ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

BMS COLLEGE OF ENGINEERING

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME & SYLLABUS FOR AUTONOMOUS COURSE

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು–೫೬೦ ೦೧೯

BMS COLLEGE OF ENGINEERING

Bull Temple Road, Bangalore - 560 019

BMS COLLEGE OF ENGINEERING, BANGALORE-19

Autonomous College under VTU (2009 -2010)

III SEM

Subject Code	Title	Teching Hours			Cerdits
		L	T	P	
09MA 3IC MAT	MATHEMATICS-III	3	2	0	4
09ME3DC MSM	MATERIAL SCIENCE & METALLURGY	4	0	0	4
09ME3DC SOM	STRENGTH OF MATERIALS	3	2	2	5
09ME3DC MP1	MANUFACTURING PROCESS-I	3	0	2	4
09ME3DC BTD	BASIC THERMODYNAMICS	3	2	0	4
09MI 3GC CMD	COMPUTER AIDED MACHINE DRAWING	2	2	2	4
				Total	**25**

IV SEM

Subject Code	Title	Teching Hours			Cerdits
		L	T	P	
09MA 4IC MAT	MATHEMATICS-IV	3	2	0	4
09ME4DC ATD	APPLIED THERMODYANAMICS	3	2	2	5
09ME4DC KOM	KINEMATICS OF MACHINES	3	2	0	4
10 ME4DC DM1	DESIGN OF MACHINE ELEMENTS-I	3	2	0	4
09ME4DC MP2	MANUFACTURING PROCESS-II	3	0	2	4
09ME4DC FME	FLUID MECHANICS	3	2	2	5
				Total	**26**

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V SEM

SubjectCode	Title	Teaching HOURS			Credits
		L	T	P	
11ME5DC MAE	MANAGEMENT & ENTREPRENEURSHIP	4	0	0	4
11ME5DC DM2	DESIGN OF MACHINE ELEMENTS-II	3	2	0	4
11ME5DC MMM	MECHANICAL MEASUREMENTS & METROLOGY	3	0	2	4
11ME5DC DOM	DYNAMICS OF MACHINES	3	2	0	4
11ME5DC TUM	TURBO MACHINES	3	2	0	4
11 ME5DL TUM	TURBO MACHINES LABORATORY	0	0	3	1
11ME5DEA	ELECTIVE A	4	0	0	4
				Total	**25**

Elective- A Course Code	Course	Elective- A Course Code	Course
11ME 5DEA TOE	THEORY OF ELASTICITY	11ME 5DEA NTM	NON TRADITIONAL MACHINING
11ME 5DEA ICE	I C ENGINES	11ME 5DEA CEE	COST ESTIMATION AND ENGG. ECONOMIC
11ME 5DEA SQC	STATISTICAL QUALITY CONTROL	11ME 5DEA ENE	ENERGY ENGINEERING
11ME 5DEA RAC	REFRIGERATION & AIR CONDITIONING	11ME 5DEA AEμ	APPLIED ELECTRONICS AND MICROPROCESSOR
11ME 5DEA OPM	OPERATION MANAGEMENT		

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VI SEM

SubjectCode	Title	Teaching HOURS			Credits
		L	T	P	
12ME 6DC HMT	HEAT & MASS TRANSFER	3	2	0	4
11ME 6DC MEV	MECHANICAL VIBRATION	3	2	0	4
11ME 6DC MFE	MODELLING & FINITE ELEMENT ANALYSIS	4	0	0	4
11ME 6DC HAP	HYDRAULICS AND PNEUMATICS	4	0	2	5
11ME 6DC PWI	MINI PROJECT/INTERNSHIP	0	0	3	3
11 ME DEB	**Elective- B**	4	0	0	4
12 ME6DL DES	DESIGN LABORATORY	0	0	2	1
12ME6DL HMT	HEAT TRANSFER LABORATORY	0	0	03	1
				Total	**26**

Elective- B Course Code	Course	Elective- B Course Code	Course
11 ME6 DE BTOP	Theory of Plasticity	11 ME6 DE BROB	Robotics
11 ME 6DEBSOE	Solar Energy	11 ME 6DE BCFD	Computation Fluid Dynamics
11 ME6 DE BAGM	Agile Manufacturing	11 ME6 DEB FOT	Foundry Technology

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VII SEM

SubjectCode	Title	Teaching HOURS			Credits
		L	T	P	
12 ME 7DC COE	CONTROL ENGINEERING	4	0	0	4
12 ME 7DC MP3	MANUFACTURING PROCESS - III	4	0	0	4
11 ME 7DEC	*Departmental Elective-* C	4	0	0	4
11 ME 7DED	***Departmental Elective-* D**	4	0	0	4
11 ME 7 IE	***Institutional Elective***	4	0	0	4
12MEDLNAM	Numerical Applications for Mechanical Engineering	0	0	3	1.5
12 ME 7DLCAE	COMPUTER AIDED MODELLING & ANALYSIS LAB	0	0	3	1.5
12ME7DC PRW	Project Work :*Phase 1*	–	–	02	03
				Total	**26**

Elective- C Course Code	Course	Elective- D Course Code	Course
11 ME7 DEC ESD	Engineering System Design	11 ME 7DE DFRM	Fracture Mechanics
11 ME7 DEC PDM	Product Design & Manufacturing	11 ME 7DE DIEE	Industrial Engineering & Ergonomics
11 ME7 DECCIM	Computer Integrated Manufacturing	11 ME 7DED COG	Computer Graphics
11 ME7 DE CMIS	Management Information Systems	11 ME7 DED RAP	Rapid Prototyping
11 ME 7DEC AUM	Automation in Manufacturing	11 ME7DE DTED	Tool Engineering Design
11 ME7DE CTQM	Total Quality Management	11 ME 7DE DTRI	Tribolog
11 ME7DEC POM	Project Management	11 ME 7DE DCMT	Composites Material Technology

BMS COLLEGE OF ENGINEERING, BANGALORE-19

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VIII SEM

SubjectCode	Title	Teaching HOURS			Credits
		L	T	P	
11 ME DEE	***Departmental Elective*- E**	4	0	0	4
11 ME 8IE	**Institutional Elective**	4	0	0	4
12 ME8DC PRW	Project Work :*Phase 2*				12
11 ME8DC SEM	Seminar				2
				Total	**22**

Elective- E Course Code	Course	Course Code	Course
11 ME8 DEE MTD	Machine Tool Design	11 ME 8IEE MSS	Micro & Smart System
11 ME8 DEE FIM	Financial Management	11 ME 8IE ENAT	Nano Technology
11 ME 8DEE AUE	Automotive Engineering	11 ME 8IEE EDS	Engineering Drawing & Sketching
11 ME 8DE EARI	Artificial Intelligence	11 ME 8 IE EDBM	Data Base Management System
11 ME8 DE EAMT	Advanced Material Technology	11 ME 8DEE ORB	Organizational Behavior
11 ME8 DE EGAD	Gas Dynamics		

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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III SEMESTER : MECHANICAL ENGINEERING

Subject	MATERIAL SCIENCE & METALLURGY	Sub. Code	09 ME 3DC MSM
Credits	04	L-T-P	4-0-0

UNIT - 1

Structure of crystalline solids: Concepts of unit cell, space lattice, Unit cells for cubic structure & HCP structure and their characteristics calculations of radius, Coordination Number and Atomic Packing Factor **4 hrs**

Crystal imperfections: point, line, surface defects. Diffusion in solids: Diffusion Mechanism, Fick's laws of diffusion. Plastic deformation by slip & twinning. **6 hrs**

UNIT - 2

Testing of Materials: Tensile properties, Engineering stress-strain, true stress & strain, Hardness testing (Brinell hardness testing, Vickers, Rockwell hardness stress) **4 hrs**

Types of Fracture: Brittle, Ductile facture, Griffith's criterion. Creep: The creep curves, creep mechanism and creep tests, Fatigue – Fatigue cycles, Fatigue test, S.N curves, Fatigue mechanism, Factors affecting fatigue life. **7 hrs**

UNIT -3

Solid solutions and phase diagrams: Types of solids solutions, Rules of governing the formation of solid solutions and intermediate phases.

Cooling curves, construction of phase diagrams, Phase diagrams of Eutectic systems. Phase rules: Gibbs phase rule and Lever rule. Interpretation of phase diagrams. **6 hrs**

Iron carbon equilibrium Diagram; Equilibrium phases, Invariant reactions, critical temperatures, Solidification of steels. **5 hrs**

UNIT - 4

Heat treatment of Ferrous and Non-ferrous materials: TTT diagram, Construction of TTT diagram, TTT diagram for hypo and hyper eutectoid steels cooling curves, Non-equilibrium phases, Effect of alloying elements on steels. **5 hrs**

Heat treatment processes- Annealing, and its types, normalizing, hardening, tempering, surface heat treatment methods.Heat treatment of Non-ferrous materials.Study and Observation of Microstructure of Ferrous and Non-ferrous alloys. **5 hrs**

UNIT - 5

Ferrous, Non-ferrous and advanced materials.

Ferrous – Types, Composition, Properties and applications of plain carbon steels and cast irons. Designation of steels.

Non-ferrous – Aluminium and its alloys, Magnesium alloys, Copper and its alloys. **5 hrs**

Composite Materials – Definition, Classifications, Production methods, properties and applications of MMC and FRP composites. **5 hrs**

Text Books:

1. "Materials Science & Engineering- An Introduction", William D.Callister Jr. Wiley India Pvt. Ltd. 6th Edition, 2006, New Delhi.
2. "Materials Science & Engineering", V.Raghavan, 5th Edition, Prentice Hall.

Reference Books:

1. "Introduction to Material Science for Engineering", 6th edition James F. Shackel ford.Pearson, Prentice Hall, New Jersy, 2006.
2. "Foundation of Material Science and Engineering", Smith, 3rd Edition McGraw Hill,1997.
3. Mechanical Mellorgy 3rd Edn., George.E.Dieter, McGraw Hill, 2001.

Scheme of Examination:
Each Question from each unit and Internal choice from Unit 3 & 4.

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III SEMESTER : MECHANICAL ENGINEERING

Subject	STRENGTH OF MATERIALS	Sub. Code	09 ME 3DC SOM
Credits	04	L-T-P	3-2-2

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 – behaviour 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, shear strain, elastic constants and their relations. Stress in composite section subjected to external loads and temperature change, volumetric strain. **10 Hrs**

Compound stresses: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress. **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 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). **06 Hrs**

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 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

Colums 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**

UNIT - 6

Lab components must comprise of experiments that reinforce the theoretical understanding of the corresponding theory subject. Outlines of the laboratory components should be mentioned by the respective staff members well before the commencement of the course.

Text Books:

1. "Engineering Mechanics of Solids" Egor.P. Popov, Pearson Edu. India, 2nd, Ed 1998.
2. "Mechanics of materials" K.V. Rao, G.C. Raju,Subhash Stores, First Edition,2007

Reference Books:

1. "Mechanics of Solids", Mubeen, Pearson Edu. India, 2002
2. "Strength of Materials", W.A. Nash, Schaum's Outline Series, Fourth Edition-2007
3. "Mechanics of materials", S.I. Units, Ferdinand Beer & Russell Johnstan, TATA McGrawHill-2003.
4. "Strength of Materials", S.S.Bhavikatti, Vikas pub. House – Pvt. Ltd., 2nd Ed.,2006.

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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III SEMESTER : MECHANICAL ENGINEERING

Subject	MANUFACTURING PROCESS-I	Sub. Code	09 ME 3DC Mp1
Credits	04	L-T-P	3-0-2

UNIT – 1

CASTING PROCESS: Introduction concepts of manufacturing process, its importance. Classification of manufacturing processes, introduction to casting process & steps involved. Varieties of components produced by Casting process. Advantages & limitations of casting process. **3 Hrs**

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. **3 Hrs**

UNIT - 2

Sand Moulding and special moulding process :Types of base sand, requirement of base sand. Types of sand moulds.Sand moulds: 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. **6 Hrs**

UNIT – 3

Melting Furnaces: Classification of furnaces. Constructional features & working principle of Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.

Inspection methods: Methods used for inspection of casting & welding, visual, magnetic particle, Fluroscent particle, Ultrasonic, Radiagraphy, Eddy Current, Holography methods of inspection. **6 Hrs**

Unit – 4

WELDING: Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding.

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) **4 Hrs**

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

Special type of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding Electron beam welding. **6 Hrs**

UNIT – 5

Metallurgical aspect in welding : Structure of welds, Formation of different zones during welding. Heat affected zone (HAZ). Parameters affecting HAZ.Effect of carbon content on structure and properties of steel.Shrinkage in welds & Residual stresses.Concept of electrodes, Filler rod and fluxes.Welding defects – Detection causes & remedy. **4 Hrs**

Principles of soldering & brazing: Parameters involved & Mechanism, Different Types of Soldering & Brazing Methods. **2 Hrs**

UNIT - 6

Lab components must comprise of experiments that reinforce the theoretical understanding of the corresponding theory subject. Outlines of the laboratory components should be mentioned by the respective staff members well before the commencement of the course.

Text Books:

1. "Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House, 5th Ed, 2008/2009
2. "Manufacturing & Technology: Foundry Forming and Welding", P.N.Rao 2nd Ed., Tata McGraw Hill, 2003.

Reference Books:

1. "Manufacturing Technology", Swaroop Kalpakjian, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006.
2. "Process and Materials of Manufacturing:, Roy A Lindberg, 4th Ed. Pearson Edu. 2006.
3. Workshop Technology, Vol-I, H.K.Hajra Choudhry & A.K.Hajra Choudhry, 12th Edition, MPP Publisher,2001.

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

Subject	BASIC THERMODYNAMICS	Sub. Code	09 ME 3DC BTD
Credits	04	L-T-P	3-2-0

PART-A

UNIT - 1

a) Introduction: Macroscopic V/s Microscopic View point, Thermodynamic system and Control, Thermodynamic properties, process and cycles, Homogeneous & Heterogeneous systems, Thermodynamic Equilibrium, Quasi-static process, Pure substance, Concept of continuum, History of Thermodynamic.

b) Temperature: Zeroth Law of Thermodynamics, Measurement of temperature-the reference points, Comparison of Thermometers, Ideal Gas, Gas thermometers, Idea gas temperature, Celsius temperature scale, Electrical Resistance thermometer, Thermocouple, International Practical Temperature scale.

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, 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

a) Second Law of Thermodynamics : Qualitative different between Heat and work, Cyclic Heat engine, Energy reservoirs, Kelvin-Planck statement of Second Law, Clausius' statement of the Second Law, Refrigerator and Heat pump, Equivalence of Kelvin-Planck and Clausius statements, Reversibility and Irreversibility, Causes of Irreversibility, Conditions for Reversibility, Carnot cycle, Reversed Heat engine, Carnot's Theorem, Corollary of Carnot's Theorem, Absolute Thermodynamic temperature scale, Efficiency of the Reversible heat engine, Equality of Ideal gas temperature & Kelvin Temperature, Types of Irreversibility.

b) Entropy : Introduction, Two reversible adiabatic paths Cannot Interact each other, Clausius' Theorem, The property of Entropy, Principle of Caratheodory, The Inequality of Clausius, Entropy change in an Irreversible process, Entropy principle, Applications of Entropy principle, Entropy transfer mechanisms, Entropy generation in a closed system, Entropy generation in an open system, First & Second Laws combined, Reversible adiabatic work in a steady flow system, Entropy and direction: The second law-A directional law of nature, Entropy and Disorder, Absolute Entropy, Entropy and Information theory, Postulatory thermodynamics.

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. **10 hrs.**

UNIT - 5

a) Pure substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled 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. **6 hrs.**

Text Books:

1. "Basic and Applied Thermodynamics" by P .K. Nag, Tata McGraw Hill, 3rd Edi. 2002

2. "Thermodynamics an engineering approach", by Yunus A. Cenegal and Michael A. Boles. Tata McGraw hill Pub. 2002.

Reference Books:

1. Engineering Thermodynamics. By Rajput, Laxmi Publications pvt ltd., 3rd Edi. 2007.

2. Engineering Thermodynamics by J.B. Jones and G.A.Hawkins, John Wiley and Sons.

3. Thermo Dynamics by S.C.Gupta, Pearson Edu.Pvt. Ltd., 1s t Ed. 2005.

4. Fundamentals of Classical Thermodynamics by Gordon J.Van Wylan & Richard.E.Sonntagg, Wily Eastern Ltd., New Delhi/Bangalore.

Scheme of Examination:

One Question from each unit and internal choice must be given in unit 1 & 3.

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III SEMESTER : MECHANICAL ENGINEERING

Subject	COMPUTER AIDED MACHINE DRAWING	Sub. Code	09 MI3 GC CMD
Credits	04	L-T-P	2-2-2

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. **08 Hrs**

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. **08 Hrs**

Chapter 3 –Threaded Fasteners: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread. Etc.

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. **08 Hrs**

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:

1. Machine Drawing" by K.R.Gopalkrishna, 20th Edition, Subhas stores, 2007.
2. "Machine Drawing" by Sri N.D.Bhat & V.M.Panchal, 42nd Edition, Charotar Publishing House,2007.
3. "Machine Drawing" by N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata Mc GrawHill,2006.

Reference Book:

1. "Machine Drawing with Auto CAD". Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005.
2. "Auto CAD 2006, for engineers and designers". Sham Tickoo. Dream tech 2005

Scheme of evaluation:

CIE:

Lab Components (using computers) – 25 marks.

CIE (Manual Drafting) – 10 marks

Drawing Sheets – 15 marks

SEE : 100 Marks by Manual Drafting

One questions from Sections of Solids : 25 marks.

One question from Unit 3 : 75 marks.

TOTAL :100 marks

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IV SEMESTER : MECHANICAL ENGINEERING

Subject	APPLIED THERMODYNAMICS	Sub. Code	09 ME 4DC ATD
Credits	05	L-T-P	3-2-2

UNIT - 1

a) Exergy & Irreversiblity: 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 and Gouy-Stodola Theorem, Availability of Exergy Balance, Second Law efficiency,

Comments on Exergy. **07 Hrs**

UNIT - 2

a) Gas Power cycles, Gasturbine : Carnot cycle, Stirling cycle, Ericsson cycle, Air standard cycle, Otto cycle, Diesel cycle, Limited pressure cycle, Mixed cycle or Dual cycle, Comparison of Otto, Diesel and Dual cycles, Brayton cycle, Aircraft propulsion, Brayton-Rankine Combined cycle.

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, Reheat-regenerative cycle, Feed water Heaters, **13 Hrs**

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 humidifies 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

a) Reciprocating compressors: Operation of a single stage reciprocating compressors. Work input through p-v diagram and steady state steady flow analysis. Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, Saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression. **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 Sl and CI engines for performance, related numerical problems, heat balance, Morse test **08 Hrs**

UNIT - 6

Lab components must comprise of experiments that reinforce the theoretical understanding of the corresponding theory subject. Outlines of the laboratory components should be mentioned by the respective staff members well before the commencement of the course.

Text Books:

1. "Basic and Applied Thermodynamics" by P .K. Nag, Tata McGraw Hill, 3rd Edi. 2002
2. Fundamentals of Thermodynamics by G.J. Van Wylen and R.E. Sonntag, Wiley Eastern.

Reference Books:

1. Thermodynamics an engineering approach, by Yunus A. Cenegal and Michael A. Boles. Tata McGraw hill Pub. 2002.
2. Engineering Thermodynamics. By Rajput, Laxmi Publications pvt ltd., 3rd Edi. 2007.
3. Engineering Thermodynamics by J.B. Jones and G.A.Hawkins, John Wiley and Sons.
4. An Introduction to Thermo Dynamics by Y.V.C.Rao, Wiley Eastern Ltd.,
5. Thermodynamics by Radhakrishnan.
6. Thermodyanmics for Enginees by Michel Sadd.
7. I.C Engines by Ganeshan.V. Tata McGraw Hill, 3rd Edi. 2002.
8. I.C.Engines by M.L.Mathur & Sharma.

Scheme of Examination:

One Question from each unit and internal choice must be given in unit 2 & 3.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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IV SEMESTER : MECHANICAL ENGINEERING

Subject	KINEMATICS OF MACHINES	Sub. Code	09 ME 4DCKOM
Credits	04	L-T-P	4-0-0

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. **06 Hrs**

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. **07 Hrs**

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. **10 Hrs**

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. **06 Hrs**

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. 06 Hrs

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. **06 Hrs**

Text Books:

1. Rattan S.S, "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition -2005.
2. Sadhu Singh, "Theory of Machines," Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2ND Edi. 2006.
3. Jagadish Lal, 'Theory of Machine', Dhanpat Rai Publications, New Delhi.

Reference books:

1. Shigley. J. V. and Uickers, J.J., "Theory of Machines & Mechanisms" OXFORD University press.2004
2. "Theory of Machines -I", by A.S.Ravindra, Sudha Publications, Revised 5th Edi. 2004.
3. Design of Machine Elements: M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh,Pearson Education, 2006.
4. Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, TataMcGraw Hill Publishing Co. Ltd., New Delhi, Special Indian Edition, 2008.
5. Fundamentals of Machine Component Design: Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt.Ltd., New Delhi, 3rd Edition, 2007.

Scheme of Examination:

2 questions each from Unit 1 & 2, one question each from Units 3, 4 & 5.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

IV SEMESTER : MECHANICAL ENGINEERING

Subject	MANUFACTURING PROCESS-II	Sub. Code	09 ME4DC Mp2
Credits	04	L-T-P	3-0-2

UNIT – 1

Theory of Metal Cutting: Single point cutting tool nomenclature, Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis, 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. **6 Hrs.**

Cutting tool materials: Desired properties, types of cutting tool materials – HSS, carbides coated carbides, ceramics, cutting fluids: Desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation, Heat distribution in tool and W/P, Measurement of tool tip temperature. **5 Hrs.**

UNIT-2

Production Lathe: Classification of Lathes, Capstun & Turret lathes-Constructional features, tool layout, tool and work holding devices.

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. **6 Hrs.**

Drilling machines: Classification, constructional features, drilling & related operations, types of drill & drill bit nomenclature, drill materials. Calculation of machining time. **6 Hrs**

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UNIT – 3

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 numericals on indexing. Broaching machines: Classification, Construction and principle of operations **8 Hrs.**

UNIT – 4

Grinding, Laping and Honing machines: Types of abrasives, bonding process, classification, constructional features (cylindrical and surface grinding, centre less grinding), selection of grinding wheel. Laping and Honing: Principles of operation, construction, applications. **6 Hrs.**

UNIT – 5

Non-traditional machining processes: Principle, need, equipment, operation and LBM, plasma arc machining, Electro chemical machining, ultrasonic machining, abrasive let machining, water jet machining. **6 Hrs.**

UNIT - 6

Lab components must comprise of experiments that reinforce the theoretical understanding of the corresponding theory subject. Outlines of the laboratory components should be mentioned by the respective staff members well before the commencement of the course.

Text Books:

1. Workshop Technology by Hazara Choudhry, Vol-II, Media Promoters & Publishers Pvt. Ltd. 2004
2. Production Technology by R.K.Jain, Khanna Publications, 2003.
3. Production technology by HMT, Tata MacGraw Hill, 2001.

Reference Books:

1. Manufacturing Science by Amitabha Ghosh and Mallik, affiliated East West Press, 2003.
2. Fundamentals of Metal Machining and Machine Tools by G. Boothroyd, McGraw Hill, 2000.

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 & 6.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

IV SEMESTER : MECHANICAL ENGINEERING

Subject	FLUID MECHANICS	Sub. Code	09 ME 4DC FME
Credits	04	L-T-P	4-0-0

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. Types of Fluids.

Fluid pressure at a point, Pascal's law, pressure variation in a static fluid in 2D, Absolute, gauge, atmospheric and vacuum pressures **10 Hrs**

UNIT - 2

Fluid Statics

Types of Manometers, 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. **10 Hrs**

UNIT - 3

Fluid Kinematics and Dynamics

Types 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. **10 Hrs**

UNIT - 4

Fluid flow measurements

Introduction, Vena-contracta, Jet of water, 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, Hagen poiseulle's equation, Bend losses, Change of section losses. **10 Hrs**

UNIT - 5

Laminar flow and viscous forces, Dimensional Analysis

Reynold's number, critical reynold's number, Laminar flow through parallel stationery plates.

Drag, Lift, expression for lift and drag, pressure drag and friction drag, boundary layer concept, Mach number.

Dimensional Analysis- Rayleigh's method, Buckingham ∏ theorem, dimensionless numbers. **12 Hrs**

Unit - 6. FLUID FLOW Lab. **Hours / Week = 2**

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
4. Calibration of flow measuring devices
    a. Orifice Plate meter
    b. Nozzle
    c. Venturimeter
    d. V-notch

Text Books:

1. Fluid Mechanics by Dr. Bansal.R.K, Lakshmi Publications.
2. Hydraulics, Fluid Mechanics and Fluid Machines, S Ramamrutham, Dhanpat Rai pub co.,

Reference books:

1. Fluid Mechanics ,and Hydraulics Machines by R.K Rajput, S.Chand & Company.
2. A Textbook of Hydraulics Fluid Mechanics & Hydro Machines by Khurmi R.S, S.Chand & Co
3. Fluid Mechanics and Hydraulics, Dr. Jagadishlal: Metropolitan Book Co-Ltd.
4. Fluid Mechanics, Fundamental & applications, by Yunus A, Cenegel, John M,Cimbala, Tata McGraw Hill, 2006.

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

IV SEMESTER : MECHANICAL ENGINEERING

Subject	DESIGN OF MACHINE ELEMENTS - I	Sub. Code	10ME4DC Dm1
Credits	04	L-T-P	3-2-0

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**

Design of Keys & Cotter joints: Keys: Types of keys, Design of keys and cotter joints, Design of splines. **4 Hrs**

UNIT 4

Couplings: Rigid and flexible couplings: Flange coupling, Bush and Pin type coupling. **3 Hrs**

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:

1. Design Data Hand Book – K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
2. Design Data Hand Book by K. Mahadevan and Balaveera Reddy, CBS Publication
3. Machine Design Data Hand Book by H.G. Patil, Shri Shashi Prakashan, Belgaum.
4. PSG design data handbook by PSG College of Technology, Coimbatore

TEXT BOOKS

1. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.
2. Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

REFERENCE BOOKS:

1. Machine Design: Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements: M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. Fundamentals of Machine Component Design: Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

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)

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	MANAGEMENT & ENTREPRENEURSHIP	Sub. Code	11 ME 5DC MAE
Credits	04	L-T-P	4-0-0

Unit –1

Management : Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management – Management as a science, art or profession – Management & Administration, Development of Management Thought – early management approaches – Modern management approaches. **7hours**

Planning : Nature, importance and purpose of planning process – objectives – Types of plans (Meaning only) – Decision making – Importance of planning – steps in planning & planning premises – Hierarchy of plans. **7 hours**

Unit – 2

Organising and Staffing : Nature and purpose of organization – principles of organization – Defination – Personnel management, Concept – Aims and Objectives – Recruitment and selection – Selection process technique – Training –methods of training – Span of control – MBO and MBE (Meaning only) Nature and importance of Staffing **7 hours**

Unit – 3

Directing &Controlling :Meaning and nature of directing – Leadership styles, Motivation Theories, Communication – Meaning and importance – Coordination, meaning and importance and Techniques of Co-ordination. Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief). **8 hours**

Unit – 4

Entrepreneur : Meaning of Entrepreneur, Evolution of Concept, Functions of Entrepreneur, Types of Entrepreneur, Entrepreneur – an emerging class. Concept of Entrepreneurship – Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of Entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers. **8 hours**

Unit – 5

Small Scale Industry :Definition; Characteristics; Need and rationale : Objectives, Scope, role of SSI in Economic Development. Advantages of SSI. Steps to start an SSI – Government policy towards SSI, Different Policies of SSI., Government Support on SSI., during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI.Effect of WTO / GATT Supporting Agencies of Government for SSI Meaning.Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only).

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)
3. **Entrepreneurship Development – Small Business Enterprises –** Poornima M. Charantimath – Pearson Education – 2006 (2&4).

REFERENCE BOOKS:

1. **Management Fundamentals – Concepts, Application, Skill Development –** Robert Lusier – Thomson (Ch.1,4,12).
2. **Entrepreneurship Development –** SS Khanka – S Chand & Co. (Chap 1, 2, 5, 11, 12, 13, 16, 18, 20)
3. **Management – Stephen Robbins –** Pearson Education / PHI – 17th Edition, 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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	DESIGN OF MACHINE ELEMENTS-II	Sub. Code	11 ME 5DC Dm2
Credits	04	L-T-P	3-2-0

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). **5 Hours**

Springs: Types of springs - stresses in Helical coil springs of circular and non-circular cross sections. Tension and compression springs, springs under fluctuating loads, Leaf Springs: Stresses in leaf springs. Equalized stresses, – Energy stored in springs. **6 Hours**

UNIT 2

Clutches & Brakes: Design of Clutches: Single plate, multi plate and cone clutches. Design of Brakes: Block and Band brakes: Self locking of brakes: Heat generation in Brakes. **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. **7Hours**

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. **6 Hours**

UNIT 4

Lubrication and Bearings: Mechanisms of Lubrication, bearing modulus, coefficient of friction, minimum oil film thickness, Heat Generated, Heat dissipated, Numericals on journal bearing and thrust bearing design. **6 Hours**

UNIT 5

Belts Ropes and Chains: Flat belts: Length & cross section, Selection of V-belts, ropes and chains for different applications. **6 Hours**

Design Data Hand Books:

1. **Design Data Hand Books –** K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
2. **Design Data Hand Book by** K. Mahadevan and K.Balaveera Reddy, CBS Publication

TEXT BOOKS:

1. **Mechanical Engineering Design:** Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.
2. **Design of Machine Elements:** V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

REFERENCE BOOKS:

1. **Machine Design:** Robert L. Norton, Pearson Education Asia, 2001.
2. **Design of Machine Elements:** M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. **Machine Design:** Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S. K. Somani, Tata McGraw Hill Publishing Co. Ltd., New Delhi, Special Indian Edition, 2008.
4. **Machine Design:** Das J.B.K and Murthy PLS ,Sapna publications.2009

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.

Subject	MECHANICAL MEASUREMENTS & METROLOGY	Sub. Code	11 ME 5DC MMM
Credits	04	L-T-P	3-0-2

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**

Comparators: Introduction to Comparator, Characteristics, classification of comparators, mechanical comparators - Johnson Mikrokator, Sigma Comparator, dial indicator, Optical Comparators -principles, Zeiss ultra optimeter, Electric and Electronic Comparators - principles, LVDT, Pneumatic Comparators - Principles, Solex Comparator. **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**

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. **5Hrs**

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, Mc Leod gauge, Pirani Gauge. Bridgeman gauge.

4 Hrs

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.

4 Hrs

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

6. Measurements using Optical Projector / Toolmaker Microscope.
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)
11. Measurements of Surface roughness. Using Tally surf/mechanical Comparator.
12. Measurements of gear tooth profile using gear tooth vernier.
13. Calibration of micrometer using slip gauges **12 Hrs.**

Text Books:

1. "Mechanical measurements" Beckwith Marangoni and Lienhard, Pearson Education, 6 th Ed., 2006.
2. "Engineering Metrology" R.K.Jain, Khanna Publishers, 1994.

Reference Books:

1. "Engineering Metrology" I.C.Gupta, Dhanpat Rai Publications, Delhi
2. Measurements Systems, Applications & Design, by Ernen O Dobeblein, 5TH ed.
3. Mechanical Measurements, R.S.Shrohi & H.C.Radhakrishna, 3rd Ed., New Age Intl.Pvt Ltd.,

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	DYNAMICS OF MACHINES	Sub. Code	11 ME 5DC DOM
Credits	04	L-T-P	3-2-0

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.7Hour

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 **5 Hours**

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. **6 Hours**

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. **6 Hours**

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 **6 Hours**

TEXT BOOKS:

1. Theory of Machinesand mechanisms: Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd., New Delhi, 2nd Edition, 1999.

2. Theory of Machines: Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2006.

REFERENCE BOOKS:

1. Theory of Machines by Thomas Bevan, CBS Publication 1984.

2. Kinematics & Dynamicsof Machinery by Robert L. Norton, McGraw Hill, 2009.

3. Theory of Machines by P.L.Ballaney, Khanna publishers, New Delhi, 16th Edition, 1988.

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.

Subject	TURBO MACHINES	Sub. Code	11 ME 5DC TUM
Credits	05	L-T-P	3-2-0

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 fo 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. **12 Hours**

TEXT BOOKS:

1. An Introduction to energy conversion, Volume III – Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers (P) Ltd.
2. Turbines, Compressors & Fans, S. M. Yahya, Tata-McGraw Hill Co., 2nd Edition (2002).

REFERENCE BOOKS:

1. Principles of Turbo Machinery, D. G. Shepherd, The Macmillan Company (1964)
2. Fundamentals of Turbo machinery: William W Perg, John Wiley & Sons, Inc. 2008.

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

Subject	TURBO MACHINES LABORATORY	Sub. Code	11 ME 5DLTUM
Credits	01	L-T-P	0-0-3

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

2 Performance testing of Pumps
   a. Single stage / Multi stage centrifugal pumps
   b. Reciprocating pump

3. Performance test of a two stage Reciprocating Air Compressor

4. Performance test on an Air Blower

TEXT BOOKS:

1. **An Introduction to energy conversion,** Volume III – Turbo machinery, V. Kadambi
and Manohar Prasad, New Age International Publishers (P) Ltd.
2. **Turbines, Compressors & Fans,** S. M. Yahya, Tata-McGraw Hill Co., 2nd Edition (2002).

REFERENCE BOOKS:

1. **Principles of Turbo Machinery,** D. G. Shepherd, The Macmillan Company (1964)
2. **Fundamentals of Turbo machinery:** William W Perg, John Wiley & Sons, Inc. 2008.

Scheme of Evaluation for SEE	
	30 marks
	10 marks
Viva-voce	10 marks
Total	**50 marks**

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	THEORY OF ELASTICITY	Sub. Code	11 ME 5DEA TOE
Credits	04	L-T-P	4-0-0

UNIT - 1

Introduction : Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions. **7 Hours**

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. **10 Hours**

Uniqueness theorem, Principle of super position, reciprocal theorem, Saint Venant principle. **2 Hours**

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. **9 Hours**

UNIT - 4

GENERAL EQUATIONS IN CYLINDRICAL CO-ORDINATES: Thick cylinder under uniform internal and / or external pressure, shrink and force fit, **7 Hours**

Stresses in an infinite platewith a circular hole subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders. **7 Hours**

UNIT – 5

TORSION OF CIRCULAR, ELLIPTICAL AND TRIANGULAR BARS: membrane analogy, torsion of thin open sections and thin tubes. **6 Hours**

TEXT BOOKS:

1**. Advanced Mechanics of solids,** L. S. Srinath, Tata Mc. Graw Hill,2003
2. **Theory of Elasticity:** S. P. Timoshenko and J. N Gordier, Mc.Graw Hill International, 3rd edition, 1972

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
4. **Applied Elasticity,** C.T. WANG Sc. D. Mc. Graw Hill Book Co.1953

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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	INTERNAL COMBUSTION ENGINES	Sub. Code	11 ME5 DEA ICE
Credits	04	L-T-P	4-0-0

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

CARBURATION AND COMBUSTION PROCESS IN S.I. ENGINES: Mixture requirements in S.I engine. Simple Carburetor and its limitations. Knock free and knocking combustion-Theories of combustion process in S.I. engines. Effect of Knock on engine

performance.Effect of operating variables on knocking. Knock rating of fuels-octane number. HUCR values. Anti knock agents - Pre ignition - Post ignition.

COMBUSTION IN C.I. ENGINES: Ricardo's three stages of combustion process in C.I. engines. Delay period & factors affecting delay period. Diesel knock- Methods of controlling diesel knock. Knock rating of Diesel fuels. **15 Hours**

UNIT - 3

COMBUSTION CHAMBERS: Requirements of combustion chambers. Features of different types of combustion chambers system for S.I. engine.I-head, F-head combustion chambers. C.I. engine combustion chambers-Air swirl turbulence-M. type combustion chamber. Comparison of various types of combustion chambers. **7 Hours**

UNIT - 4

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

FUEL INJECTION SYSTEMS: Diesel injection systems jerk pump injectors, Nozzles of different types, Petrol injection systems for S.I. engines. Electronic fuel injection system.Cooling system- Water cooling, air cooling & liquid cooling-role of thermostats-radiator construction. **14 Hours**

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 9 Hours

TEXT BOOKS:

1. **A course in I.C. Engines,** M. L. Mathur and R. P. Sharma, Dhanpat Rai Pub, 2001.
2. **Internal Combustion Engines,** Colin R. Ferguson C. John Wiley & sons, 1986

REFERENCE BOOKS:

1. **I.C. Engines, Edward. F. Obert,** Harper International edition, 1973.
2. **Internal Combustion Engines,** Ganeshan, Tata McGraw Hill, 2nd Edition, 2003.
3. **Engineering Fundamentals of the I.C. Engine,** Willard W. Pulkrabek. 1998.
4. **Combustion Engine Process,** Lichty, Judge 2000

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 .

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	STATISTICAL QUALITY CONTROL	Sub. Code	11 ME5DEASQC
Credits	04	L-T-P	4-0-0

1. Use of Statistical quality control table is permitted in the examination

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). **06 Hours**

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. **08 Hours**

METHODS OF STATISTICAL PROCESS CONTROL: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

06 Hours

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.

08 Hours

UNIT - 4

PROCESS CAPABILITY: The foundation of process capability, Natural Tolerance limits, cp – process capability index, cpk, pp – process performance index, summary of process measures. Numerical problems. **06 Hours**

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 **09 Hours**

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 **09Hours**

TEXT BOOKS:

1. **Statistical Quality Control,** E.L. Grant and R.S. Leavenworth, 7th edition, McGraw- Hill publisher.
2. **Statistical Quality Control,** RC Gupta, Khanna Publishers, New Delhi, 2005

REFERENCE BOOKS:

1. **Statistical Process Control and Quality Improvement,** Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
2. **Statistical Quality Control for Manufacturing Managers,** W S Messina, Wiley & Sons, Inc. New York, 1987
3. **Statistical Quality Control,Montgomery,** Douglas, 5th Edition, John Wiley & Sons, Inc. 2005, Hoboken, NJ (ISBN 0-471-65631-3).
4. **Principles of Quality Control,** Jerry Banks, Wiley & Sons, Inc. New York.

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

Subject	REFRIGERATION & AIR CONDITIONING	Sub. Code	11ME5DEA RAC
Credits	04	L-T-P	4-0-0

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

8Hours

UNIT – 2

GAS CYCLE REFRIGERATION: Introduction , reverse Carnot cycle, Bell Coleman cycle, advantages & dis-advtanges 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. **8 Hours**

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 construction, Expansion devices: Types- Automatic expansion valve, Thermostatic expansion valves, capillary tube. Sizing Evaporator: Types & construction. **14 Hours**

UNIT - 4

VAPOURABSORPTION SYSTEM: Common refrigerant absorbent combinations, Binary mixtures, Ammonia Water Absorption system, Actual vapour absorption cycle and its representation on enthalpy-composition diagram, calculations. Triple fluid vapour absorption refrigeration system. Water - Lithium Bromide absorption chiller. **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:

1. **'Refrigeration and Air-Conditioning'** by C. P. Arora, Tata McGraw Hill Publication, 2nd edition, 2001.
2. **'Refrigeration and Air-Conditioning'** by W. F. Stoecker, Tata McGraw Hill Publication, 2nd edition, 1982.

REFERENCE BOOKS:

1. **'Principles of Refrigeration'** Dossat, Pearson-2006.
2. **'Heating,Ventilation and Air Conditioning'** by McQuistion, Wiley Students edition, 5th ed 2000.
3. **'Air conditioning'** by PITA, 4th edition, pearson-2005
4. **'Refrigeration and Air-Conditioning'** by Manohar prasad
5. **'Refrigeration and Air-Conditioning'** by S C Arora & S Domkundwar, Dhanpat Rai 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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	OPERATION MANAGEMENT	Sub. Code	11ME5DEA OPM
Credits	04	L-T-P	4-0-0

UNIT - 1

0PERATIONS MANAGEMENT CONCEPTS: Introduction, Historical Development, Operations Management Definition, Production and Manufacturing Systems, Products v/s Services, Productivity, Factors affecting Productivity, International Dimensions of Productivity, The environment of operations, Operational excellence and world class manufacturing practices.

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 **6 Hours**

UNIT - 5

MATERIAL AND CAPACITY REQUIREMENTS PLANNING:

Overview: MRP and CRP, MRP: Underlying Concepts, System Parameters, MRP Logic, System refinements, Capacity Management, CRP activities. Concept of continuous improvement of process. **6 Hours**

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. **8 Hours**

TEXT BOOKS:

1. Operations Management, I. B. Mahadevan. Theory and practice, Pearson, 2007.
2. Operations Management, Monks, J.G., McGraw-Hili International Editions, 1987.

REFERENCE BOOKS:

1. Modern Production/Operations Management, Buffa, Wiley Eastern Ltd.2001
2. Production and Operations Management, Pannerselvam. R., PHI. 2002
3. Productions & Operations Management, Adam & Ebert. 2002
4. Production and Operations Management, Chary, S. N., Tata-McGraw Hill. 2002

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.

Subject	NON TRADITIONAL MACHINING	Sub. Code	11 ME5DEANTM
Credits	04	L-T-P	4-0-0

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. **8 Hours**

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, imitations & application of CHM. **7 Hours**

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, imitations & application of EDM, EDM accessories / applications, electrical discharge grinding, models for material removal rates (MRR), Traveling wire EDM. **8 Hours**

PLASMA ARC MACHINING AND LASER BEAM MACHINING: Introduction, equipment, mechanism of metal removal, process parameters, process characteristics, advantages, imitations & applications. **7 Hours**

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:

1. Modern machining process, Pandey and Shan, Tata McGraw Hill 2000
2. New Technology, Bhattacharya 2000

REFERENCE BOOKS:

1. Production Technology, HMT Tata McGraw Hill. 2001
2. Nontraditional manufacturing Processes, Geoffrey Boothroyd, Marcel Dekker, 1987
3. Advanced methods ofMachining, 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.

DEPARTMENT OF MECHANICAL ENGINEERING.

Subject	COST ESTIMATION & ENGINEERING ECONOMICS	Sub. Code	11ME5DEACEE
Credits	04	L-T-P	4-0-0

INSTRUCTION: USE OF DISCRETE COMPOUNDING INTEREST FACTORS TABLE IS PERMITTED IN EXAMS

UNIT – 1

INTRODUCTION: Engineering Decision-Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Engineering Economic Decision, Maze. Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion. **08 Hours**

UNIT – 2

PRESENT-WORTH COMPARISONS: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Present-worth, Assets with unequal lives, infinite lives, Future-worth comparison, Pay-back comparison, Exercises, Discussions and problems. **07 Hours**

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. **07 Hours**

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 Statements of Financial Information: Source of financial information-Book keeping, Journal, Ledger, Trial balance. Financial statements: Trading account, Profit and Loss account, Balance sheet, relation between Balance sheet and Profit and Loss account. 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:

1. **Engineering Economy,** Riggs J.L., , McGraw Hill, 2002
2. **Industrial Engineering and Management,** OP Khanna, Dhanpat Rai & Sons. 2000

REFERENCE BOOKS:

1. **Engineering Economy,** Tarachand, Nem Chand & Bros, 2000.
2. **Financial Mangement,** Prasanna Chandra, TMH, 2004
3. **Financial Management,** IM PANDEY, Vikas Publishing House, 2002
4. **Engineering Economy,** Thuesen H.G,. PHI , 2002

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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	ENERGY ENGINEERING	Sub. Code	11ME5DEA ENE
Credits	04	L-T-P	4-0-0

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 schmidt stam 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. **15 Hours**

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. **7 Hours**

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:

1. **Power Plant Engineering,** P. K. Nag Tata McGraw Hill 2nd edn 2001.
2. **Power Plant Engineering,** Domakundawar, Dhanpath Rai sons. 2003

REFERENCE BOOKS:

1. **Power Plant Engineering,** R. K. Rajput, Laxmi publication, New Delhi.
2. **Principles of Energy conversion,** A. W. Culp Jr., McGraw Hill. 1996
3. **Non conventional Energysources,** G D Rai Khanna Publishers.
4. **Non conventional resources:** B H Khan TMH – 2007

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING.

Subject	APPLIED ELECTRONICS AND MICROPROCESSOR	Sub. Code	11ME5DEAAEU
Credits	04	L-T-P	4-0-0

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. **05 Hrs.**

UNIT - 6

Lab. Experiments: 13 x 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 :

1. Gaonkar, "Microprocessor Architecture programming and application," Wiley Eastern Ltd.,New Delhi.
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
2. Introduction to Microprocessors by A.P.Mathur, Tata McGraw Hill Pub. Co., New Delhi.
3. Digital Fundamentals by Maris and Melvino.

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.

Subject	HEAT & MASS TRANSFER	Sub. Code	12ME6DC HMT
Credits	04	L-T-P	3-2-0

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,spheres, composite planes, cylinders 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.

HEAT TRANSFER IN EXTENDED SURFACES: Introduction, Heat transfer through rectangular fin: Infinitely long fin, short fin with insulated tip and without insulated tips. Fin efficiency and effectiveness. Numerical problems.

TRANSIENT CONDUCTION: Lumped parameter analysis, Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere; Numerical Problems. **17 Hours**

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). **03 Hours**

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. **06 Hours**

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. **07 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. **05Hours**

UNIT - 5

MASS TRANSFER: Mass transfer definition and its modes, concentration, velocities and fluxes; Ficks law of diffusion with numericals. Geneal mass diffusion equation in stationary media, steady state diffusion through a plain membrane, steady state equimolar counter diffusion, isothermal evoperation of water into air from a surface, convective mass transfer and correlations. **06 Hours**

TEXT BOOKS:

1. **Heat transfer-A basic approach,** Ozisik, Tata Mc Graw Hill 2002
2. **Heat transfer by Suchdev. R.C,** New Age Internatinal Pub, 2001.

3. **Fundamentals of heat and mass transfer,** Frenk P. Incropera and David P. Dewitt, John Wiley and son's.

REFERENCE BOOKS:

1. **Heat transfer,** a practical approach, Yunus A- Cengel Tata Mc Graw Hill
2. **Principles of heat transfer,** Kreith Thomas Learning 2001
3. **Heat transfer,** P.K. Nag, Tata Mc Graw Hill 2002.

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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	MECHANICAL VIBRATION	Sub. Code	11ME6DCMEV
Credits	04	L-T-P	3-2-0

UNIT 1

Introduction:

Types of vibrations, SHM, principle of super position applied to Simple Harmonic Motions (simple problems).

Continuous systems:

Introduction, longitudinal vibration of rods with fixed -free end and free-free condition **5 Hours**

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. **6 Hours**

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.

6 Hours

UNIT 3

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 exitation and support motion. **6 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. **5 Hours**

UNIT 4

Systems with two degrees of freedom: Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Forced Oscillations-Harmonic excitation. Applications: a) Vehicle suspension. b) Dynamic vibration absorber. **6 Hours**

UNIT 5

Numerical methods for Multi degree Freedom systems:

Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation.Matrix iteration-Method, Holzer's method, Stodola method. **6 Hours**

TEXT BOOKS:

1. **Mechanical Vibrations:** V.P. Singh, Dhanpat Rai & Company Pvt. Ltd., 3rd edition, 2006.
2. **Mechanical Vibrations:** G.K. Grover, Nemchand & Bros, Roorkee -1996

REFERENCE BOOKS:

1. **Mechanical Vibrations:** S.S. Rao, Pearson Education Inc, 4th Edition, 2003.
2. **Mechanical Vibrations:** S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007.
3. **Theory & Practice of Mechanical vibrations:** J.S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.

4. **Theory of Vibration with Applications:** W.T. Thomson and Marie Dillon Dahleh, Pearson Education 5th edition, 2007.
5. **Elements of Vibrations Analysis:** Leonanrd Meirovitch, Tata McGraw Hill, Special Indian edition, 2007.

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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	MODELLING & FINITE ELEMENT ANALYSIS	Sub. Code	11ME6DCMFE
Credits	04	L-T-P	4-0-0

UNIT - 1

Fundamental concepts: Principles of Elasticity: stresses-principal, maximum shear and Vonmises stresses, Equilibrium equations, strain displacement relationships in matrix form – Constitutive relationships for plane stress, plane strain , Axi-symmetric and 3D. Boundary conditions. **06 Hrs**

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 . **08 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 . **03 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. **08 Hrs**

UNIT -3

Local and Global co-ordinate systems, Trusses – assumptions, formulation of Truss element, Hermite functions, formulation of beam.Numericals on Trusses and beams. **06 Hrs**

UNIT -4

Formulation of triangular and quadrilateral elements.Introduction to axis symmetric –formulation of axis symmetric triangular elements. **08 Hrs**

Iso parametric, sub parametric and super parametric elements. Convergence criteria-requirements of convergence of a displacement model 3D elements, Pascal pyramid,tetrahedral and hexahedral elements- displacement models and shape functions.Higher order elements in bar, triangular ,quadrilateral elements-displacement models and shape functions (no formulations). **05 Hrs**

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:

1. **Introduction to Finite Elements in Engineering",** T. R. Chandrupatla and A. D. Belegundu, "2nd Edition, Prentice Hall, India, 2003.
2. **The Finite Element Method in Engineering,** S.S. Rao, 4th Edition, Elsevier, 2006.

REFERENCE BOOKS:

1. **Finite Element Procedures.** Bathe, K. J., Cambridge, 2007. ISBN: 9780979004902.
2. **Concepts and Applications of Finite Element Analysis** by Robert D.Cook, DavidS. Malkus and Michael E.Plesha. John Wiley & Sons.2003.
3. **Finite Element Method,** J.N.Reddy, McGraw –Hill International Edition.
4. **Finite Element Methods,** by Daryl. L. Logon, Thomson Learning 3rd edition, 2001.
5. **Finite Element Analysis,** C.S.Krishnamurthy,–Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1995.
6. **Text book of Finite Element analysis** by P.Seshu–Prentice Hall of India

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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	HYDRAULICS & PNEUMATICS	Sub. Code	11ME 6DC HAP
Credits	05	L-T-P	4-0-1

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 CONTORL 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

INTRODUCTION TO PNEUMATIC CONTROL: Compressed air:Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout. Characteristics of compressed air.Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod–less cylinders, types, working advantages. Rotary cylinder types construction and application. Design parameters, selection. **6 Hours**

ELECTRO-PNUEMATICS: Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve.Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve. Electro-Pneumatic control:Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. **7 Hours**

UNIT-6 LAB COMPONENT

1. Development of basic hydraulic circuits using power generating, controlling, utilizing elements and accessories
2. Development of basic pneumatic circuits using power generating, controlling, utilizing elements and accessories **13 Hours**

TEXT BOOKS:

1. **Fluid Power with applications,** Anthony Esposito, Fifth edition pearson education, Inc. 2000.
2. **Pneumatics and Hydraulics,** Andrew Parr. Jaico Publishing Co. 2000.

REFERENCE BOOKS:

1. **Oil Hydraulic Systems - Principles and Maintenance,** S.R. Majumdar, Tata Mc Graw Hill publishing company Ltd. 2001.
2. **Pneumatic Systems,** S.R. Majumdar, Tata Mc Graw Hill publishing Co., 1995.
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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	MINI PROJECT/INTERNSHIP	Sub. Code	11ME 6DC PWI

Teaching scheme 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 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 6th 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 examiners.

11. 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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	DESIGN LABORATORY	Sub. Code	12ME6DLDES
Credits	01	L-T-P	0-0-3

PART - A

1. Determination of Fringe constant of Photoelastic material using.
   a) Circular disc subjected to diametral compression.
   b) Pure bending specimen (four point bending)

2. 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.

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.

PART - B

5. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)

6. Determination of Frequencies and mode shapes of cantilever beam

7. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proel /Hartnel Governor.

8. Determination of Pressure distribution in Journal bearing.

9. Experiments on Gyroscope .

Scheme of Evaluation for SEE	
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**

Subject	HEAT & MASS TRANSFER LABORATORY	Sub. Code	12ME6DLHMT
Credits	01	L-T-P	0-0-3

PART - A

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in a free Convection on a vertical/horizontal tube.
5. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.
6. Determination of Emissivity of a Surface.

Total: 21 Hours

PART - B

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
10. Performance Test on a Vapour Compression Refrigeration.
11. Performance Test on a Vapour Compression Air - Conditioner
12. Experiment on Transient Conduction Heat Transfer.

Total: 21 Hours

Scheme of Evaluation for SEE	
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**

Subject	THEORY OF PLASTICITY	Sub. Code	11 ME 6DEB TOP
Credits	04	L-T-P	4-0-0

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**

COMPUTATIONAL PLASTICITY :1-D Mathematical Model: Yield Criterion. Flow Rule. Loading / Unloading Conditions. Isotropic and Kinematic,Hardening Models. 1-D Elasto-Plastic Boundary Value Problem. Computational Aspects of 1-D Elasto-Plasticity: Integration Algorithms for 1-D Elasto-Plasticity. **8 Hours**

TEXT BOOKS:

1. **Theory of Plasticity,** Sadhu Singh, Khanna publisher
2. **Engineering plasticity :** Theory and application to metal forming ,Slater, R. A. C. Macmillan, London , 1977

REFERENCE BOOKS:

1. **Basic Engineering Plasticity,** DWA Rees 1st Edition Elsevier.
2. **Computational Methods for Plasticity:** Theory and Applications, E. A. de Souza Neto, D. Perić, D. R. J. Owen John Wiley & Sons, Ltd 2008 ISBN: 9780470694527

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

Subject	SOLAR ENERGY	Sub. Code	11 ME 6DEB SOE
Credits	04	L-T-P	4-0-0

UNIT - 1

INTRODUCTION: Energy sources, Renewable energy sources, Renewable energy potential and achievements in India, General characteristics of solar energy; the Sun, solar spectrum, spectral solar impedance. Solar constant beam, diffuse and global radiation.Solar radiation data of India.Measurement of solar radiation. **6 Hours**

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 RADIATION MEASURING DEVICES: Pyronometer, Pyrheliometer, Sunshine recorder (schematic diagram and working principles of the devices.) Flux on a plane surface, Solar radiation on a inclined surface- Beam, diffuse, reflected radiation on a tilted surface, expression for flux on a tilted surface, monthly average hourly and daily radiation on inclined surface. Numerical examples.

SOLAR THERMAL RADIATION DEVICES: Liquid flat plate collectors, solar air heaters, concentrating collectors like cylindrical, parabolic, evacuated tubular collectors. **15 Hours**

UNIT - 3

CONCENTRATORS, TYPES, CLASSIFICATION, TRACKING: Concentration, Non tracking concentrator. Geometrical optics in concentrators:- Ray tracing in a reflecting surface, ray tracing in a refracting surface. Theoretical solar image. Thermal analysis:- Cylindrical parabolic concentrator, Hemispherical Bowl Mirror, V- trough. Tracking Methods:- Three Dimensional Concentrators, Two dimensional concentrators. Materials for concentrators: - Reflecting and Refracting surfaces, receiver cover and surface coating, working fluids, insulation, Numerical problems. **8 Hours**

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. **15 Hours**

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).

SOLAR PHOTOVOLTAIC SYSTEM: Introduction, Description, Principles of working of solar cell:- Doping, Fermi level, p-n junction, photovoltaic effect. Photovoltaic Material:- Single crystal solar cell, Poly crystal solar cell, thin film solar cell, I-V characteristic, limits to cell efficiency, Cell temperature factors affecting PV cell performance Current status and Future potential of P.V. cells. **8 Hours**

TEXT BOOKS:

1. Solar Energy- Principles of thermal collection and storage, S.P Sukhatme, Tata McGraw- Hill publishing company limited, NewDelhi,ISBN 0-07-462453-9.
2. Solar Power Engineering, P. K. Nag THH 2003.

REFERENCE BOOKS:

1. Solar Engineering of thermal processes, Duffie, J.A. and Beckman, W.A., John Wiley and Sons, Netwark (1991)

2. Solar Energy Utilization – G.D.Rai
3. Non Conventional Energy Resources, B.H. Khan- TMH
4. Renewable Energy, Sorensen; Elsvier publications.

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

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	AGILE MANUFACTURING	Sub. Code	11 ME6 DEB AGM
Credits	04	L-T-P	4-0-0

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

AGILE SUPPLY CHAIN MANAGEMENT: Principles, IT/IS concepts in supply chain management, enterprise integration and management in agile manufacturing, concepts, Agility, Adaptability and leanness – comparison of concepts. **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:'

1. **'Agile Manufacturing-** Forging Mew Frontiers', **Poul T Kidd**, Amagow Co. UK, ISBN-0-201-63163-6, 1994
2. **'Agile Manufacturing,** A Gunasekharan, the 21st Century Competitive strategy, ISBN -13 978-0-08-04 3567-1, Elsevier Press, India

REFERENCE BOOKS:

1. **O Levine Transitions to Agile Manufacturing,** Joseph C Moutigomery and Lawrurence – Staying Flexible for competitive advantage, ASQC quality press, Milwaukee. Wisconsiw, USA 1996
2. **Agile Development for Mass Customization,** David M Anderson and B Joseph Pine, Irwin Professional Publishing, Chicogo USa 1997

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.

Subject	ROBOTICS	Sub. Code	11 ME 6DEB ROB
Credits	04	L-T-P	4-0-0

UNIT - 1

Introduction: Automation and robotics, brief history of Robotics, social and economic aspects of robots, advantages & disadvantages of using robots in industries. Overview of robots – present and future applications. **03 Hours**

Classification and structure of robotic system: Classifications, geometrical configurations, wrist and its motions, end effectors and its types, links and joints.

Robot drive systems : Hydraulic, electric and pneumatic drive system, resolution, accuracy and repeatability, advantages and disadvantages of drive systems. **05 Hours**

UNIT - 2

Control systems and components: Basic control system concepts and models, transformation and block diagram of spring mass system, controllers ON and OFF, proportional intergral, proportional and intergral, transient and response to second order system. Robot Actuation and Feedback components: position, velocity sensors, Actuators. **06 Hours**

UNIT - 3

Robot Arm Kinematics: Kinematics – Introduction, direct and inverse kinematics, rotation matrix, composite rotation matrix, rotation matrix about an arbitrary axis, Euler angles representation, homogeneous transformations, links joints and their parameters, D-H representation. **10 Hours**

Robot Arm Dynamics: Lagrange – Euler formulations – Joint velocities, kinetic energy, potential energy and motion equations of a robot manipulator. **08 Hours**

UNIT - 4

Trajectory planning: Introduction, general considerations on trajectory planning, joint interpolated trajectories, 4-3-4 trajectory example. Planning of Cartesian path Trajectories. **08 Hours**

Robot Programming : Introduction, manual teaching, lead through teaching, programming languages – AML and VAL (Simple examples), programming with graphics, storing and operating, Task programs. **04 Hours**

UNIT - 5

Sensors: Internal state sensors, tactile sensors, proximity sensing, range sending and force-torque sensors. Elements of computer vision. Sensing and digitizing function in machine vision – image devices – lighting techniques – analog to digital signal conversion – sampling – quantization – encoding – image storage. Image processing and analysis, Feature Extraction and Object recognition. **08 Hours**

TEXT BOOKS:

1. **Industrial Robotics –** Grovver, Mc Graw Hill 2003.
2. **Robotics –** K.S.Fu, R.C Gonzales and Lee, Mc Graw Hill International 1987.

REFERENCE BOOKS:

1. **Robotics Manipulators,** Mathematics, Programming and Control – Richard Paul, 2000.
2. **Fundamentals of Robotics, Analysis and Control,** Schilling R. J., PHI, 2006.
3. **Robetics –** Yorem Coren**,** Mc Graw Hill Intl Book Co. New Delhi, 2001.
4. **Robtics Engineering –** Richard D Klafter, PHI, 2003.
5. **Robotics and Control by** R.K.Mittal & J.Nagarath, Tata McGraw Hill 1995.

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.

Subject	COMPUTATIONAL FLUID DYNAMICS	Sub. Code	11 ME6 DEB CFD
Credits	04	L-T-P	4-0-0

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, Initial and boundary conditions. **10 Hours**

UNIT - 3

CFD SOLUTION TECHNIQUES:

Finite Difference Method: Introduction to finite differences, Difference equations, Explicit and Implicit approaches, Errors and analysis of stability. FDM applied to one and two dimensional steady state heat conduction.

Finite Volume Method: Descritisation rules, FVM for one, two and three dimensional steady state diffusion problem. NumericS on 1D steady state conduction.

CFD Solution Analysis: Introduction, consistency, stability, convergence, accuracy, efficiency(Discussion only). **14 Hours**

UNIT - 4

FVM for convecton-diffusion problems: Introduction, steady state one dimensional convection and diffusion, properties of discretization schemes, CDS, UDS, assessment of CDS and UDS.

Algorithms for N-S equations: Need of staggered grid, pressure correction equation, simple algorithm to solve flow problems. **08 Hours**

UNIT - 5

ADVANCED TOPICS IN CFD:

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).

Turbulence simulation – DNS, LES, RANS-LES coupling for turbulent flows.

Compressible flows: Upwind schemes, Flux-Vector splitting, The Godunov approach, High-resolution schemes: TVD and flux limiters and multigrid method.

Incompressible flows: Artificial compressibility method, projection method and vorticity stream function approach. **14 Hours**

TEXT BOOKS:

1. **Computational Fluid Dynamics –** The basics and applications, Anderson J.D. Jr, (1995), Mcgraw-Hill, New York.
2. **An introduction to CFD,** H. Versteeg and W. Malalashekara, Pearson, Education, 2nd Edition, 2008.

REFERENCE BOOKS:

1. **Introduction to Computational Fluid Dynamics,** Anil W. Date, Cambridge University press, 2007.
2. **Computational Fluid Dynamic – a practical approach,** Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu, Butterworth-Heinemann (ELSEVIER), 2008.
3. **Computational Fluid Dynamicsand Heat Trtansfer,** Tannehill, Anderson and Pletcher, Taylor and Francis-IInd edition, 1997.

Scheme of Examination: Answer Five full questions selecting one from each unit.

To set one question each from Unit 1, 2 & 4and two questions each from Units 3& 5.

Subject	FOUNDRY TECHNOLOGY	Sub. Code	11 ME 6DEB FOT
Credits	04	L-T-P	4-0-0

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. **05 Hours**

Casting design: Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, cast weld design, safety factors, design for low pattern cost and minimum manipulation, model making as an aid in design. **05 Hours**

UNIT – 2

Solidification of castings: Crystallization and development of cast structure - nucleation, growth and dendritic growth. Structure of castings - significance and practical 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. **08 Hours**

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 exostherimic 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. **08Hours**

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. **07 Hours**

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. **07 Hours**

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 treatement process etc. **12 Hours**

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. **04 Hours**

TEXT BOOKS:

1. **Foundry Engineering,** Howard F Taylor, Merton C Flemings & John Wulff Wiley Eastern Limited.
2. **Principle at Foundry Technology,** P.L.Jain, TMH – 2006.

REFERENCES:

1. **Foundry Technology,** R.K.Jain
2. **Foundry Technology** P.N.Rao
3. **Manufacturing process** – III, Dr. K. Radha Krishna, Sapna Book House, August 2009.
4. **Principles of metal cutting,** Hein Coper & Rosenthal TMH - 2005

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.

Subject	CONTROL ENGINEERING	Sub. Code	12 ME 7DC COE
Credits	04	L-T-P	4-0-0

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:

1. **Modern Control Engineering:** Katsuhiko Ogata, Pearson Education, 2004.
2. **Control Engineering:** U, A Bakshi and V.U.Bakshi. Technical publications Pune 2004

REFERENCE BOOKS:

1. **Feedback Control Systems:** Schaum's series 2001.
2. **Control systems:** I. J. Nagarath & M. Gopal, New age International publishers 2002.
3. **Automatic Control Systems** – B.C.Kuo, F.Golnaraghi, John Wiley & Sons, 2003.

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject	MANUFACTURING PROCESS-III	Sub. Code	12ME 7DC Mp3
Credits	04	L-T-P	4-0-0

UNIT - 1

INTRODUCTION AND CONCEPTS: Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, triaxial& biaxial stresses.Determination of flow stress. Principal stresses, Tresca& Von-Mises yield criteria, concepts of plane stress & plane strain. Problems. **7 Hours**

EFFECTS OF PARAMETERS: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, Residual stresses in wrought products. **6 Hours**

UNIT - 2

FORGING: Classification of forging processes.Forging machines & equipment.Expressions for forging pressures & load in open die forging and closed die forging by slab analysis, concepts of friction hill and factors affecting it.Die-design parameters. Material flow lines in forging. Forging defects, Residual stresses in forging. Simple problems. **8 Hours**

UNIT - 3

ROLLING: Classification of Rolling processes. Types of rolling mills, expression for Rolling load. Roll separating force. Frictional losses in bearing etc, power required in rolling, Effects of front & back tensions, friction, friction hill. Maximum possible reduction.Defects in rolled products.Rolling variables, simple problems.

POWDER METALLURGY: Production of components using powder metallurgy technique. Advantages limitations and applications. **9 Hours**

UNIT – 4

SHEET & METAL FORMING: Forming methods, dies & punches, Types of presses & their working. Progressive die, compound die, combination die. Rubber forming. Different sheet metal work like punching, piercing, blanking, bending. Deep drawing, LDR in

drawing, Forming limit criterion, defects in drawn products, stretch forming. Roll bending & contouring, Stresses in deep drawing simple problems.

HIGH ENERGY RATE FORMING METHODS: Principles, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming. **9 Hours**

UNIT - 5

DRAWING: Drawing equipment & dies, Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, Tube drawing , defects. Simple problems. **6 Hours**

EXTRUSION: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion of seamless tubes. Extrusion variables. Simple problems. **7 Hours**

TEXT BOOKS:

1. **Mechanical metallurgy (SI units),** by G.E. Dieter, McGraw Hill pub.2001
2. **Manufacturing Process-III** by Dr.K.Radhakrishn, Sapna Book House, Aug 2009.

REFERENCE BOOKS:

1. **Materials and Processes in Manufacturing** by E.paul, Degramo, J.T. Black, Ronald, A.K. Prentice -hall of India 2002
2. **Principles of Industrial metal working process -** G.W. Rowe, CBSpub. 2002
3. **Manufacturing Science,** hyAmitabhaGhosh& A.K. Malik - East -Westpress 2001
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, & 4and two questions each from Units 1 & 5.
ELECTIVE (GROUP - C)

Subject	ENGINEERING SYSTEM DESIGN	Sub. Code	11 ME7 DEC ESD
Credits	04	L-T-P	4-0-0

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

IDENTIFICATION AND ANALYSIS OF NEED: Preliminary need statement, analysis of need, specifications, and standards of performance and constraints.

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 ofsensitivity, 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:

1. **An Introduction to Engineering Design Method,**
   by V. Gupta and P. Murthy, Tata McGraw Hill. 2000
2. **Introduction of Engineering Design** by T. Woodson, McGraw Hil1.2001

REFERENCE BOOKS:

1. **Design & Planning of Engineering systems**
   by D.D. Meredith, K.W. Wong, R.W. Woodhead& K.K. Worthman. 2000
2. **Introduction to Design** by M.A. Asimov-Prentice Hall. 1996
3. **Design Methods - Seeds of Human Futures -** Wiley Inter Science. 1970.

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.

Subject	PRODUCT DESIGN & MANUFACTURING	Sub. Code	11 ME7 DEC PDM
Credits	04	L-T-P	4-0-0

UNIT-1

INTRODUCTION: Characteristics of successful product development who Designs and develops products, duration and cost of product development, the challenges of product development. **2 Hrs**

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. **4 Hrs**

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. **4 Hrs**

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. **4 Hrs**

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:

1. **Product Design and Development:**Karl.T.Ulrich, Steven D Eppinger,. Irwin McGrawHill-2000.

REFERENCE BOOKS:

1. **Product Design and Manufacturing:** A C Chitale and R C Gupta, PH1
2. **New Product Development:**Timjones. Butterworth Heinmann, , Oxford. UCI. 1997
3. **Product Design for Manufacture and Assembly:** GeofferyBoothroyd, Peter Dewhurst and Winston Knight.

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.

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject	COMPUTER INTEGRATED MANUFACTURING	Sub. Code	11 ME 7DEC CIM
Credits	04	L-T-P	4-0-0

UNIT - 1

COMPUTER INTEGRATED MANUFACTURING SYSTEMS: Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations. **5 Hours**

UNIT - 2

HIGH VOLUME PRODUCTION SYSTEM: Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Rachet& Pawl, Geneva wheel, Buffer storage, control functions-sequence, safety, Quality, Automation for machining operation. **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**

MINIMUM RATIONAL WORK ELEMENT: Work station process time, Cycle time, precedence constraints. Precedence diagram, Balance delay methods of line balancing-largest Candidate rule, Kilbridge and Westers method, Ranked positional weight method, Numerical problems covering above methods and computerized line balancing. **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.

Automated Guided Vehicle System: Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application. **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**

UNIT - 6

1. CNC part programming using CAM packages. Manual part programming: Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like CADEM, or any equivalent software.
2. Computer assisted part programming using CAPSTRAN & CAPSMILL or Equivalent softwares.
3. Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects, 2 programs.

TEXT BOOKS:

1. **Automation, Production system & Computer Integrated manufacturing,** M. P. Groover, Pearson India, 2007 2nd edition.
2. **Principles of Computer Integrated Manufacturing**, S. Kant Vajpayee, Prentice Hall India.

REFERENCE BOOKS:

1. **Computer Integrated Manufacturing,** J. A. Rehg& Henry. W. Kraebber
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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	MANAGEMENT INFORMATION SYSTEM	Sub. Code	11 ME7 DEC MIS
Credits	04	L-T-P	4-0-0

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 – effectivenss 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, Bandwiths 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 Mangement – Date Mining and online analysis, knowledge management. **06 Hours**

Planning, Acquisition, and Control: Systems Planning and Development –Planning Information sytems, 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

1. **Management Information Systems,** Effy Oz, Cengage Learning, INDIA EDITION, 2009.
2. **Management Information Systems,** James A O'Brien, Irwin McGraw Hill, Fifth Edition.

REFERENCE BOOKS:

1. **Management Information Systems**,Laudon&Laudon, PHI 1998 Ed. ISBN 81-203-1282-1
2. **Management Information systems,**S.Sadagopan, Prentice Hall of India, 1998 Ed. ISBN 81-203-1180-9
3. **Information systems for Modern management** G.R.Murdick PHI 2002.

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 s 1& 3.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	AUTOMATION IN MANUFACTURING	Sub. Code	11 ME 7DEC AUM
Credits	04	L-T-P	4-0-0

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 Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Noncontact Nonoptical Inspection Technologies **06 Hours**

UNIT - 5

MANUFACTURING SUPPORT SYSTEM: Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing. Basic Concepts of Lean and Agile manufacturing, Comparisons of Lean & Agile Manufacturing. **08 Hours**

TEXT BOOKS:

1. **Automation, Production Systems and Computer Integrated Manufacturing,** M. P. Groover, Pearson education. Third Edition, 2008
2. **Principles of CIM,** Vajpayee, PHI.

REFERENCE BOOKS:

1. **Anatomy of Automation,** Amber G.H & P. S. Amber, Prentice Hall.
2. **Performance Modeling of Automated Manufacturing Systems,** Viswanandham, PHI
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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	TOTAL QUALITY MANAGEMENT	Sub. Code	11 ME 7DEC TQM
Credits	04	L-T-P	4-0-0

UNIT - 1

QUALITY, TOTAL QUALITY, TQM: Introduction-Definition, Basic Approach, TQM framework, Historical Review, Benefits of TQM. **4 Hours**

EVOLUTION OF TQM: Contribution of Quality Gurus- Edward Deming, 14 points, PDSA cycle, Joseph Juran, Quality trilogy, Crosby & quality treatment, Ishikawa and company wide quality control, Taguchi & his quality loss function. **6 Hours**

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. **6 Hours**

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. **06 Hours**

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:

1. **Total Quality Management:** Dale H. Bester field, Publisher -Pearson Education India, ISBN: 8129702606, Edition 03/e Paperback (Special Indian Edition)
2. **Total Quality Management for Engineers:** M. Zairi, ISBN: 1855730243, Publisher: Wood head Publishing

REFERENCE BOOKS:

1. **A New American TQM, four revolutions in management,** Shoji Shiba, Alan Graham, David Walden, Productivity press, Oregon, 1990
2. **100 Methods for Total Quality Management:** Gopal K. Kanji and Mike Asher, ISBN: 0803977476, Publisher: Sage Publications, Inc.; Edition – 1

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.

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	PROJECT MANAGEMENT	Sub. Code	11 ME 7DEC POM
Credits	04	L-T-P	4-0-0

UNIT 1

INTRODUCTION TO PROJECT MANAGEMENT: Concepts & Categories of projects,Selection of projects, Phases of project life cycle, Roles and responsibilities of ProjectManager, tools and techniques of project management. **8 Hours**

UNIT 2

PROJECT PLANNING AND ESTIMATING: Feasibility report, Phased Planning, Projectplanning steps, Objectives and goals of the project, preparation of cost estimation. **7 Hours**

ORGANIZING AND STAFFING: The Project Team: Skills / abilities required for projectmanager, Authorities and responsibilities of project manager, Project organization andtypes, Accountability in project execution, controls, tendering and selection ofcontractors. **8 Hours**

UNIT 3

PROJECT SCHEDULING: Project implementation scheduling, different schedulingtechniques-Bar (GANTT) charts, Bar charts for combined activities. Project Evaluationand Review Techniques (PERT) planning, Simplenumericals. **8 Hours**

CO-ORDINATION AND CONTROL: Project direction co-ordination; and communicationin a project, Role of MIS in project control, performance control, schedule control, Costcontrol examples. **7 Hours**

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 presentvalue, benefit cost ratio, internal rate of return & simple numericals. **7 Hours**

TEXT BOOK:

1**. Project Management,** Timothy J Kloppenborg, Cengage Learning, Edition 2009.
2. **Project Management,** A systems approach to planning schuduing and controlling by Harold kerzner, CBS publication.
3. **Project Management:** S.Choudhury, McGraw Hill Publications

REFERENCE:

1. **Project Management** Refer, Pennington Lawrence, McGraw hill
2. **Project Management,** AModer Joseph and Phillips New Yark Van Nostrand, Reinhold.
3. **Project Management,** Bhavesh M. Patal, Vikas publishing House.
4. **Project Management,** K.R.Sharma, National Publishing House, New Delhi, 2000

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.

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject	FRACTURE MECHANICS	Sub. Code	11 ME 7DED FRM
Credits	04	L-T-P	4-0-0

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 lastic zone estimation, plane stress and plane strain concepts. The Dugdale approach, the thickness effect. **7 Hrs.**

UNIT 2

Elastic – Plastic Fracture Mechanics : Introduction, elasti-pastic factor criteria, crack resistance curve, J-integral, crack opening displacement, crack tip opening displacement, importance of R-curve in fracture mechanics, experimental determination of J-integral, COD and CTOD. **8 Hrs.**

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 :

1. **Fracture Mechanics –** Fundamentals and Application, T.L. Anderson, CRC press 1998
2. **Fracture of Engineering Brittle Materials,** Jayatilake, Applied Science, London, 2001.

REFERENCE BOOKS :

1. **Elements Of Fracture Mechanics,** Prashant Kumar, Tata Mcgraw Hill, - Mar-09, ISBN 0070656967
2. **Introduction to Fracture Mechanics,** Karen Hellan, McGraw Hill Pub. 2000
3. Elementary Engineering Fracture Mechanics, David Broek, ArtinusNiihoff, London, 1999.
4. **Fracture and Fatigue Control in Structures,** Rolfe and Barsom, , Prentice Hall, 2000.
5. **Principles of Fracture Mechanics,** Robert J Sanford, Prentice Hall, 2002.
6. **Problems of Fracture Mechanics & Fatigue,** Gdoutos E.E, RodoPoulus C.A, Yates J.R, KluwerAcademic Publishers.

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.

Subject	COMPUTER GRAPHICS	Sub. Code	11 ME 7DED COG
Credits	04	L-T-P	4-0-0

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 - 3

Types and Mathematical Representation of Solids, Solid Models, Solid entities, Solid representation, Solid modeling- set theory, regularized set operations, set membership classification, Half spaces, Half spaces of plane, cylinder, sphere, conical half-space, Boundary representation, Constructive Solid Geometry- basic elements, Building operations. **07 Hours**

VISUAL REALISM-I: Introduction, hidden line removal- visibility of object views, Visibility techniques: minimax test, containment test, surface test, Silhouttes, Homogeneity test, Sorting, Coherence, Hidden line priority algorithm, Hidden surface removal- Z-buffer algorithm, Warnock's algorithm, Hidden solid removal- ray tracing algorithm. **06 Hours**

UNIT - 4

VISUAL REALISM-II: Shading, shading models- diffuse reflection, specular reflection, ambient light, Shading surfaces- constant shading, gourmand shading, Phong shading, Shading enhancements, Shading Solids- Ray tracing for CSG, z- buffer algorithm for B-rep and CSG, octree encoded objects, Colouring- RGB, CMY, HSV, HSL colour models. **07 Hours**

UNIT - 5

COMPUTER ANIMATION: Introduction, Conventional animation-key frame, In betweening, Line testing, Painting, Filming, Computer animation- entertainment and engineering animation, Animation system hardware, software architecture, Animation types- frame buffer, colour table, zoom-pan-scroll, cross bar, real time play back, Animation techniques- key frame, skelton. Path of motion and p-curves. **06 Hours**

TEXT BOOKS:

1 CAD/CAM-Theory and Practice,IbrahamZeid, McGraw Hill, 2006
2 Mathematical Elements for Computer Graphics, Rogoer's Adams, McGraw Hill. 1990

REFERENCE BOOKS:

1. Computer Graphics, Xiang z, Plastock, R. A., Schaums outlines, McGraw Hill. 2007.
2. Computer Graphics, principles and practice, Foley, Van- Damn, Finner and Hughes, Addison Wesley.
3. Computer Graphics, Sinha A. N., Udai A. D., Tata McGraw Hill, 2008.
4. Computer Graphics, C Version- DoneldHeran, M. Pauline Baker, 2nd Edition, Pearson.

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.

Subject	RAPID PROTOTYPING	Sub. Code	11 ME7 DED RAP
Credits	04	L-T-P	4-0-0

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**

SOLID GROUND CURING: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application. **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:

1. Stereo Lithography and other RP & M Technologies, Paul F. Jacobs: SME, NY 1996.
2. Rapid Manufacturing,Flham D.T &Dinjoy S.S Verlog London 2001.

REFERENCE BOOKS:

1. Rapid Prototyping, Terry Wohlers Wohler's Report 2000" Wohler's Association 2000.
2. Rapid Prototyping Materials,Gurumurthi, IISc Bangalore.
3. Rapid Automated, Lament wood. Indus press New York

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.

Subject	TOOL ENGINEERING DESIGN	Sub. Code	11 ME 7DED TOD
Credits	04	L-T-P	4-0-0

Use of Tool Design Data Handbook is permitted in the examination

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:

1. **Tools Design C Donaldson-** G.H. Le CAIN V.C Goold, TMH -1976.
2. **Metal Cutting and Tool design -** Dr. B.J. Ranganath, Vikas Publishing house, 1993.

REFERENCE BOOKS:

1. **Metal cutting theory and Tool Design-** Arshinav MIR Publications
2. **Jigs & Fixtures- Grant –** 1976.
3. **Introduction to Jigs & Fixtures-** Kempster. ELBS, Edn. 1974.
4. **Fundamentals of Tools Design-** ASTME – Prentice Hall India Publications – 1983.

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.

Subject	TRIBOLOGY	Sub. Code	11 ME 7DED TRI
Credits	04	L-T-P	4-0-0

UNIT 1

Introduction to Tribology: Introduction, Friction, Wear, Lubricants. Regimes of lubrication, Classification of contacts. Newton's Law of viscous forces, Effect of pressure and temperature on viscosity. **06 Hours**

Flow through stationary parallel plates. Hagen's poiseuille's theory, viscometers.Numerical problems. **04Hours**

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. **06Hours**

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:

1. **Introduction to Tribology of Bearing,** Mujamdar.B.C, Wheeler Publishing, New Delhi 2001.
2. **Tribology in industrySusheel Kumar Srivasthava ,**S.Chand and Co.

REFERENCE BOOKS:

1. **Theory and practice of Lubrication for Engineers,** Dudley D.Fulier, New York Company.1998
2. **Principles and applications of Tribology,Moore** ,Pergamon press.
3. **Theory of Hydrodynamic Lubrication,**Pinkus '0' Stemitch.
4. **Active Magnetic bearings, Gerhandschwetizer,** HannesBleuler&AlfonsTraxler, Authors working group, www.mcgs.ch., 2003.
5. **Lubrication of Bearings -** Theoretical principles and design,Radixmovsky, The Oxford press Co, 2000.

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.

Subject	COMPOSITES MATERIAL TECHNOLOGY	Sub. Code	11 ME7 DEC CMT
Credits	04	L-T-P	4-0-0

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

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. **08 Hours**

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. **08Hours**

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

METAL MATRIX COMPOSITES: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.

FABRICATION PROCESS FOR MMC'S: Powder metallurgy technique, liquid metallurgy technique, diffusion bonding, squeeze technique and secondary processing. **08Hours**

TEXT BOOKS:

1. **Composite Science and Engineering,** K. K. Chawla Springer Verlag 1998.
2. **Mechanics of composite materials,** Autar K. Kaw CRC Press New York.

REFERENCE BOOKS:

1. **Fiber Reinforced Composites,** P. K. Mallick, Marcel Dekker,Inc
2. **Mechanics of Composite Materials**, Robert M. Jones, McGraw Hill Kogakusha Ltd.1998
3. **Composite materials hand book,** MeingSchwaitz," McGraw Hill book company.1984
4. **Principles of composite Material mechanics,** Ronald F. Gibron. McGraw Hill international, 1994.
5. **Mechanics of Composite Materials and Structures,** MadhujitMukhopadhyay , University Press 2009

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING

Subject	COMPUTER AIDED MODELLING & ANALYSIS LAB	Sub. Code	12ME 7DLCAE
Credits	1.5	L-T-P	0-0-3

PART - A

Study of a FEA package and modeling stress analysis of

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

b. Trusses **3 Hours**

c. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc Torsion of circular shafts. **12 Hours**

PART - B

a) Stress analysis of a rectangular plate with a circular hole **3 Hours**

b) Thermal Analysis – 1D & 2D problem with conduction and convection boundry conditions **9 Hours**

c) Dynamic Analysis

1) Natural frequency and mode shapes of Bars and beams
2) Bar subjected to forcing function
3) Fixed – fixed beam subjected to forcing function **9 Hours**

REFERENCE BOOKS:

1. Practical Finite Element Analysis. Nitin S. Gokhale, Sanjay S. Deshpande, Sanjeev V. Bedekar and Dr. Anand N. Thite .2007 Finite To Infinite.
2. Finite Element Analysis ,Theory and applications with ANSYS,Saeed Moveni,Pearson
3. Engineering Analysis with ANSYS software,Tadeuz Solarski.

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**

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject	NUMERICAL APPLICATIONS FOR MECHANICAL ENGG.	Sub. Code	12ME7DL NAM
Credits	1.5	L-T-P	0-0-3

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)
2. Danilo.6.094Introduction to MATLAB, January IAP 2010. (Massachusetts Institute of Technology :MIT Open Course Ware)

http://ocw.mit.edu(Accessed31May,2012).License: Creative Commons BY-NC-SA
3. Essential MATLAB for Engineers and Scientists Brian Hahn, Daniel Valentine.
4. http://www.mathworks.in/
5. http://www.masteringmatlab.com/matweb.html
6. http://eecourses.technion.ac.il/matlab/

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**

12 ME7DC PRW Project Work Phases 1

Teaching scheme 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: _____

Sl. No.	USN	Name of The Student	Assessment by guide(70%)					Assessment by Departmental Committee (30%)			Grand Total 50	
			Literature Survey 10	Topic Selection 05	Documentation 15	Attendance 05	Total 35	Evaluation (10%) 05	Presentation (20%) 10	Total 15		

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19
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DEPARTMENT OF MECHANICAL ENGINEERING

Subject	INDUSTRIAL ENGINEERING & ERGONOMICS	Sub. Code	11 ME7 DEDIEE
Credits	04	L-T-P	4-0-0

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:

1. **Work study,** ILO, 3rd edition, 2006
2. **Human Factor Engineering:** Sanders & McCormick McGraw Hill Publications.

REFERENCE BOOKS:

1. **Applied Ergonomics Hand Book,** Brain Shakel, Butterworth Scientific, London 1988
2. **Introduction to Ergonomics,** R. C. Bridger, McGraw Hill Publications.
3. **Industrial Design for Engineers,**Mayall W. H. London Hiffee Books Ltd., 1988
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 Unit

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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DEPARTMENT OF MECHANICAL ENGINEERING

VIII SEMESTER

Subject	MACHINE TOOL DESIGN	Sub. Code	11 ME8 DEE MTD
Credits	04	L-T-P	4-0-0

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

MACHINE TOOL DRIVES AND MECHANISMS: Working and auxiliary motion. Drives-Electric drives, Hydraulic transmission, Kinmatic structure, Regulation of speed and feeds, stepped regulation, standardization of speed and feed, stepless regulation of speeds and feeds. **7 Hours**

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

DYNAMICS OF MACHINE TOOLS: Concept of dynamic cutting process, Physical causes of chatter and vibrations, Types of Chatter. Stability chart, chatter vibration in Lathe, Drilling machine, Grinding machine and Milling machine. Different methods for avoiding machine tool chatter and vibration. **7 Hours**

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. **7 Hours**

TEXT BOOKS:

1. **Machine Tool Dessign,** N.K. Mehta Tata McGraw Hill, 2001.
2. **Principles of Machine Tools,** Sen and Bhattacharaya ,Oxford IBM Publishing, 2000.

REFERENCE BOOKS:

1. **Machine Tool Design Volume –** II and III, N. Acharkan , MIR Publications 2000.
2. **Design of Machine Tools,** S. K. Basu and D. K. Pal, 2000.
3. **Principles of Machine Tool Design**, Koensberger 1993 .

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.

Subject	FINANCIAL MANAGEMENT	Sub. Code	11 ME8 DEE FIM
Credits	04	L-T-P	4-0-0

UNIT - 1

Introduction to Financial Management,Book keeping – systems of book keeping, journal and ledger posting.Financial Statement, Preparation of Trial balance, profit and Loss Account, Balance Sheet with adjustments. **12 Hours**

UNIT - 2

WORKING CAPITAL MANAGEMENT: Definition, need and factors influencing the working capital requirement. Determination of operating cycle, cash cycle and operating cycle analysis.Calculation of gross working capital and net working capital requirement. **10 Hours**

LONG TERM FINANCING: Raising of finance from primary and secondary markets. Valuation of securities, features of convertible securities and warrants. Features of debt, types of debt instruments, return on investment(ROI) and credit rating of units. Shares, debentures. **08 Hours**

UNIT - 3

RATIO ANALYSIS / ACCOUNTING RATIO: Liquidity ratio – Current ratio, quick ratio, turnover ratio, capital structure ratio- Debt – equity ratio, Coverage ratio, Profitability ratio, Profit margin, Return on assets, Activity ratios – Inventory turnover ratio, Debtors Turnover ratio. Preparation of the balance sheet from various ratios. Analysis of any one published balanced sheet. **09 Hours**

UNIT - 4

COSTING: Classification of cost, preparation of cost sheet, absorption and variable costing, job costing, process costing.Classification of the variances analysis – material, labour and overhead variances. **07 Hours**

UNIT - 5

BUDGETING: Types of budgets – Flexible budgets, preparation of cash budgets, purchase and production budgets and master budget, Budgetory control, advantages & limitations of budgeting. **06 Hours**

TEXTBOOKS:

1. **Financial Management,** Khan & Jain, text & problems TMH ISBN 0-07-460208-A. 2001.
2. **Financial Accounting, Costing and Management Accounting,** S. M. Maheshwari, 2000.

REFERENCE BOOKS:

1. **Financial Management,** I. M. Pandey, Vikas Publication House.
2. **Financial Management,** Abrish Gupta, Pearson.
3. **Financial Decision Making,** Humpton, 2000.
4. **Financial Management,** Theory and Practice, Prasanna Chandra, TMH, 3rd edition 2002.

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

Subject	AUTOMOTIVE ENGINEERING	Sub. Code	11 ME8 DEE AUE
Credits	04	L-T-P	4-0-0

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. **07 Hrs**

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. **07 Hrs**

UNIT-2

SUPERCHARGERS AND TURBOCHARGERS: Naturally aspirated engines, Forced Induction, Types of superchargers, Roots supercharger, Spiral (Scroll) supercharger, Turbocharger construction and operation, Intercooler, Turbocharger lag. **06 Hrs**

UNIT-3

IGNITION SYSTEMS: BatteryIgnition 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, Hotchkiss 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:

1. **Automotive mechanics,** William H Crouse & Donald L Anglin, 10th Edition Tata McGraw Hill Publishing Company Ltd., 2007.
2. **Automotive Mechanics** by S.Srinivasan, Tata McGraw Hill 2003.

REFERENCE BOOKS:

1. **Automotive mechanics: Principles and Practices,** Joseph Heitner, D Van Nostrand Company, Inc
2. **Fundamentals of Automobile Engineering,** K.K.Ramalingam, Scitech Publications (India) Pvt. Ltd.
3. **Automobile Engineering,** R.B.Gupta, Satya prakashan, 4th edn. 1984.
4. **Automobile engineering**, Kirpal Singh. Vol I and II 2002.

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

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

DEPARTMENT OF MECHANICAL ENGINEERING.

Subject	DATA BASE MANAGEMENT SYSTEM	Sub. Code	11ME8DEEDBM
Credits	04	L-T-P	4-0-0

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:

1. **Fundamentals of Database Systems,** Ramez Elmasri and Shanmkanth B. Navathe, 3rd Edition, Addison Pearson.
2. **Database Management System,** Raghu Ramakrishnan, Tata Mc Graw Hill, 3rd Edn. 2002.

REFERENCE BOOKS:

1. **Database Management and Design,** Gray W.hansen and James V. Hansen, 2nd Edn. Printice Hall India Pvt. Ltd., 2002.
2. **Database Management Systems,** Designing and Building business applications by Gerald V. Post, 3rd Edition, Tata Mc Graw Hill Publishing company Ltd.,- 2005
3. **Project Mangment with PERT and CPM,** Moder Joseph J and Phillips cerel, R., VAN Noserand, Reinhold, 2nd Edn., 1976.

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.

Subject	ARTIFICIAL INTELLIGENCE	Sub. Code	11 ME8 DEE ARI
Credits	04	L-T-P	4-0-0

UNIT - 1

ARTIFICIAL INTELLIGENCE: Introduction, definition, underlying assumption, importance f A1, 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, Certainity 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, **6Hours**

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:

1. **Principles of Artificial Intelligence,** Springer Verlag, Berlin, 1981.
2. **Artificial Intelligence in business, Science & Industry,** Wendy B. Ranch
3. **A guide to expert systems,** Waterman, D.A., Addison – Wesley inc. 1986.
4. **Building expert systems,** Hayes, Roth, Waterman, D.A. Addison – Wesley, 1983.

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

Subject	ADVANCE MATERIALS TECHNOLOGY	Sub. Code	11ME8DEEMT
Credits	04	L-T-P	4-0-0

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 nanomateirals, methods of preparation –plasma arcing, 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:

1. **Materials Science & Engineering -** William D. Callister Jr. an introduction, 4th edition. John Wiley & Sons.
2. **Engg. Materials & their applications -** R. A. Flinn & P. K. Trojan, 4th edition, Jaico Publishing House.

REFERENCE BOOKS:

1. **Composite Materials, Science & Engg -** Krishan K. Chawla, 2nd edition, Springer publicat1on.
2. **ASM Handbook on Metal Casting -** Vol .15, 9th edition, ASM publication
3. **ASM Handbook on Powder Metallurgy -** Vol 17, ASM publications
4. **Nanotechnology –** Basic Science and Emerging Technologies, -Mick Wilson, Kamali Kannangara, Overseas Press India Private Limited, First Indian Edition 2005.

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.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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DEPARTMENT OF MECHANICAL ENGINEERING

Subject	GAS DYANAMICS	Sub. Code	11 ME 8DEE GAD
Credits	04	L-T-P	4-0-0

UNIT - 1

FUNDAMENTAL EQUATIONS OF STEADY FLOW: Definition of Compressible Flow, Flow Regimes, Aerocynamic Forces on a Body, Continuity and momentum equation. and energy equation. **08 Hours**

UNIT - 2

ISENTROPIC FLOW: Acoustic velocity, Mach number, Mach cone and Mach angle. Flow parameters, stagnation temperature, pressure, and density. **08 Hours**

UNIT-3

FLOW IN CONSTANT AREA WITH HEAT TRANSFER: Stagnation temperature change.

Rayleigh line, Pressure ration 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 flow equations. **14 Hours**

UNIT – 4

FLOW WITH NORMAO SHOCK WAVES: Development of shock wave, Rarefaction wave, Governing equations, Prandti-Meyer relation, March number downstream, Static pressure rise, Density ration, Temperture 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 **14 Hours**

UNIT - 5

VARIABLE AREA FLOW: Velocity variation with Isentropic flow, Criteria for acceleration and deceleration. Flow through nozzle, Effect of pressure ratio on Nozzle operation.Convergent nozzle and convergent divergent nozzle. Effect of back pressure on nozzle flow. Isothermal flow functions. Comparison of flow in nozzle.Generalized one dimensional flow. **08 Hours**

TEXT BOOKS:

1. **Fundamentals of Compressible flow:** Yahya, 2nd Edn. 1991; Wieley Eastern.
2. **Gas Dynamics**, E Radhakrishnan PHI-2006
3. **Gas Dynamics, Becker,** Academic Press.Inc.

REFERENCE BOOKS:

1. Introduction to Gas Dynamics: Rolty, wiley 1998
2. Elements of Gas Dynamics: Liepmann and roshko, Wiley 1994.
3. The dynamics and thermodynamics of compressible fluid flow: Shapiro Ronold press. 1994.
4. ModernCompressible Fluid Flow, Anderson John. D, McGraw Hill Publication, 1990.

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.

Subject	ORGANIZATIONAL BEHAVIOR	Sub. Code	11 ME 8DEE ORB
Credits	04	L-T-P	4-0-0

UNIT-1

Introduction: Definition of Organization Behaviour and Historical development, Environmental context (Information Technology and Globalization, Design and Cultural, Reward Systems). **4 Hrs**

The Individual: Foundations of individual behaviour, individual differences. Ability. Attitude, Aptitude, interests. Values. **8 Hrs**

UNIT-2

Learning: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement. **6 Hrs**

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. **5 Hrs**

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. **6 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:

1. **Organizational Behaviour,** Stephen P Robbins, 9th Edition, Pearson Education Publications, ISBN-81-7808-561-5 2002
2. **Organizational Behaviour-** Fred Luthans, 9th Edition, Me Graw Hill International Edition, ISBN-0-07-120412-12002

REFERENCE BOOKS:

1. **Organizational Behaviour -** Hellriegel, Srocum and Woodman, Thompson Learning, 9th Edition, Prentice Hall India, 2001
2. **Organizational Behaviour -** Aswathappa - Himalaya Publishers. 2001
3. **Organizational Behaviour-** VSP Rao and others, Konark Publishers.2002
4. **Organizational Behaviour** (Human behaviour at work) 9th Edition, John Newstron/ Keith Davis. 2002
5. **Management of Organizational Behaviour** ,Paul Henry & Kenneth.H. Blanchard, PHI, 1996.

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 2& 3.

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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11 ME8DC SEM - SEMINAR

CIE:50Marks and SEE:50Marks

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.

iii. Theory 1) Implementation 2) Methodology,3) Application 4) Advantages/Disadvantages.

iv. Conclusion.

v. Future scope.

References

ASSESSMENT OF SEMINAR

Title of seminar _____

Name of guide _____

B.M.S COLLEGE OF ENGINEERING, BANGALORE-19

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Sl.No.	USN	Name of The Student	Topic Selection 05	Literature Survey 10	Report Writing 10	Depth of understanding 10	Presentation 15	Grand Total 50

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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12 ME8DC PRW - Project Work Phase 2

Scheme CIE:50 Marks and SEE: 50Marks

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: _____

Sl.No.	USN	Name of The Student	Assesment by guide(70%)					Assesment by Departmental Committee (30%)			Grand Total
			Execution 10	Results and Discussions 10	Project Report 10	Attendance 05	Total 35	Evaluation (10%) 05	Presentation (20%) 10	Total 15	50
1.											
2.											
3.											
4.											

Sign of Guide **Sign.of Committee Members** **Sign. Of H. O. D.**

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

Note