Scheme and Syllabus of
B.E. MBA MECHANICAL
ENGINEERING
3\textsuperscript{RD} TO 6\textsuperscript{TH} Semester 2010-2011
## Scheme of Examination

### THIRD SEMESTER

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*These marks are based upon four weeks Vocational Training in the workshop after second semester

(i)
## Scheme of Examination

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There will be four weeks vocational training after 4th Semester either in the College or in the Factories approved by the Principal / Head of the Department.
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## BE MBA integrated (Mechanical Engineering)

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There will be four weeks Vocational Training in the manufacturing concerns after 6th semester

(iv)
MEC 301: Applied Thermodynamics-I

Part A

1. Reciprocating Air Compressors:


2. Steam Generators:


3. Boiler Draught:

Classification, Natural, Forced and Induced draught, Comparison. Estimation of height and diameter of chimney condition for maximum discharge, Chimney efficiency, Draught losses. Balanced draught, Power required to drive fan.

4. Performance of Steam Generators:


5. Steam Engine:


Part B

6. Nozzles and Diffusers:

Classification of diffusers, effect of friction and area change. The converging-diverging super-sonic diffuser.

7. **Impulse Steam Turbine**: (4)


8. **Reaction Turbine**: (4)

   Degree of reaction, velocity diagrams, blade efficiency and its derivation, calculation of blade height etc. Requirement of an ideal working fluid, binary vapour cycles, Methods of attachment of blades to turbine rotor, losses in steam turbine, Labyrinth packing and governing of steam turbine.

9. **Condensers**: (3)


10. **Elements of Power Plants**: (2)


**Books Suggested**


**MEC 302: Mechanical Measurements**

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**Note:** The examiner shall set 8 questions four from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

**Part A**

1. **General Concept**: (2)
Need and classification of measurements and instruments: basic and auxiliary functional elements of a measurement system; Mechanical vs. electrical/electronics instruments, primary, secondary and working standards.

2. **Static and Dynamic Characteristics of Instruments**: (5)

Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution: speed of response, lag, fidelity and dynamic error, dead time and dead zone.
Zero, first and second order systems and their response to step, ramp and sinusoidal input signals.

3. **Error in measurements**: (3)

Sources of errors, systematic and random errors. Statistical analysis of test data.

4. **Functional elements**: (7)

Review of electro-mechanical sensors and transducers – variable resistance, inductance and capacitive pickups, photo cells and piezo-electric transducers, and application of these elements for measurement of position/displacement, speed/velocity/acceleration, force and liquid level etc. Resistance strain gauges, gauge factor, bonded and unbonded gauges, surface preparation and bonding techniques, signal conditioning and bridge circuits, temperature compensation, application of strain gauges for direct, bending and torsional loads.

**Part B**

5. **Pressure and Flow Measurement**: (5)

Bourdon tube, diaphragm and bellows, vacuum measurement-Mecleod gauge, thermal conductivity gauge and ionization gauge; Dead weight pressure gauge tester.


6. **Temperature Measurement**: (5)

Thermal expansion methods- bimetallic thermometers, liquid-in-glass thermometer and filled-in-system thermometers; thermo-electric sensors-common thermo couples, reference junction considerations, special materials and configurations: metal resistance thermometers and thermistors; optical and total radiation pyrometers; calibration standards.

7. **Speed, Forces, Torque and Shaft Power Measurement**: (4)

Mechanical tachometers, vibration tachometer and stroboscope; proving ring, hydraulic and pneumatic load cells, torque on rotating shafts, Different types of Dynamometers: electrical and mechanical.

8. **Measurement Systems Applied to Micro & Nanotechnology.** (3)
Micro scale sensors, Micro-Motion-Positioning Systems, Particle Instruments and Clean – Room Technology, Magnetic Levitation Systems for Wafer Conveyors, Scanning- Probe Microscope Bibliography

BOOKS SUGGESTED:


MEC 352 : MECHANICAL MEASUREMENTS

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1. Measurement of the area of an object by using a planimeter.
2. Calibration of Pressure-gauge with the help of a dead weight gauge tester.
4. Measurement of speed by photoelectric pick up, electromagnetic pick up, proximity type sensors.
5. Measurement of light intensity by LDR, photo voltaic cell, photo diode.
6. Measurement of linear displacement by linear motion potentiometer, servo potentiometer, LVDT, inductive pick up, capacitive pick up.

MEC 303 MECHANICS OF MATERIALS-I

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Note: Eight questions to be set in all. Candidates are required to attempt a total of five questions, selecting at least two questions from each part.

PART – A

1. Thermal Stresses: (2)

Longitudinal stresses in fixed bars of uniform cross-section, temperature effect in compound bars, stress calculation due to combination of longitudinal and temperature stresses.

2. Stresses and Strains at an oblique plane: (4)

2-D stress and strain systems, derivation and application of formulae in 2-D stress and strain system for: Normal stress and strain on any place, shear stress and strain on any plane, principal stress and strain, maximum shear stress and strain, position of principal planes, position of maximum shear stress/ strain planes, Mohr’s stress circle.
3. Strain Energy:

Strain energy, strain energy due to gradually applied loads (axial, shear, bending moment and torque), Strain energy of dilation and distortion due to three principal stresses, Stress due to suddenly applied and impact loads.

4. Theories of Elastic Failures:

Maximum principal stress, maximum principal strain, maximum shear stress, total strain energy and distortion energy theories. Comparison and graphical representation of these theories for 2-Dimensional stress condition, Application of these theories of failures to 2-D stress problems such as (i) Combined bending and torsion and (ii) Combined torsion and axial loads

Part B

5. Distribution of Shear Stresses in Beams:

Derivation of general formula and its application to rectangular, triangular, T, Circular and hollow circular sections, Simple Problems

6. Slope and Deflection:

Relationship between bending moment, slope and deflection, Moment area method, Method of integration, Macaulay's method, Castigliano's theorem and Maxwell's theorem of reciprocal deflection (proof not required for these theorems)

Use of all these methods to calculate slope and deflection for cantilever & simply supported beams with or without overhang under various types of loads and its combinations

7. Fixed Beams:

Calculation of deflection, fixing moment and reactions by Macaulay's double integration methods for beams;

a. Fixed at one end and simple supported at other end with or without overhangs
b. Fixed at both ends :

Under following loads:

i. Uniformly distributed load (UDI)

ii. Uniformly varying loads.

iii. Concentrated loads (one, two, or three etc.).

iv. Combination of the above loads.

Bending moment and Shear Force diagrams for the above cases.

BOOKS SUGGESTED:

MEC 353: MECHANICS OF MATERIALS – I

List of Experiments:

1. Study of wood testing machine and performance of various tests on it.
2. Determine the stiffness of a spring on a spring tester.
3. Determine the hardness of various materials with Brinell, Vicker,s Pyramind and Rockwell hardness testing.
4. Study of creep testing machine.
5. Study of Fatigue testing machine and perform fatigue test on various materials.
7. Determine strain aging phenomenon of given metal.
8. Determine and plot shear stress distribution in various beams through interactive C/C++ computer programming or using MATLAB.
9. Determination & plot various cylindrical and spherical shells parameters through interactive C/C++ computer programming or using MATLAB.

MEC 354: Machine Drawing

The candidates will be required to make minimum of 15 drawing sheets using the software such as AutoCAD, ProE and Inventor on the following topics as per B.I.S. SP46-1988 for General Engg. Drawing. First angle method of Projection should be used.

1. Symbols of standard tolerances, machining symbols, Surface finish and welding symbols
2. Free hand sketching of shafts, splined shafts, keys and keyways
3. Form of screw threads, conventional representations of single and start threads, riveted joints, bolts, studs, screw, locking devices, pipe and pipe fittings.(3 Sheets Min.)
4. Cotter joints, knuckle joints. Pulleys and brackets. (2 Sheets Min.)
5. Flange and muff coupling. Pin type flexible coupling; claw Coupling and cone friction clutch. (2 Sheets Min.)
6. Footstep bearing, Plummer block, swivel bearing(2 Sheets Min.).
7. Steam engine piston and stuffing box. (2 Sheets Min.)
8. I.C. Engine Piston, connecting rod, cross head and eccentric. (2 Sheets Min.)
9. Machine Tool Parts: Tail stock. (1 Sheet Min)
10. Miscellaneous: Screw jack, drill press vice (1 Sheet Min.)
Note: Students should develop the understanding of study of drawing with reference to manufacturing processes, projections, assembly drawings and should be able to draw simple assembly drawings and projections of simple machine parts. The syllabus given above indicates the broad outlines and the scope of subject to be covered. Teacher concerned may take suitable examples to make the student understand the topic.

Book Suggested


MEC-305: THEORY OF MACHINES-1

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Note: The examiner shall set 8 questions i.e., 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

PART-A

1. Basic concepts:
   (3)
   Kinematics and Dynamics of Machines, Mechanism, Pairs, Inversions of slider crank chains, Degrees of freedom, Kutzbach's equation. Grubler criterion and Numerical problems

2. Velocity and Acceleration:
   (5)
   Basic concepts of machines, link, Mechanism, Kinematic chain, relative motion of parts of Mechanism, displacement, velocity, acceleration diagrams of all basic mechanisms including quick return motion mechanism. Advance problems on velocity diagrams (relative velocity method, instantaneous center method).
   Acceleration diagram. Coriollis component. Advanced problems involving their application and torque calculation.

3: Kinematics Synthesis of Mechanism.
   (4)
   Movability, Number synthesis, Frudensteins’s equation. Chebyshev spacing of precision points, Two and three position synthesis of Four-bar mechanism and slider crank mechanism, Overlay Method, Block’s method, Transmission angle, Limit position and Least square techniques.

4: Flywheel and Turning Movement Diagrams:
   (4)
   Turning moment and crank effort diagrams for steam and I.C. engine, dynamics of simple horizontal and vertical engine. Fluctuation of speed, co-efficient of fluctuation of speed and energy.
   Simple problems on turning moment diagrams and the determination of size of a flywheel taking centrifugal stresses into consideration.

5: Force Analysis:
   (4)
   Equations of equilibrium, Couple, equilibrium of three force and four force systems, Free body diagrams, Forces on slider crank mechanism, quick return mechanism, four bar mechanism and slider crank mechanism with friction at turning pairs and numerical problems.

PART-B
6: Friction
Efficiency of inclined plane, Friction in V-threads, screw-jack, pivots and collars plate and cone-clutches, Power lost in friction, friction circle and the friction axis of a link.

7: Belts, Ropes and chains.
Materials, type of drive, idle pulley, intermediate or counter shaft pulley, angle and right angle drive, quarter turn drive, velocity ratio, crowning of pulley, loose and fast pulleys, stepped or cone pulleys, ratio of tensions on tight and slack sides of belt. Power transmitted by belts with consideration of creep and slip, centrifugal tension and its effect on power transmitted. Use of gravity idler, flat, V-belts and rope material, Length of belt, rope and chain drive, types of chains.

8: Brakes and Dynamometer:
Types of brakes, principle of friction brakes, band, band and block, internal expanding shoe brakes, simple Problems of these brakes, description of vacuum brake, types of dynamometer, measurement of power by Prone brake and rope brake dynamometer, belt transmission dynamometer, Heenan and Froude’s Hydraulic dynamometer, Bevis- Gibson’s flash light torsion dynamometer.

9: Governors.

BOOKS SUGGESTED.

ASC 305: COMPUTATIONAL METHODS

Part A
1. Matrices and linear system of equations (10)
Linear dependence of Vectors, relation between rank of a matrix and linearly independent vectors of matrix, similar matrices, characteristic vector and characteristic roots of a matrix, Cayley-Hamilton Theorem, Consistency of a linear system of equations, solution of linear systems, direct method Matrix inversion, Gaussian elimination, method of factorization, iterative methods--jacobi’s method, Gauss-Siedal method, solution of tridiagonal systems.

2. Sequences and series (8)

PART-B
3. Numerical Methods (12)

BOOKS SUGGESTED


IBM 301: ORGANIZATIONAL BEHAVIOUR

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Note: Examiner shall set eight questions, four from Part-A and four from Part-B of the syllabus. Candidate will be required to attempt any five questions selecting at least two questions from Part-A and two from Part-B.

Part A

Introduction to Organization Behavior

Definition and meaning of OB, impact of other sciences (Anthropology, Sociology, Psychology) on OB, perception, self esteem, attitude & personality, meaning of culture, impact of technology on OB.

Motivation, Learning & Leadership

Meaning of Motivation, Content theories of motivation (Maslows Hierarchy of needs, Herzberg’s two factor theory), Process theories (Vroom’s Expectancy theory, Porter-Lawler Model), Motivation applied (Job design, job rotation, goal setting, MBO), various methods of motivating employees, Behavioral & Cognitive theories of learning, Leadership theories (Trait theory, Fiedler’s Contingency theory, Path–Goal leadership theory), Leadership styles (Blake & Mouton managerial grid, Hersey & Blanchard’s life cycle approach).

Part B

Group behavior:

Group Dynamics, conflict, power & politics, Group behavior, types of groups, group decision making, conflict in organizations and reason, interpersonal conflict, inter group conflict, meaning of power, classification of power, politics in organizations.

Organization environment & Communication

Authority & responsibility, delegation and division of work, quality of work life, communication process, modes of communication in organization and barriers to communication, formal & informal communication.

Recommended Books:
MEC 357: VOCATIONAL TRAINING after 2\textsuperscript{nd} Semester

SYLLABUS FOR
BE-MBA INTEGRATED (MECHANICAL ENGINEERING)
FOURTH SEMESTER

MEC 401 MECHANICS OF MATERIALS-II

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Part A

1. Cylinders and Spheres

Thin cylindrical and spherical shells under internal pressure, Cylindrical shells with hemispherical ends, volumetric strain, Thick cylinders, Derivation of Lame's equations, Calculation of radial and longitudinal stresses and strains in thick cylinders. Compound cylinders: Hub shrunk on solid shaft

2. Rotational Stresses:

   a. Rotating Rings. Derivation of formulae and calculations of stresses in rotating rings neglecting effects of spokes.
   b. Rotating Discs- Calculation of stresses in rotating discs with central hole and without central hole. Disc of uniform strength, Temperature stress in uniform disc.
   c. Rotating Cylinders- Derivation of formulae of stresses of rotating cylinders with or without central hole.

3. Columns and Struts:

Theory of columns, assumptions made in the derivation of Euler's theory of column, Derivation of Euler's equation for various end conditions, Rankine-Gordan’s formula, empirical formula for axially loaded column and their application.

Part B

4. Bending of Curved Bars:

Curved beam theory and calculation of stresses in

   a. Cranes and Chain Hooks
   b. Rings
   c. Chain links with straight sides of (i) circular (ii) Trapezoidal sections.

5. Springs:

   a. Closed coiled helical springs
i. Deflection of free end and strain energy under axial load
ii. Rotation of free end and strain energy under axial couple
iii. Combination of two closed coiled springs in (i) Series (ii) Parallel

b. Leaf Springs Deflection and bending stresses.
c. Open coiled Helical Springs Deflection and rotation of free end and strain energy under (i) Axial load (ii) Axial couple.

6. Analysis of Plane Frames:
   (4)

   statically determinate and indeterminate, truss, frame, method of joints, simple problems

BOOKS SUGGESTED:


MEC 402: APPLIED THERMODYNAMICS II

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3 1 0

Note: The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

Part-A

1. Thermodynamics of I.C. Engines:


   1.2 Combustion in SI Engines: Combustion in S.I. Engines, Combustion phenomenon, flame speed, ignition delay, effect of engine variables on Delay Period, abnormal combustion, preignition, detonation, effect of various engine parameters on detonation, effect of detonation on engine performance and methods employed to reduce detonation. Combustion chamber design for S.I. Engines (3)

   1.3 Combustion in CI Engines: Combustion in C.I. Engines, Combustion phenomenon, Delay period, Diesel Knock, CI engine combustion chambers, High speed cinematography for combustion visualization- a brief note (2)

   1.4 Fuels: rating of SI Engines fuels; cetane ratings of CI Engine fuels, Octane and Cetane numbers (2)

   1.5 Performance of IC engines: Performance curves of C.I. and S.I engines. Overall IC engine performance (engine sizing, mean effective pressure (MEP), power and torque) Effect of compression ratio and of air fuel ratio on power and efficiency of an engine: Variation of engine power with altitude, supercharging, its advantages and its applications, types of superchargers (2)

2. Gas Turbines:
Position of gas turbine in power industry; Classification of Gas turbines: on the basis of system of operation and on the basis of combustion (at constant volume, or at constant pressure).

Thermodynamics of constant pressure gas turbine cycle: calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; cycle air rate, temperature ratio; effect of change in Sp. heat and mass of fuel on power and efficiency. Operating variables and their effects on thermal efficiency and work ratio.

Thermal refinements and their effects on gas turbine cycle i.e. gas turbine cycle with regeneration, inter cooling and reheating; multistage compression and expansion, pressure losses in heat exchangers and combustion chambers.

Comparison of gas turbine with a steam turbine and I.C. engine. Field of application of gas turbines. (6)

**Part B**

3. **Aircraft Propulsion using gas turbine:**

Principle of propulsion thrust work and thrust power, propulsion efficiency, Overall thermal efficiency, specific fuel consumption. Intake and Propelling nozzle efficiencies. classification and comparison of ram jets, turbojets, turbo props, pulse jets and rockets

Thermodynamics cycle analysis and efficiencies of propulsive devices of turbojet engine, Advantages and disadvantages of jet propulsion over other propulsion systems. Variation of thrust and SFC with flight conditions for a given engine. Fields of application of various propulsion units. (4)

4. **Rotary Compressors:**

Introduction and general classification of rotary compressors: Comparison of rotary compressors with reciprocating compressor

Stagnation and static values of pressure, temperature and enthalpy etc, for flow through rotary machines.

4.1 **Positive Displacement Compressors**: Operation of positive displacement type of rotary Compressor like Roots Blower, Screw Compressor and Vane type Blower. (2)

4.2 **Centrifugal Compressors**: Principle of operation, components of a centrifugal compressor. Complete thermodynamics analysis of centrifugal compressor stage, polytropic, isentropic and Isothermal efficiencies; work done and pressure rise. Velocity vector diagrams for centrifugal compressors and power calculation, preguide vanes and prewhirl, slip factor, power input factor; degree of reaction and its derivation, energy transfer in backward, forward and radial vanes; Pressure coefficient as a function of Slip Factor, efficiency and outcomes velocity profile from the impeller.

Non-dimensional parameters for plotting compressor characteristics; Surging and choking in centrifugal compressor.

Field of application of centrifugal compressor. (5)

4.3 **Axial Flow compressors**

Components of axial flow compressor and their arrangement, Principle of operation, velocity vector diagrams, thermodynamics analysis and power calculation; Factors affecting stage pressure rise, work done factor; Degree of reaction and blade Efficiency and their derivation; Isentropic, polytropic and isothermal efficiencies.

Surging, choking and stalling in axial flow compressors. Characteristic curves for axial flow compressors, Flow parameters of Axial Flow Compressors like Pressure Coefficient, Flow Coefficient, Work Coefficient and Temperature rise coefficient, specific speed etc.

Comparison of Axial Flow Compressors with Centrifugal Compressors. Field of application of Axial Flow Compressors (5)

**BOOKS SUGGESTED:**
List of Experiments.
1. Study of constructional details, cooling system, Lubrication system and Fuel Flow system of following Engines:
Two stroke and four stroke Diesel engine.
Four stroke Petrol Engine.
2. To find the mechanical and thermal efficiency of a Diesel Engine.
3. To draw the valve timing diagram for a Diesel Engine
4. Determination of B.H.P. at various loads (pump being given fixed setting not to be changed by governor) for a Diesel Engine/Semi Diesel Engine. Graphical representation of B.H.P. and torque with speed and its interpretation.
5. Trial of a Diesel Engine/Semi Diesel Engine. Determination of B.H.P., fuel consumption ,I.H.P. and mechanical efficiency at various loads (speed parameters constant). Discussion on variation of thermal efficiency and specific fuel consumption with B.H.P.
6. To estimate the indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine when running at constant speed under constant settings of a carburetor (Morse test).
7. To obtain a power consumption curve, thermal and mechanical efficiency curve for the four stroke diesel engine when tested over a range of power from no load to full load. Also to draw up the heat balance sheet for this range of output of power.

MEC 403: DESIGN OF MACHINE ELEMENTS-I

Note: The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part. Design data book is allowed in the examination hall.

PART-A

Introduction:
Scope and meaning of design with special reference to machine design, design process, codes and standards, economic aspects of design, safety aspects of design, introduction to computer-aided design and engineering.
General Design Considerations:
Mechanical behavior of materials, statistical nature of material properties, selection of materials.
Concept of tearing, bearing, shearing, crushing, bending etc., stress and strength, stress concentration under static and dynamic loading, notch sensitivity, methods of avoiding stress concentration, fatigue loading, mechanism of fatigue failure, S-N diagram, endurance limit, endurance strength, design stresses for fatigue loading.
Fits, tolerances and surface finish

Fasteners:
Screws and bolts:
Design of screws, preloaded bolts, bolts subjected to shear, tension and torque, Design of eccentrically loaded bolted joints
Riveted Joints:
Types of failures of riveted joints, strength and efficiency of a riveted joint, design of butt and lap joints of a boiler, design of Lozenge joint, design of eccentrically loaded riveted joints
Welded Joints:
Types of failures of welded joints, strength of a welded joint, design of eccentrically loaded riveted joints
Design of cotter joint, design of knuckle joint

Shafts, Keys and Couplings:
Design of shafts subjected to torsional loading, bending loading, and axial loading and combined loading, design of shafts based on rigidity concept.
Types of keys, effect of keyway on strength of shaft, design of keys under different loading conditions.
Types of couplings, design of sleeve coupling, clamp coupling, slip coupling, Oldham coupling and pin type flexible coupling.

PART-B

Levers:
First, second and third types of levers, Design of hand lever, foot lever, bell crank lever.

Pipes and Pipe Joints:
Design of pipes, design of circular, oval and square flanged pipe joints.

I.C. Engine Parts:
Design of Piston, cylinder and connecting rod.

Power Screws:
Various types of threads used in power screw drives, conditions for self-locking and overhauling, efficiency of power screw drives, stresses developed in screws, design procedure for power screw drives like screw jack etc.

Books Suggested:
MEC 453: DESIGN OF MACHINE ELEMENTS-I

Design assignment to be given so as to cover the syllabus outlined in MEC 403

MEC 404: MATERIALS & HEAT TREATMENT

Note: The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

PART A

1. **Structure of crystalline solids** (6)
   Fundamental concepts of unit cell space lattice, Bravais space lattices, unit cells for cubic structure & HCP, study of stacking of layers of atoms in cubic structure & HCP, calculations of radius, Coordination Number and Atomic Packing Factor for different cubic structures, Crystal directions and planes, Miller indices.

2. **Crystal Imperfections** (3)
   Point Imperfections, Line, Surface and volume imperfections- their types and significance.

3. **Engineering Materials** (7)
   Classification of materials; Types, properties and application of CI, Carbon Steels, Alloy Steel, IS code for designation of steels, Stainless Steel, High Speed Steel- properties and applications.

4. **Phase Transformations** (3)
   Types of Phase transformation; Stages of phase transformation, Homogeneous nucleation and heterogeneous nucleation, Crystal growth.

PART B

5. **Solid solutions, Phase diagrams:** (9)
   Solid solutions, Types. **Phase diagrams:** Basic terms, phase rule, cooling curves, construction of phase diagrams, interpretation of equilibriums diagrams, Types of phase diagrams, Lever rule.

   Detailed study of Iron-Carbon equilibrium diagram and explanation of various connected terms, TTT diagram, and CCT diagram.

6. **Heat Treatment Process** (4)
   Heat treatment processes for steel – Annealing, Normalizing, Spheroidizing, Hardening, Tempering, Austempering and Martempering.

7. **Case Hardening and Surface Hardening** (4)

Suggested Books:
1. **Introduction to Material Science for Engineering**  

2. **Physical Metallurgy, Principles & Practices**  
   V. Raghavan, PHI, New Delhi, 2nd edition.

3. **Materials Science & Engineering- An Introduction**  

4. **Engineering Foundation of Material Science and Engineering**  

5. **Introduction to Physical Metallurgy**  

6. **Elements of Machine Design**  

**MEC 454: Materials & Heat Treatment Lab**

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1. Study of different engineering materials and their mechanical properties.
2. To study microstructure of following materials:
   - Hypo-eutectoid steel and Hyper-eutectoid steel
   - Hypo-eutectic and Hyper eutectic steel
   - Grey and White Cast iron
3. Study of microstructure and hardness of steel at different rate of cooling.
6. Hardness testing of metals on Vickers scale
7. Interpretation of microstructures.
8. Evaluation of mechanical properties of metallic materials by conducting following tests:
   - Hardness test (Vicker, Brinell and Rockwell Test)
   - Charpy Impact test
   - Tension Tests
   - Fatigue test
9. Study of testing machines.
10. Means of determining crystal structures (X-ray and Electron Diffraction method)
11. Specimen preparation and microstructure studies using Metallurgical and Scanning electron microscope.

**MEC405- Manufacturing Technology-I**

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**Note:** The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

**PART-A**  
Total Lectures: 38

1. **Mechanics of metal cutting:**  
   Methods of machining, Types of chips, Tool signature, Shear angle determination, Forces in metal cutting, Merchant diagram, Tool wear, Tool life, Economics of metal cutting, machinability.

2. **Analysis of Metal forming Processes:**  
   Analytical theory of metal forming, Classification of forming processes, effect of variables,
Methods of analysis, open die forging, Plain strain and axi-symmetric forging, rolling load estimation, Drawing stress in Wire/rod drawing, Calculation of extrusion pressure.

3. **Jigs and Fixture Design.** (5)
Principles of jig and fixture design, Principles of Degrees of Freedom, Method of location and clamping, Various devices for location and clamping, Indexing devices, Hydraulic and pneumatic actuation of clamping devices, Jig bushes, Use of standard parts for jig design, types of drilling jigs, Milling fixtures, Lathe fixtures, Grinding fixtures and their classification.

4. **Die Design:** (5)
Components of die design, design of die blocks, punches and strippers, methods of holding punches, sketches of stock stops. Design procedure for progressive dies, compound dies and combination dies for press tool operation, Forging die design for drop and machine forging parts.

**PART-B**

(5): **Tool Layout for Turrets.**

6. **Tool Layout for Automatics.** (3)
Classification of Automatics: Turret type automatic, tool layout procedure, time required for each operation, operation sheet, tool layout cam layout.

7. **Tooling Costs:** (4)
Estimating costs of a product, Estimating costs of tools, Economics of tooling, Break even point analysis, Minimum cost analysis.

8. **Gauges:** (4)
Limits and fits, Plain Gauges, Types of gauges, Fundamental of gauge design, Gauge makers tolerance, allowance for wear, practical application of Taylor’s principles of limit gauging, care of gauge, limitation of limit gauging.

9. **Surface Finish** (4)
Elements of surface finish. Factors affecting surface finish, Effect of surface quality on functional properties of machine parts, evaluation of surface finish, Indian standards on surface finish, Measurement of surface finish, Relationship of surface finish to the production methods. Finishing operation like honing, lapping, buffing, super finishing etc.

**BOOK SUGGESTED:**

**IBM 401 : MANAGEMENT OF INFORMATION TECHNOLOGY**

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Note: Examiner shall set eight questions, four from Part-A and four from Part-B of the syllabus. Candidate will be required to attempt any five questions selecting at least two questions from Part-A and two from Part-B.

Part A

**Information Technology (IT)**

IT and society, IT infrastructure in India vis-à-vis developed nations (Telecommunication, Internet reach, PC, Broadband, Mobile Phones), IT applications in Healthcare & Education, meaning of E-Readiness and E-participation index as defined by United Nations, areas where growth is expected in future.

**System Investigation & Analysis, Networking**

System Analysis & Design, Symbols used in modeling a business process, Networking concepts, Ethernet, IP addressing, Functioning of Routers, Bridges, hubs and switches in a network, Telecommunication (GSM, CDMA, Wireless and other new technologies)

**Internet & Intranet**

Functioning of Internet, Encryption & Digital signatures, Firewalls, Fraud on the Internet, Virus, Hacking & Denial of Service attacks, Intellectual Property Protection on the Internet, Intranet & security

Part B

**E-Commerce & E-Governance**

E-Commerce models, Intermediaries in E-Commerce, E-Governance in India, study of successful E-Governance models like E-Choupal, E-Payments (E-Cash, E-Wallets) and major players in the area, Online Shopping, Revenue models for Online Shopping Portals, Web Auctions like EBay, dealing with E-Waste.

**Knowledge Management & Business Intelligence**

Meaning of Knowledge Management, Designing a Knowledge Management System, Nature & Scope of Business Intelligence, Software for Business Intelligence, Data Warehousing and Data Mining techniques.

**Recommended Books:**

**SYLLABUS FOR**

**BE-MBA INTEGRATED (MECHANICAL ENGINEERING)**

**FIFTH SEMESTER**

**MEC-501 Fluid Mechanics**

L T P 3 1 0
Note: - Eight questions to be set in all. Candidates are required to attempt five questions selecting at least two questions from each part. S. I. units to be strictly followed. Part A questions to be set from topics 1 and 2 while part B questions are to be set from topics 3 and 4.

**Part-A**

1. **Incompressible Frictionless Flow:**
   
   Potential flow: Uniform flow, plane source and sink flows, potential vortex flow, flow past half body, doublet, flow around circular cylinder, flow past rankine oval body and flow past a cylinder with circulation. 8

2. **Incompressible Flow with Friction:**

   Concepts of boundary layer, boundary layer parameters (thickness, displacement thickness, momentum thickness, energy thickness and shape factor), equilibrium equation, derivation of Navier stokes equations of motion for incompressible viscous (constant viscosity), laminar flow in rectangular coordinates and their applications, Prandtl’s boundary layer equations. Details of Blassius solution of Prandl’s boundary layer equations for flat plate (no derivations) and its applications for finding drag co-efficient, local skin friction coefficient, velocity distribution and drag force for flat plate.

   Von- karman –Momentum –integrals equation and its applications to laminar boundary layer with cubic profile. Application of Van- Karman Momentum integral equation to turbulent flow, boundary layer for smooth flat plate( Drag coefficients and drag forces), Boundary layer separation and prevention. 10

**Part-B**

3. **Compressible- Isentropic Flow in Ducts (with negligible elevation changes)**

   Propagation of small weak disturbance (velocity of sound),Mach number and Mach cone, Continuity, momentum and energy equation for steady flow (one dimensional case only),Pipe flow problems, variation of stagnation parameters with mach numbers, compressibility correction factor, flow through nozzles & diffusers, changes of density, velocity, temperature, pressure & area with Mach number in a variable area flow duct, critical throat area related to Mach number, effect on convergent divergent nozzle parameters along the length of the nozzle with a variation of back pressure(discussion only). 10

4. **Flow around immersed a Bodies,(Drag and Lift):-**

   Introduction, Drag force, Lift & Drag coefficients, stream- line & bluff bodies. Drag on a circular cylinder, Drag on a sphere Drag and lift on an airfoil, circulation & lift on a circular cylinder, circulation and lift on an airfoil. 8

**Books Suggested:**


MEC-502 Theory of Machines-II

L T P 3 1 0

Note: The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

Part-A

1. Inertia Forces in Mechanism
Determination of Forces and couples for a link, inertia of reciprocating parts, dynamically equivalent system. Analytical and graphical methods, inertia force analysis of basic engine mechanism (crank, connecting rod and piston etc). Torque required to overcome inertia and gravitational force of a four bar linkage. 5

Lower Pairs:
Universal Joint: - single and double, calculation of maximum torque, Oldham’s Coupling, steering mechanism including. Ackermann’s and Davis steering mechanism. Mechanisms with lower pairs, pantograph, exact and approximate straight line motion, engine indicator, elliptical trammel.

Elementary knowledge of Kinematic synthesis of linkage by graphical and analytical methods. 4

Gyroscope:-
Definition, axis of spin, axis of precession gyroscope, gyroscopic couple, Gyroscope effect on the momentum of ships and vehicle, ship stabilization, stability of automobile and locomotive taking a turn. 5

2. Cams
Types of cams and followers, definition – basic circle & least radius, angle of ascent, dwell, descent & action. Displacement, velocity and acceleration diagrams for the followers with uniform velocity motion, simple harmonic motion, uniform acceleration and retardation, determination of maximum velocity, acceleration and retardation, analysis of follower motion for pre-specified cam profiles (tangent cams and convex cams). 7

Part-B

3. Balancing
Classification, need for balancing, balancing for simple and multiple masses, static and dynamic balancing – Primary and secondary balancing for reciprocating masses, inside and outside the cylinder locomotive balancing, swaying couple and variation of tractive effort, partial balancing of locomotive, balancing of the coupled locomotives and its advantages multicylinder in the line engines (primary and secondary balancing conditions and their applications), balancing of V-engines balancing machines (Static balancing M/c: dynamic balancing M/c, universal balancing M/c), introduction of balancing of the flexible rotors. 7

4. Gears
Toothed gears are their uses, types of toothed gears (spur gears, internal spur gears, spur &rack, bevel gears, helical gears, double helical gears, spiral gears, worm gears) definitions, pitch circle
diameter, pitch surface, pitch point, circular pitch, diametric pitch, module pitch, addendum, dedendum, clearance addendum circle, outside diameter, internal diameter, dedendum circle, root diameter, base.

Base circle diameter, face and flank of tooth, fillet, angle of obliquity or pressure angle, path of contact, arc of contact, arc of approach, condition for correct gearing, forms of teeth, cycloid and its teeth variants epicycloids and hypocycloid, involute methods of drawing in involute and cycloidal curves, interference in involute gears and methods of its removal, comparison of involute and cycloidal gear systems.

5. Gear Trains
Types of gear trains single and compound epicyclic gear trains, Problems involving their applications, estimation of velocity ratio of worm and worm wheel, helical and spiral gears (Determination of No. teeth, spiral angle and efficiency).

Books Suggested:-


MEC-552 Theory of Machines-II

L T P 0 0 3

Note: Minimum of ten experiments has to be performed.

1. Perform following practicals on Cam Analysis Machine.
   (a) To plot the n – θ (follower displacement Vs angle of cam rotation) curves for different cam follower pairs.
   (b) To study the effect of follower weight on bounce.
   (c) To study the effect of spring compression on bounce.
   (d) The test can be repeated by changing compression springs, follower weights & cam speed.

2. To find out critical speed experimentally and to compare the whirling Speed of a Shaft with Theoretical values, when
   (a) Both ends directionally fixed.
   (b) One end fixed and other free.
   (c) Both ends directionally free.

3. To perform the experiment of balancing of rotating parts and find the unbalanced couple and forces with the help of Static & Dynamic balancing set up.
4. (a) To study the gyroscopic effect of a rotating disc.
   (b) Experimental justification of the equation $T = I \omega \cdot \omega_p$ for calculating the
       gyroscopic couple by observation and measurement of results for independent variation
       in applied couple $T$ and precession $\omega_p$.

5. To perform the following practicals on Journal Bearing Apparatus.
   (a) To study the pressure profile of lubricating oil at various conditions of load and speed.
   (b) To measure the frictional torque & power transmitted.
   (c) To plot the Cartesian pressure curve.

6. To perform the following practicals on Universal Governor Apparatus.
   (a) Determination the characteristics of sleeve position against speed for all governors.
   (b) Determination the characteristics curves of radius of rotation against controlling force
       for all governors.
   (c) To study the effect of varying the mass of central sleeve for porter and proell
       governors.
   (d) To study the effects of varying initial spring compression for Hartnell Governor.

7. To find the Coriolli’s component of acceleration and verify the result.

8. Plot pressure variation curve in longitudinal and transverse direction of a pad for various
   speeds and pad inclination, of Michell Tilting pad bearing apparatus.

9. To perform the following practicals on Slip & Creep Measurement Apparatus.
   (a) To measure the co-efficient of friction between pulley material and different belt material.
   (b) To measure the power transmitted with varied belt tensions.
   (c) To measure percentage slip at fixed belt tension by varying load on the brake drum
       and plot the graph of $(T_1 - T_2)$ Vs percentage slip i.e. slip characteristics.
   (d) To study the creep of the belt.

10. To perform the following practicals on Epicyclic Gear-Train Apparatus.
    (a) To measure epicyclic gear ratio between input shaft & output shaft.
    (b) To measure input torque, holding torque and output torque to verify the Torque
        equation: $T_i + T_h + T_o = 0$.

11. To study the working and construction of D-slide valve, Stephenson link motion, Allan
    link motion, Gooch link motion, Walschaert valve gear and different inversions of single
    slider crank chain and double slider crank chain mechanism and describe their relative
    merits.

12. (a) Find the moment of inertia of a given body with the help of Fly-wheel.
    (b) Calculate the minimum possible periods of oscillation if the point of
        suspension may be moved.

13. Find out experimentally the viscosity of the given fluid under varying conditions
    temperature and pressure and draw the graphs – Viscosity Vs Temp. and Viscosity Vs
    Pressure.

14. To study and calculate the influence of inertia upon velocity and acceleration with the
    help of influence of inertia upon velocity and acceleration model.
# MEC-503 Manufacturing Processes-I

**L T P 3 0 0**

1. **Foundry:** (a) Definition, patterns, difference between pattern and casting, type of patterns, pattern allowances, colour scheme on patterns, moulding material, types of moulds, moulding techniques, cores, core boxes, directional solidification of casting, gates, gating system and design, riser.
   (b) Die-casting and shell moulding, investment casting, continuous casting, cleaning, finishing, inspection of casting, classification of defects, salvage of defective casting. Construction & working of cupola furnace, electric furnaces, induction furnace.
2. **Metal Forming:** (a) Definition and classification of metal forming, type of rolling, hot rolling, rolling mills, forging, smith forging, drop forging, machining forging and press forging, defects in forging.
   (b) Pipe and tube manufacture, extrusion, hot spinning, drawing and cupping, piercing, cold rolling, wire drawing, rod and tube drawing, metal spinning, coining, embossing and shot peening, sheet metal working operations, piercing, blanking, bending and drawing, punch and die setup, presses.
3. **Powder Metallurgy:** Definition and classification of metal powder, advantages and limitation, metal powder product, method of producing powders, briquetting and sintering, hot iso-static Processing, sizing and finishing operation.
4. **Welding:** (a) Definition and classification, types of welded joints, weldability, Gas welding: oxy-acetylene welding, equipment, lighting up, type of flames, welding techniques, welding of cast iron, flame cutting, advantages and limitations Electric arc welding: principle, metal transfer in arc welding, straight & reverse polarity in AC & DC, relative merits & demerits, various electric arc welding processes, coding & selection of welding electrodes.
   (b) TIG, MIG welding processes, electric resistance welding, spot, butt, seam, upset, projection & high frequency resistance welding, thermit welding, brazing and soldering, description of special welding techniques, choice of process for welding, defects in welding joint, their causes and remedies.

**Books Suggested:**


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# MEC-553 Manufacturing Processes-I

**L T P 0 0 3**

Laboratory Work: Experimental work pertaining to study & use of sand testing equipment, Relevant shop floor exercises involving practice in pattern making, sand casting, machining (exercises on lathe, milling machine, shaper etc.), welding (Performance on any two techniques
MIG/TIG /Gas/Resistance welding), Application of sheet metal fabrication techniques, fitting work.

**MEC 504: Design of Machine Elements –II**

**L T P 3 0 0**

**Note:** The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

**Part –A**

Types of mechanical drives and their applications. Factors influencing the choice of a mechanical drive.

Design of following mechanical drives and their components.

(i) Design of belt and rope drives including selection and type of a belt and design of pulleys. 5
(ii) Design of chain drives including section of type of chain. 3
(ii) Design of gear drives, factors influencing the choice of a gear. Design details of spur, helical, worm and bevel gears. 6

**Part-B**

(iv) Selection of a sliding and rolling type of bearings. Design of Journal bearing. Details of bearing housings. 6
(v) Design of Flywheels. 4
(vi) Concept of positive contact clutches, Design of friction contact clutches (Axial & Radial). Brakes (Band, Band & Block and Pivoted block brakes with long shoes). Internal Expanding Shoe Brakes. 6
(vii) Design of Spring – Helical and Leaf springs. 6

**Suggested Books:**


**MEC-554 Design of Machine Elements –II**

**L T P 0 0 6**
Design assignments so as to cover the principles outlined in MEC-504 such as:

1. Design of belt and rope drive.
2. Design of pulleys.
3. Design of chain drives.
4. Design of gear involving spur, helical, worm and bevel gears.
5. Design of flywheels.
7. Design of clutches.
8. Exercise on selection of sliding bearings.
10. Design of journal bearings
12. Details of bearing housings.
14. Factors influencing the choice of gear drive.
15. Factors influencing the choice of selection of type of belt
IBM 501 : MARKETING MANAGEMENT

L T P 3 0 0

Note: Examiner shall set eight questions, four from Part-A and four from Part-B of the syllabus. Candidate will be required to attempt any five questions selecting at least two questions from Part-A and two from Part-B.

Objectives: (i) To understand the nature, tasks and the environment under which marketing operates. (ii) To study the theory, principles and practical aspects of various marketing functions. (iii) To learn to take marketing decisions.

Part A

Introduction to Marketing: [5]
Definition; Scope and Importance of Marketing; Key Customer Markets; Concepts/Philosophies of Marketing; Holistic Marketing Concept; Marketing Tasks; Marketing Mix

Marketing Environment: [5]
Marketing Environment; New Marketing Realities; New Consumer Capabilities; Demographic Environment; Social-Cultural Environment; Natural Environment; Technological Environment and Political-Legal Environment; SWOT analysis.

Analyzing Markets: [5]
Marketing Research Process; Sources of data collection; factors influencing consumer behavior; buying decision process; post-purchase behavior; Organizational Buying; Stages in the Buying Process.

Market Segmentation: [6]
Levels of market segmentation; segmenting consumer markets; Niche Marketing; segmenting business markets; Michael Porter’s five forces model; Analyzing competitors; strategies for market leaders; Targeting and Positioning.

Part B

Product Decisions: [6]
Product characteristics; classifications; differentiation; packaging and labeling; Product Life Cycle.

Pricing Strategies: [6]
Understanding Pricing; Setting the Price; Initiating and Responding to Price Changes; Reactions to Competitor’s Price Changes.

Marketing Channels: [6]
Marketing Channels; Role of Marketing Channels; Identifying Major Channel Alternatives; Types of Intermediaries; Channel-Management Decisions, Retailing, Wholesaling.

Marketing Communication: [6]
The Role of Marketing Communications; Communications Mix-Advertising, Sales Promotion, Public Relations and Publicity, Events and Experiences, Direct and Interactive Marketing, Personal Selling.

References:
IBM 502: HUMAN RESOURCE MANAGEMENT

L T P 3 0 0

Note: Examiner shall set eight questions, four from Part-A and four from Part-B of the syllabus. Candidate will be required to attempt any five questions selecting at least two questions from Part-A and two from Part-B.

Objectives: The objective of the paper is to make student aware of the various functions and importance of the HR department in any organization. It is basically concerned with managing the human resources, whereby the underlying objective is to attract, retain and motivate the human resources in any organization, which is the most challenging and daunting look for any organization today.

Part A

Introduction: [5]
Meaning, scope, objectives and functions of HRM; Importance of Human Resource Management; HRM & HRD a comparative analysis;

Environment of HRM: [5]
Role of government, internal and external forces; Human Resource Management practices in India.

Definition, objectives, process and importance; Job analysis, description, specification & job evaluation; Recruitment, selection, placement and induction process;

Human Resource Development: [6]
Concept, Employee training & development; Career Planning & development; Promotions, demotions, transfers, separation, absenteeism & turnover;

Part B

Job Compensation: [6]
Wage & salary administration, incentive plans & fringe benefits.

Performance Management: [6]
Concept & process, performance appraisal, Potential appraisal;
Quality of work life (QWL): Meaning, techniques for improving QWL.

Industrial Relations: Concept and theories, trade unions; Health, Safety & Employee welfare measures; Employee grievances and discipline, participation & empowerment; Introduction to collective bargaining.

References:

MEC 556 Vocational Training after 4th Semester

Each student shall attend 4 weeks training after 4th semester in Mechanical Industry, National/International level technical institute/research organization.

SYLLABUS FOR
BE-MBA INTEGRATED (MECHANICAL ENGINEERING)
SIXTH SEMESTER

MEC 601- Mechanical Vibrations
L T P 3 1 0

Note: The examiner shall set 8 questions i.e., 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

Part-A

1. Fundamentals of Vibration
   Free vibration, Forced vibration, Simple harmonic motion, Combination of two simple harmonic motions, Fourier analysis, Fourier integral.

2. Single degree of freedom system-free vibration
   Natural frequency, Equivalent systems, Energy method (average energy principle, principle of conservation of energy, principle of virtual work, maximum energy principle), Response to an initial disturbance, Phase plane method, Duhamel’s integral.

3. Single degree of freedom system-damped vibrations
   Damping models (viscous damping, structural damping, and coulomb damping), Over-damped case, critically damped case, under-damped system, Logarithmic decrement.

4. Single degree of freedom system-forced vibrations
   Harmonic excitation, Mechanical impedance (analysis of system with structural damping, analysis of system with elastically coupled viscous damper), System identification from
frequency response, Support motion (solution for absolute/relative motion of the system, seismometer, accelerometer), Bending critical speeds of simple shafts, Vibration isolation (viscous damper and elastically coupled viscous damper).

Part-B

5. **Two degrees of freedom systems**
   Free vibration of spring coupled systems, Two degrees of freedom mass coupled systems, Bending vibrations of two degrees of freedom systems, Forced vibration of an undamped two degrees of freedom system, Undamped vibration absorbers, Vibration isolation.

6. **Multi degree of freedom methods**
   Close coupled systems (eigen value problem upto four degree of freedom system using Graeffe’s method), Far coupled systems, Orthogonality of mode shapes, Modal analysis (Undamped analysis, damped systems), Forced vibration (modal analysis, forced vibration by matrix inversion).

7. **Numerical methods**
   Dunkerley’s lower bound approximation, Rayleigh’s upper bound approximation, Holzer method (fixed-free systems, free-free systems, branched systems), Method of matrix iteration.

8. **Continuous systems**
   Systems governed by wave equation (stretched string, axial vibrations of a bar, torsional vibration of a circular rod), Free vibration of beams.

**Books suggested:**

**MEC 651 - Mechanical Vibrations**

1. To determine the mass moment of inertia of a body by Trifilar suspension.
2. To determine damping ratio of a vibrating body by rap test.
3. To determine damping ratio of a damper by forced vibration.
4. Investigate node and antinode position for a cantilever.
5. Find first three natural frequencies of a body from it’s time response. (using FFT algorithm of Matlab)
6. Experimentally find out different harmonic frequencies present in vibrations of an IC engine.
7. Use instrumented impact hammer to find transfer function between two given points of a structure.

**MEC-602 Heat Transfer**
Note: The Examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part. Numerical terminology must be in S.I. units only. Students shall be permitted to consult Heat and Mass Transfer data book compiled by the staff of P.S.G. College of Technology, Coimbatore.

PART – A

1. Basic Concepts
   Difference between the subject of Heat Transfer and its parent subject “THERMODYNAMICS”
   Different methods of heat transfer – Conduction, Convection, and Radiation. 2

2. Conduction
   Fourier’s law of heat conduction, coefficient of thermal conductivity, effect of temperature and pressure on thermal conductivity of solids, liquids and gases and its measurement. Definition and explanation of the term Thermal Diffusivity.

   Three-dimensional most general conduction equation in rectangular, cylindrical and spherical co-ordinates involving internal heat generation and under unsteady state conditions. Derivation of equations for simple one dimensional steady state heat conduction without heat generation from three-dimensional equations through walls, cylinders and spherical shells (simple and composite). Electrical analogy of the heat transfer phenomena in the cases discussed above. Equipment areas, shape factors. Critical thickness of insulating layers on electric wire and pipes carrying hot fluids. Influence of variable thermal conductivity on conduction through simple cases of wall, cylinder and sphere.

   System with Heat Sources: Internal generation cases along with some practical cases of heat conduction, heat conduction through piston crown and case of nuclear fuel rod with cladding. Introduction to unsteady heat transfer. 8

3. Extended Surfaces
   Straight rod type of fins of uniform cross-section: (e.g. of circular and rectangular cross-section). Circumferential fins of rectangular cross-section provided on the circumference of a cylinder.
   Fins effectiveness and fins efficiency for straight rod fins of rectangular and circular cross-section. Application of fins in temperature measurement of flow through pipes and determination of error in its measurement. 5

PART- B

5. Convection
   Introduction, Processes, Newton’s law of cooling, theory of dimensional analysis as applied to free and forced convective heat transfer. Analytical formulae of heat transfer in laminar and turbulent flow, flow over vertical and horizontal tubes and plates. Hydrodynamic and Thermal boundary layers over a flat plate, Blasius solution for hydrodynamic and Thermal boundary layer (No. Derivation) 3

1. Heat Exchanger
   Classification of heat exchangers, Overall coefficient of heat transfer, effect of scale formation, Log mean temperature difference for parallel and counter flow heat
2. Heat Transfer with change of phase

Boiling, Boiling Regimes, Bubble Growth and Nucleate Boiling, forced convection boiling, Theory accounting for the increased values of h.t.c. during nucleate phase of boiling of liquids; different phase of flow boiling (theory only).

Condensation and its classification, laminar filmwise condensation on a flat vertical plate and its mathematical analysis, drop-wise condensation.

3. Radiation


Derivation formula for radiation exchange between two bodies using the definition of radiosity and irradiation and its application to cases of radiation exchange between three bodies, simplification of the formula for its application to simple bodies like two parallel surfaces.

Books Suggested:


MEC-652 Heat Transfer

LT P 0 0 3

1. To study and compare temperature distribution, heat transfer rate, overall heat transfer in parallel flow and counter flow heat exchanger.
2. To study the parallel flow and counter flow heat exchanger.
3. To find the thermal conductivity of metal rod
4. To determine heat transfer coefficient in natural convection.
5. To determine heat transfer coefficient in forced convection for air flowing in a tube.
6. To determine heat transfer coefficient in drop wise and film wise condensation.
7. To determine the emissivity of a given plate at different temperatures.
8. Evaluate the performance of a heat pipe.
9. To determine Overall Heat Transfer coefficient in Shell and Tube heat exchanger.
10. To determine the Stefan Boltzmann’s constant in radiation heat transfer process.
MEC-603 Robotics

L T P 4 0 0

Note: The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt a total of 5 questions with at least 2 questions from each part.

Part-A

1. **Fundamentals of Robot**
   Robot degrees of freedom, robot parts: base, end effectors, drives, joints, classification, characteristics and applications of Robots. 4

2. **Spatial Descriptions and Transformations**
   Robot kinematics, Inverse of transformation matrices, Conventions for affixing frames to Links. 6

3. **Inverse Manipulator Kinematics**
   Solvability, Algebraic versus Geometric solutions, reduction to polynomial solution, Pieper’s solution, Examples of inverse manipulator kinematics. 6

4. **Jacobians: Velocities and Static forces**
   Differential relationships, Jacobians, Differential motions of a robot and its hand frame. 6

Part-B

5. **Manipulator Dynamics**
   Dynamic equations for multiple degree of freedom robots, Langrangian mechanics, effective moment of inertia. 6

6. **Trajectory Planning**
   Joint space vs. Cartesian-space descriptions, Joint space trajectories, Cartesian space trajectories. 6

7. **Sensors & Manipulator Mechanism Design**
   Robot sensors: proximity, range, force, tactile, visual, auditory sensors. Kinematic configuration, actuation schemes, stiffness and deflections, position sensing, force sensing. 6

8. **Robot Programming**
   Methods of robot programming, Types of Programming, Robot programming Languages. 4

Books Suggested:

MEC-653 Robotics

L T P 0 0 3

1. Study of different types of robots based on configuration and application.
2. Study of different type of robotics links and joints.
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
7. Robot programming exercises on Pick and place, Painting, welding, polishing, gluing, stacking and drilling

**MEC-604 Fluid Machinery**

Note: - Eight questions to be set in all with four questions in each of the part A and B. Candidates are required to attempt a total of five question selecting at least two questions from each part. Part A questions to be from 1, 2, 3, 4 and Part B questions to be set from 5, 6, 7 and 8. S.I. System of Units to followed.

**Part-A**

1. **Principles of Hydraulic Machines & General Study of Hydro Power Plants:**
   Force of Jet on stationery, moving flat and curved plates, flow over radial, vanes, velocity triangles, Determination of power. Different types of runners, classification of Hydraulic Power and turbines (General description)

2. **Impulse Turbine:**
   Description of Pelton impulse turbine, design of Pelton turbines such as number of jets, number of buckets, depth and width of buckets, velocity diagrams, jet ratio, power and efficiency.

3. **Reaction Turbines:**
   Description of Francis, Kaplan Turbines, velocity diagrams, speed ratio, flow ratio, degree of reaction as applied to Kaplan and Francis turbines, cavitation. Governing of Turbines: Description of oil pressure governor, double regulation of impulse and reaction turbines. Draft Tube: Description, function and simple problems.

**Part-B**

4. **Centrifugal Pumps:**

5. **Dimensional Analysis and Performance of Hydro Machines:**
   Derivation of equations for Reynold, Froude Euler, Mach, and Weber numbers from ratio of forces. Buckingham Theorem and its practical applications to turbines and pumps. Derivation of various dimensionless, specific and unit quantities for turbines and pumps by application of Buckingham theorem. Characteristics curves of turbine and pumps.

6. **Reciprocating Pumps**
   Slip and coefficient of discharge, Effect of acceleration on pressure in suction and delivery pipes, Air vessels (work saved by air vessel on suction and delivery pipe) Comparison with centrifugal pumps.

7. **Hydraulic Devices and Control (Description only):**
   Basis of control system, Brief classification of control devices, symbolic representation of control system components, Example of control devices (valves) such as accumulator, Intensifier, relief valve, reversing valve and time delay valves, gear pumps and hydraulic ram controls. Brief description of hydraulic fluids used in control system.

**Books Suggested:**
4. Fluid Machinery

MEC-654 Fluid Machinery

L T P 0 0 2

1. Determination of various efficiencies of Hydraulic Ram.
2. To draw characteristics of Francis turbine.
3. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance.
4. To draw the characteristics of Pelton Turbine.
5. To draw the various characteristics of Centrifugal pump.
6. Determine the effect of vane shape and vane angle on the performance of centrifugal fan.

MEC-605 Manufacturing Processes-II

L T P 3 0 0

Note: The examiner shall set 8 questions i.e. 4 from each part and students shall be required to attempt any 5 questions with at least 2 questions from each part.

PART A

1. Machine Tools: Role of cutting tool materials on machining efficiency and economy, cutting tool materials, essential properties of modern cutting tool materials, high carbon steels, alloy steels, high speed steel, cast alloy, cemented carbides, ceramics, diamond’s CBN and PCD etc. geometry of single point cutting tools, twist drill and milling cutters, cutting speeds and feeds. Coolants: Definition, classification, purpose, properties, its effect on speed and feed. Lubricants: Function and properties.

2. Metal Cutting
   (a) Lathe: Machine and its accessories, lathe operation, taper turning and thread cutting, kinematics scheme of lathe.

   (b) Shaper: classification, quick return and hydraulic mechanism, shaper operations.
   Planer: Difference between planer and shaper, classification, operations, drive mechanism.
   Slotting operations.


   (d) Milling: classification, operations, types of cutters, up milling and down milling. Indexing: Simple, compound and differential indexing.
(e) Grinding, grinding wheel-designation and selection, essential qualities for a grinding wheel, types of grinding wheels, cylindrical, surface, and center less grinding. Broaching operation and broaching machine.

PART B
3. Processing of Ceramics & Composite Materials: Definition, difference between ceramics and composites, classification of ceramics, properties, processing, product applications, composite materials, types, processing, particulate composites, fiber reinforced composites, metal matrix composites, filament winding, laminates, machining, cutting and joining of composites.


Books Suggested:

IBM 601: MANAGERIAL ECONOMICS
L T P 3 0 0

Note: Examiner shall set eight questions, four from Part-A and four from Part-B of the syllabus. Candidate will be required to attempt any five questions selecting at least two questions from Part-A and two from Part-B.

Objectives: To provide students with an understanding of basic economic principles of production & exchange-essential tools in making business decisions in today’s global economy. The object presents the foundation to understanding how the economy works, covering microeconomic description of business applications, including pricing for profit maximization, price elasticity, market structures and modeling of business in varying economic climates. The focus is on market economics, the organization that operation there and their business strategies.

Part A

Introduction to Managerial Economics:
Nature Scope and Importance of Managerial Economics, opportunity costs, incremental principle, time perspective, discounts and equi marginal principles.

Demand Concepts and Analysis:
Individual Demand, Market Demand, Kinds of Demand, Determinants of Demand, Demand Functions, Functions, Demand Schedule and Law of Demand.

Theory of Consumer Behavior:
Cardinal Utility Approach and Ordinal Utility (Indifference Curves) Approach;

Elasticity of Demand:
Concept, Types, Measurement and importance.

Demand Forecasting:
Sources of Data: Expert Opinions, Surveys and Market Experiments; Time Series Analysis: Trend Projection; Barometric Forecasting: Leading Indicators, Composite and diffusion Indices.

**Part B**

**Production Function:**

Concept and types, Returns to Factor and Returns to Scale, Law of Variable Proportions.

**Cost concepts and Analysis:**

Concept of Cost, Short run and Long-run Cost Curves, Relationships among various costs, Break-even Analysis.

**Revenue Curves:**

Concept and Types.

**Perfect Competition:**

Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run;

**Monopoly:**

Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run; Price Discrimination;

**Imperfect Competition:**

Monopolistic Competition, oligopoly and Barriers to Entry.

**References:**


**IBM 602: CORPORATE LEGAL ENVIRONMENT**

L T P 3 0 0

**Note:** Examiner shall set eight questions, four from Part-A and four from Part-B of the syllabus. Candidate will be required to attempt any five questions selecting at least two questions from Part-A and two from Part-B.
Objective: Corporate legal environment represents that external environment in which the organization has to work. The course covers the basic laws which a student must be aware of.

Part A

Information Technology Act-2000:
Objective of the act, documents excluded from the scope of the act, digital signatures, types of digital signatures in India, certifying authorities in India, regulation of certifying authorities, duties of subscribers, offences, appellate tribunal, penalties and adjudication

Company Law:
Definition and nature of a company, kinds of companies, formation of a company, memorandum of association, articles of association, prospectus, membership in a company, shares, transfer and transmission of shares, meetings and proceedings.

Part B

Patents Law:

Consumer Protection Act 1986:
Definitions under the act: complaint, consumer, defect, deficiency, unfair trade practice, consumer protection councils, redressal machinery under the act, district forum, state commission, national commission

References: