERING

<table>
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COURSE OUTCOMES

1. CO1. Demonstrate mathematical solutions using MATLAB tool.
2. CO2. Develop mathematical models for real-time engineering problems

PART-A

1. Introduction to vector and Matrix conventions and their manipulations, Variables, scripts, and operations
2. Visualization and programming
3. Solving ode and pde equations and curve fitting
4. Introduction to Complex Numbers
5. Building Waveforms From Basic Functions
6. Graphical Differentiation and Integration of Waveforms
7. Introduction to Laplace Transform
8. Finding Roots of a Polynomial

PART-B

Applications

1. Representation of Fourier series and plot for different functions Step and Ramp Functions and Gaussian distribution
2. Cams: Plotting different cam profiles
3. Fins: Heat transfer 1 D fin with different end conditions
4. Plot bending moment and shear force diagrams for different beams Cantilever and Simply supported beam
5. Solutions of ODE and PDE
6. Solutions to system of equations
7. Second Order Systems with One Degree of Freedom-Free Response and forced response

References:
1. MATLAB: An Introduction with Applications by R.V.Dukkipati, New Age International Pvt Limited, 2010 (free ebook)
3. Essential MATLAB for Engineers and Scientists Brian Hahn, Daniel Valentine.

Scheme of Examination:
One question from Part A - 20 Marks (05 Write up +15)
One question from Part B - 20 Marks (05 Write up +15)
Viva - Voce - 10 Marks
-------------
Total: 50 Marks

Scheme of Evaluation for SEE

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<tbody>
<tr>
<td>One question from Part A</td>
<td>20 Marks (05 Write-up +15)</td>
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<td>One question from Part B</td>
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<td>Viva-voce</td>
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<tr>
<td><strong>Total</strong></td>
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</table>
Teaching scheme and Examination scheme

CIE: 50Marks and SEE: 50Marks

1. Every student individually or in a group (group size is of 4 students. However, if project complexity demands a maximum group size of 5 students, the committee should be convinced about such complexity and scope of the work.) Shall take a project in the beginning of the seventh semester in consultation with the guide and the project must be completed in the eighth semester.

2. The project proposal must be submitted in the institute in the beginning of the (B.E. first Term) seventh term. While submitting project proposal care is to be taken that project will be completed within the available time of two term i.e. 4Hrs per week for (B.E. first Term) seventh term and 28 Hrs per week for (B.E. Second Term) eighth semester (total time become 12*4 + 12*28 = 384 Hrs per project partner). The final title of the project work should be submitted at the end of the seventh semester.

3. Project title should be precise and clear. Selection and approval of topic:
   - Topic should be related to real life application in the field of MECHANICAL, OR
   - Investigation of the latest development in a specific field of MECHANICAL OR
   - Software development project related to MECHANICAL OR Interdisciplinary.
   - Interdisciplinary projects should be encouraged.

4. The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by guide.

5. The group is expected to complete details system design, layout etc. in seventh semester, as a part of Project work in the form of a joint report. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

6. One guide will be assigned at the most two project groups.

7. The guides should regularly monitor the progress of the project work.

8. Assessment of the project for award of CIE marks shall be done by the guide and a departmental committee (consisting of minimum two Associate/Assistant Professors with experience more than three years) as per the guidelines given
ASSESSMENT OF **12 ME7DC PRW** Project Work Phase 1

NAME OF THE PROJECT ________________________________________________

NAME OF THE GUIDE: ________________________________________________

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<th>Assessment by Departmental Committee (30%)</th>
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<td>Topic Selection 05</td>
<td>Documentation 15</td>
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Sign of Guide Sign. of Committee Members Sign. Of H. O. D.

9. The guide should be internal examiner for oral examination.

10. The other examiner (Internal) should be from the related area of the concerned project.

11. The evaluations at final oral examination should be done jointly by both the examiners.
UNIT - 1

PRINCIPLES OF MACHINE TOOL DESIGN: General requirements of machine tool design - design process machine tool layout general requirements of machine tool design – design process machine tool layout

CUTTING FORCE ANALYSIS AND POWER REQUIREMENT: In Turning, Milling, Drilling, operation with simple problems. 8 Hours

UNIT - 2


DESIGN OF MACHINE TOOL STRUCTURES: Functions-Requirements-Design criteria Material used – static and dynamic stiffness – Profile and basic design procedure for machine tool structures. Design of beds, columns, housing, bases, tables, cross-rails, arms saddle, carriages. 7 Hours

UNIT - 3

DESIGN OF GUIDE WAYS AND POWER SCREWS: Function and types of guide ways – Design and lubrication of slide ways - aerostatic slide ways - antifriction guide ways, combination guide ways - protecting devices, design of power screws. 8 Hours

UNIT - 4

DESIGN OF SPINDLE AND SPINDLE BEARINGS: Functions-Requirements and materials for spindle compliance and machining accuracy. Design of spindles, antifriction bearing, Hydrodynamic and Hydrostatic bearing, Air lubricated bearing. 8 Hours
UNIT - 5


CONTROL SYSTEMS IN MACHINE TOOLS: Functions, requirements and classification. Control system for speed and feeds centralized control pre selective control, control system for forming and auxiliary motions – Mechanical control– Ergonomic consideration and compatibility – Automatic control system – Electric Hydraulic and pneumatic systems.

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 3 & 4 and two questions each from Units 2& 5.
DEPARTMENT OF MECHANICAL ENGINEERING

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Prerequisites
1. Basic and applied thermodynamics
2. Turbomachinery

Course Outcomes
CO1: Understand the construction and functions of components of IC engine
CO2: Understand the use of Super and Turbo Chargers for enhancing the power output.
CO3: Understand the different ignition systems used in IC engines.
CO4: Understand the various transmission system, braking and safety mechanisms

ASSESSMENT
1. CIE – 50 MARKS
2. SEE – 100 MARKS

UNIT-1
ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS: SI & CI engines, cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Types of combustion chambers for S.I.Engine and C.I.Engines, Compression ratio, methods of a Swirl generation, choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements.

FUELS, FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES: Conventional fuels, alternative fuels, normal and abnormal combustion, cetane and octane numbers, Fuel mixture requirements for SI engines, types of carburetors, C.D.& G., C. carburetors, multi point and single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors.

UNIT-2
SUPERCHARGERS AND TURBOCHARGERS: Objectives of supercharging of SI and CI engines, effects of supercharging on performance of the engine. Methods of supercharging, Types of superchargers, vane blower, Roots supercharger, centrifugal
compressor. Turbochargers, Methods of Turbo charging constant pressure, Pulse and pulse converted, pluse and pluse converted. Turbocharger construction and operation, Intercooler, Turbocharger lag. Limitations of Turbo charging

**UNIT-3**

**IGNITION SYSTEMS:** Battery ignition systems, magneto Ignition system, Electronic Ignition, Automatic Ignition advance systems.

**06 Hrs**

**UNIT-4**

**POWER TRAINS:** General arrangement of clutch, Principle of friction clutches, Torque transmitted, Constructional details, Fluid flywheel, Single plate, multi-plate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, synchromesh gear boxes, 3,4 and 5 speed gear boxes. Free wheeling mechanism, planetary gears systems, over drives, fluid coupling and torque converters, Epicyclic agear box, principle of automatic transmission, calculation of gear ratios, Numerical calculations for torque transmission by clutches( single plate and multiplate clutch only)

**10 Hrs**

**UNIT-5**

**DRIVE TO WHEELS.** Propeller shaft and universal joints, Hotchkoss and torque tube drives, differential, rear axle, different arrangements of fixing the wheels to rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer and neutral steer.

**08 Hrs**

**SUSPENSION, SPRINGS AND BRAKES:** Requirements, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system. Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Introduction to Antilock –Braking systems, purpose and operation of antilock braking system.

**08 Hrs**
TEXT BOOKS:

REFERENCE BOOKS:

**Scheme of Examination:** Answer Five full questions selecting one from each unit. To set one question each from Unit 2,3& 4 and two questions each from Units 1&5.
UNIT - 1

DATABASE AND DATABASE USERS: Introduction, characteristics of database approach, intended uses of a DBMS, advantages and implementation of database approach. 06 Hours

DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE: Data models, schemes and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of database management systems. 06 Hours

UNIT - 2

DATA MODELING: High level conceptual data models for database design. Entity types, entity sets, attributes and keys, Relationships, relationship types, roles and structural constraints. Weak entity types, ER diagram and design issue. 08 Hours

RECORD STORAGE AND PRIMARY FILE ORGANIZATIONS: Secondary storage devices, buffering of the blocks, placing file records on the disk, operations on files, heap files and sorted files, hashing techniques. 06 Hours

UNIT - 3

RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA: Brief discussion on code rules, relational model concepts, constraints and schemas. Update operation on relations, basic and additional relational algebra operations, queries in relational algebra. 07 Hours

STRUCTURAL QUERY LANGUAGE (SQL): Data definition etc., in SQL2. Basic and complex queries in SQL, Inser, Delete; Update statements, and views in SQKL, embedded SQL. 07 Hours
UNIT - 4
DATABASE DESIGN: Design guidelines for relational schemas, functional dependencies, normalization 1st, 2nd, 3rd, 4th and 5th; normal forms. Database design process, factors influencing physical database design guidelines, and guidelines for relational systems.

07 Hours

UNIT - 5
SYSTEM IMPLEMENTATION: System catalogue for RDBMSs, transaction processing, and system concepts, properties of transaction, brief discussion on concurrency control and recovery techniques, database security and authorization.

05 Hours

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 2, 4,& 5 and two questions each from Units 1& 3.
UNIT - 1

ARTIFICIAL INTELLIGENCE: Introduction, definition, underlying assumption, importance of AI, AI and related fields. 6 Hours

UNIT - 2

SPACE REPRESENTATION: Defining a problem. Production systems and its characteristics, Search and Control strategies – Generate and Test, Hill Climbing, Best-first Search, Problem reduction, Constraint Satisfaction, Means – Ends Analysis. 7 Hours

UNIT - 3

KNOWLEDGE REPRESENTATION ISSUES: Representations and Mappings, Types of knowledge – Procedural Vs Declarative, Logic programming. Forward Vs Backward reasoning, Matching. 7 Hours

UNIT - 4

USE OF PREDICATE LOGIC: Representing simple facts, Instance and Isa relationships, Syntax and Semantics for Prepositional logic, FQPL and properties of Wffs, Conversion to Clausal form, Resolution, Natural deduction. 6 Hours

STATISTICAL AND PROBABILISTIC REASONING: Symbolic reasoning under uncertainty, Probability and Bayes' theorem, Certainty factors and Rule based systems, Bayesian Networks, Shafer Theory, Fuzzy Logic. 7 Hours

UNIT - 5

EXPERT SYSTEMS: Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition Learning classification patterns, recognizing and understanding speech. Introduction to knowledge Acquisition, Types of Learning. 7 Hours
TYPICAL EXPERT SYSTEMS: MYCIN, Variants of MYCIN, PROSPECTOR, DENDRAL, PUFF, ETC, 6 Hours

TEXT BOOKS:
1. Artificial Intelligence, Elaine Rich & Kevin Knight, M/H 1983.
2. Introduction to AI & ES, Dan W. Patterson, Prentice Hall of India, 1999.

REFERENCE BOOKS:

Scheme of Examination:
Answer Five full questions selecting one from each unit.
To set one question each from Unit 1, 2 & 3 and two questions each from Units 4 & 5.
UNIT - 1

**Composite Materials**: Classification of composites, types of matrices and reinforcements, characteristics and selection, particulate composites, laminates; sandwich structures; fabrication technologies for laminates and sandwich structures. Production of MMC’s (Liquid Metallurgy, Squeeze casting, diffusion bonding) need for MMCs.  
8 Hours

**Micromechanics of laminae**: Rule of mixture for evaluation of physical and elastic properties of laminae (density, thermal conductivity, elastic moduli, ultimate tensile strength), Numericals.  
8 Hours

UNIT - 2

**Powder Metallurgy**: Process details and special characteristics of powder metallurgy process. Compaction techniques like CIP & HIP (Cold Isostatic and Hot Isostatic pressing) Sintering, Applications of Powder metallurgy.  
6 Hours

UNIT - 3

**High temperature alloys**: Classification of Titanium alloys, properties, microstructure and applications, heat treatment and machining of Ti alloys.  
6 Hours

UNIT - 4

**Surface technology**: Coatings for specific applications, coating materials and their selection, coating technologies and their merits and demerits, coating characterization, Use of LASER for coating life enhancement, hardfacing.  
8 Hours

UNIT - 5

**Nanotechnology**: Nanopowders and nanomaterials, methods of preparation – plasma arc ing, chemical vapour deposition, electrodeposition, sol-gel synthesis, ball milling, comparative studies of the advantages and disadvantages of nanopowder production technologies.  
8 Hours

Carbon nanotubes, types of nanotubes, formation of nanotubes, advantages of nanotubes
over nanopowders nanofabrication technologies, characterization of nanomaterials and nanostructured materials, AFM, STEM, XRD, FTIR for nanocharacterisation.

8 Hours

TEXT BOOKS:

REFERENCE BOOKS:
3. **ASM Handbook on Powder Metallurgy** - Vol 17, ASM publications

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 2, 3 & 4 and two questions each from Units 1 & 5.
UNIT - 1
FUNDAMENTAL EQUATIONS OF STEADY FLOW:
Definition of Compressible Flow, Flow Regimes,Aerodynamic Forces on a Body, Continuity and momentum equation and energy equation.

UNIT - 2
ISENTROPIC FLOW: Acoustic velocity, Mach number, Mach cone and Mach angle. Flowparameters, stagnation temperature, pressure and density.

UNIT - 3
FLOW IN CONSTANT AREA WITH HEAT TRANSFER: Stagnation temperature change. Rayleigh line, Pressure ratio and temperature ratio, Entropy considerations and maximum heat transfer.
FLOW IN CONSTANT AREA WITH FRICTION: Fanno curves, The fanning equation, Friction factor and friction parameter, Fanno line and Fanno flow equations.
UNIT - 4
FLOW WITH NORMAL SHOCK WAVES: Development of shock wave, Rarefaction wave, Governing equations, Prandtl-Meyer relation, Mach number downstream, Static pressure rise, Density ratio, Temperature ratio, Tables and charts for normal shock.

FLOW WITH OBLIQUE SHOCK WAVES: Fundamental relations, Prandtl's equation, Rankine-Hugoniot equation, Variation of flow parameters and Gas tables for oblique shocks.  

UNIT - 5

TEXT BOOKS:
2. Gas Dynamics, E Radhakrishnan PHI-2006

REFERENCE BOOKS:
1. Introduction to Gas Dynamics: Rolty, Wiley 1998

Scheme of Examination: Answer five full questions selecting one from each unit.
To set one question each from Unit 1, 2 & 5 and two questions each from Units 3 & 4.
B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

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UNIT-1

**Introduction:** Definition of Organization Behaviour and Historical development, Environmental context (Information Technology and Globalization, Design and Cultural, Reward Systems).

**The Individual:** Foundations of individual behaviour, individual differences. Ability. Attitude, Aptitude, interests. Values.

4 Hrs

UNIT-2

**Learning:** Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement.

**Perception:** Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

6 Hrs

UNIT-3

**Motivation:** Maslow's Hierarchy of Needs, Me. Gregor's theory X and Y, Herzberg's motivation Hygiene theory, David Me Cleland three needs theory, Victor vroom's expectancy theory of motivation.

**The Groups:** Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

5 Hrs

UNIT-4

**Conflict & Stress management:** Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity. Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process.

7 Hrs
UNIT-5

Principles of Communication: Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication. 6 Hrs

TEXT BOOKS:

REFERENCE BOOKS:

Scheme of Examination: Answer Five full questions selecting one from each unit. To set one question each from Unit 1, 4 & 5 and two questions each from Units 2 & 3.
Guide lines

1. For seminar, every student should select a guide

2. Selection of topic should be done by students in consultation with concerned guide

3. Student will individually study a topic assigned to him / her and submit a report and shall deliver a short lecture / Seminar on the topic at the end of term.
   a. Topic should be related to latest advancements in the discipline.
   b. Student should preferably refer minimum of 5 reference books / magazines/one research paper.

4. Seminar topic should not be repeated in the department and registration of the same should be done on first come first serve basis

5. Seminar report should be submitted as two paper bound copies as well as soft copy.

6. Format of content
   i. Introduction.
   ii. Literature survey.
   iv. Conclusion.
   v. Future scope.

References
ASSESSMENT OF SEMINAR

Title of seminar _____________________________________
Name of guide _____________________________________

7. Assessment of Literature survey will be based on
   a. Collection of material regarding history of the topic.
   b. Implementation.
   c. Recent applications.

8. Assessment of Depth of understanding will be based on
   a. Questioning by examiners. (Internals only)
   b. What the student understands i.e. conclusion regarding seminar.

9. Assessment of presentation will be based on;
   a. Presentation skills (10-15 minutes)
   b. Presentation contents
   c. Questioning and answering (5 minutes)

10. Examiners should be a panel of two, one of them being the guide.

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<th>Report Writing 10</th>
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B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
(Autonomous College under VTU)

12 ME8DC PRW - Project Work Phase 2

Scheme

CIE: 50 Marks and SEE: 50 Marks

1. The Project group in seventh term will continue the project work in eighth semester and complete project in all respect (assembly, testing, fabrication, tabulation, test result etc.)

2. The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by guide.

3. The guides should regularly monitor the progress of the project work.

4. The project work along with project report should be submitted as part of term work in eighth semester on or before the last day of the semester.

5. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.

6. Assessment of the project for award of CIE marks shall be done by the guide and a departmental committee (consisting of minimum two teachers with experience more than three years) as per the guidelines given in the following table.

B) Assessment of Project Work Phase 2: 12 ME8DC PRW

NAME OF THE PROJECT _____________________________________________

NAME OF THE GUIDE: ______________________________________________

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<th>Assessment by Departmental Committee (30%)</th>
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Sign of Guide                                             Sign.of Committee Members
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7. The guide should be internal examiner for oral examination.

8. The external examiner should be from the related area of the concerned project. He should have minimum of five years of experience at degree level / industry.

9. The evaluation at SEE examination should be done jointly by the internal and external examiners.