PANJAB UNIVERSITY, 
CHANDIGARH

Scheme and Syllabus of 
BE MBA Integrated (Mechanical 
Engineering) 
3\textsuperscript{RD} TO 10\textsuperscript{TH} Semester 
Examination 2012-13
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Marks* refer to mid semester evaluation and end semester evaluation.
## BE MBA integrated (Mechanical Engineering)

### FOURTH SEMESTER

#### 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**

**Marks* refer to mid semester evaluation and end semester evaluation**

(ii)
# BE MBA integrated (Mechanical Engineering)
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There will be four weeks Vocational Training in the manufacturing concerns after 6th semester

Marks* refer to mid semester evaluation and end semester evaluation

(iv)
Student can exercise **OPTION 1 or OPTION 2** according to the following:

A student may opt for one semester training in lieu of subjects of 8th Semester. The marks for six months training will be equal to the total marks of 8th Semester study. A student can opt for six month semester training under following conditions:-

a. The student got selected for job in campus placement and the employer is willing to take that student for the training.

b. The student got offer of pursuing training from reputed government research organization/govt. sponsored projects/govt. research institution provided that student should not be paying any money to get trained. For pursuing this training student needs the prior approval from the Coordinator of the respective branch.
## BE MBA integrated (Mechanical Engineering)
### SEVENTH SEMESTER

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1. The project will continue for a period of two weeks after 8th semester examinations.
2. The examination will be conducted in S.I. system of units.
3. In case of elective subject where there is no lab, project work/ seminar may be given.
4. The number of elective subjects to be offered in the 8th semester will be announced by the Branch Co-ordinator depending upon the availability of staff.

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### Option 2

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STUDENTS HAVE TO SELECT 3 SUBJECTS FROM MAJOR SUBJECT AND 2 FROM MINOR

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STUDENTS HAVE TO SELECT 2 SUBJECTS FROM THE MAJOR SUBJECT AND 2 FROM MINOR
MEC-301: APPLIED THERMODYNAMICS-I

Part A

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.

1. Reciprocating Air Compressors: (5)


2. Steam Generators: (5)


3. Boiler Draught: (4)

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: (3)


Part B

5. Nozzles and Diffusers: (4)

6. **Impulse Steam Turbine:**


7. **Reaction Turbine:**

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

8. **Condensers:**


Books Suggested


**MEC-302: 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:
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:

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-352: MECHANICS OF MATERIALS – I**

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**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. Determine & plot various cylindrical and spherical shells parameters through interactive C/C++ computer programming or using MATLAB.

**MEC-303: THEORY OF MACHINES-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**
1. Basic concepts: 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: 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).

3: Kinematics Synthesis of Mechanism. 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.


5: Force Analysis: 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.

BOOKS SUGGESTED.

MEC-353: THEORY OF MACHINES-I

List of Experiments
1. (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.
2. Study and draw the sketches of difference inversions of single slider chain and double slider crank chain.
3. Find the co-efficient of friction for different belt material on a cast iron : Pulley.
4. To perform the various practical 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.
5. Study the working and construction of D-slide valve and piston valve. Discuss their relative merits.
6. Study and sketch the Stephenson link motion and the Gooch link motion and describe their relative merits.
7. Study and sketch the Walschaert valve gear.

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. SP46-2003 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 multi 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. I.C. Engine Piston, connecting rod, spark plug, atomizer, Fuel injection pump. (2 Sheets Min.)
8. Machine Tool Parts: Tail stock. (1 Sheet Min)
9. Miscellaneous: Screw jack, drill press vice, valves (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: MANUFACTURING PROCESSES

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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


PART-B
4. Milling & Drilling : Milling; principle, types of milling machines, specifications of milling machine, Introduction to indexing, Multipoint cutting tool, Types of milling cutters. Principles,
Classification of drilling machine, Different operations on drilling machine, Speed and feed in drilling.


6. **Broaching**: Broach, Nomenclature, cutting action of broach, Broaching operations and applications.

**Recommended Books**

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<td>Workshop Technology Vol. I &amp; II</td>
<td>Hazra Chowdhry</td>
<td>Media Promotors</td>
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<tr>
<td>Manufacturing materials &amp; process</td>
<td>Lindberg</td>
<td>Prentice Hall</td>
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<td>Manufacturing processes</td>
<td>Begeman</td>
<td>John Wiley</td>
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<td>Workshop Technology</td>
<td>S.K. Garg</td>
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<td>Production Technology</td>
<td>R K Jain</td>
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**MEC-355: MANUFACTURING PROCESSES**

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**List of Experiments**

1. To prepare a mould & do casting.
2. Study of casting defects.
3. To prepare a lap joint using- electric arc welding.
4. To prepare a joint using- gas/spot welding.
5. To prepare a job on lathe machine- involves turning, grooving, drilling, boring & threading operation.
6. To prepare a job on shaper machine
7. To prepare a job on milling machine
8. To prepare a job on drill machine- involves drilling, counter sunk & reaming operation.
9. To prepare a job involves-tapping operation.

**MEC-306: COMPUTATIONAL METHODS**

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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. **Matrices and linear system of equations**

   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,
2. Sequences and series  

PART-B

3. Numerical Methods  

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


Perception: Factors Influencing perception- perceptual selectivity Linkage between perception and Individual decision making-ethics in decision making.

Personality and Emotional Quotient (EQ): The meaning of personality, its determinants-personality Traits; The big five model, Emotional quotient.
Motivation & Morale: Concepts to Applications.


Part-B


Power & Politics: Definitions of Power-Distinction between Power and Authority-Bases of Power-Power Structure and Block, Impression management-political behavior in organizations.

Conflict & Inter Group Behaviour & Collaboration: Sources of Conflict, Intra-individual Conflict, Interpersonal Conflict, Inter-group behavior and Conflict, Organizational Conflict, Negotiations-Approaches to Conflict Management-Collaboration.


References
1. Behavior in Organizations ,Greenberg, Baron , PHI
3. Organization Behavior ,Fred Luthans , TMH

MEC 357: VOCATIONAL TRAINING after 2nd Semester

SYLLABUS FOR
BACHELOR OF ENGINEERING (MECHANICAL)
FOURTH SEMESTER

SYLLABUS FOR
BACHELOR OF ENGINEERING (MECHANICAL)
FOURTH SEMESTER

MEC-401: APPLIED THERMODYNAMICS-II

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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.

   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

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

   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. **Gas Turbines:**

   Introduction; 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.

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. Fields of application of various propulsion units.

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.

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 outcoming velocity profile from the impeller. Non-dimensional parameters for plotting compressor characteristics; Surging and choking in centrifugal compressor.
Field of application of centrifugal compressor.

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

BOOKS SUGGESTED:


MEC-451: APPLIED THERMODYNAMICS-II

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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-402: MECHANICS OF MATERIALS-II**

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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. **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:  

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

BOOKS SUGGESTED:


MEC-403: THEORY OF MACHINES-II

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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. 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.

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.

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.

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).

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.

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, diametrical 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. of teeth, spiral angle and efficiency).

Books Suggested:-

MEC-453: THEORY OF MACHINES-II

1. Balance experimentally the given known force by introducing two weight (forces) parallel to the given force in two different planes and verify the result by analytical method.

2. Study the dynamic balancing machine & balance of a given body i.e. rotor by different methods.

3. Study the working and construction of the two types of steering gears. Draw neat sketches of each type and measure the angle in Ackerman's steering gear fitted in different vehicles. Find the ratio of intersection of two arms from the front axle to the base of the vehicle.

4. Study the different types of mechanisms for tracing out the approximate straight line.

5. Find out the pressure distribution graph analytically & practically around a simple Journal bearing under variable load conditions on the shaft.

6. Balance as far as possible the known unbalance due to reciprocating parts by introducing two revolving weights in two different planes. Find out experimentally the fraction of the reciprocating pans which should be balanced so that the residual unbalance force may be least.

7. Find out experimentally the viscosity of the given fluid under varying conditions of temperature and pressure and draw the graphs - Viscosity Vs' temp. and Viscosity Vs pressure.

8. Study the electrical dynamometer and find out the maximum torque of the given m/c.

9. Study the whirling speed apparatus and calculate the critical speed of the given System.

10. Find out the Co-efficient of friction between two given materials with the concept of vibration that is the effect of C. & frequency on co-efficient of friction.

11. To study the model of an Epicyclic gear train and to determine the speed ratio.

12. To study the various tooth profiles and to generate the involute profile on a blank.

MEC-404: MATERIALS AND 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**
   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**

   Point Imperfections, Line, Surface and volume imperfections- their types and significance.

3. **Engineering Materials**

   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**

   Types of Phase transformation; Stages of phase transformation, Homogeneous nucleation and heterogeneous nucleation, Crystal growth.

**PART-B**

5. **Solid solutions, Phase diagrams:**

   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**

   Heat treatment processes for steel – Annealing, Normalizing, Spheroidizing, Hardening, Tempering, Austempering and Martempering.

7. **Case Hardening and Surface Hardening**


**Suggested Books:**

1. Introduction to Material Science for Engineering
2. Physical Metallurgy, Principles & Practices
   V. Raghavan, PHI, New Delhi, 2nd edition.
4. Engineering Foundation of Material Science and Engineering
5. Introduction to Physical Metallurgy
6. Elements of Machine Design
   V.B. Bhandari, Tata McGraw Hill, New Delhi, 2nd edition

**MEC-454: MATERIALS AND HEAT TREATMENT**

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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.

IBM-401: INFORMATION TECHNOLOGY FOR MANAGERS

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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
System Investigation & Analysis, Networking: System Analysis & Design, Symbols used in modeling a business process, modeling different business processes, 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, study of successful 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: study of portals like EBay, dealing with E-Waste, E-Governance in India, study of implementation of E-Governance in different states in India, scope for further improvement

New Technologies shaping the IT field: Study of new technologies like RFID, WiMAX, Bluetooth, GPS, smart cards etc and their implementation case studies
Online Banking: infrastructure and implementation of Online Banking in India, intermediaries in online banking
Cloud Computing: The business model of cloud computing, advantages and drawbacks of adopting the cloud computing framework.

References:
1. Business Data Communications & Networking, Jerry FitzGerald, Alan Dennis, John Wiley
2. Information Technology for Management: Improving Performance in the Digital Economy, Efraim Turban, Linda Volonino, John Wiley

MEC-406: FLUID MECHANICS

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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.

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 Prandtl’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.

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).

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


Books Suggested:-

6. Introduction to Fluid Mechanics : Fox, Wiley India Pvt Ltd, 2nd edition

SYLLABUS FOR
BACHELOR OF ENGINEERING (MECHANICAL)
FIFTH SEMESTER

MEC-501: DESIGN OF MACHINE ELEMENTS-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. 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:
1. Design of Machine Members

2. Machine Design

3. Machine Design

4. Text Book of Machine Design

5. Machine Design

6. Machine Design

7. Machine Design

8. Elements of Machine Design
Design assignment to be given so as to cover the syllabus outlined in MEC 501

MEC-502: COMPUTER AIDED DESIGN AND MANUFACTURING

Note: The examiner shall set 8 questions i.e. 4 in each of part A & B and student shall be required to attempt total of 5 questions with at least 2 questions from each part.

PART-A

1. **Introduction** (2)
   The Design Process, Application of computers for design, definition of CAD, CAM and CIM, benefits of CAD, CAM, Automation and types of automation.

2. **Geometric Modeling** (3)
   Introduction & need of geometric modeling, types: wire frame, surface and solid model, coordinate systems, Geometric Modeling techniques. Use of geometric modeling.

3. **Transformations** (7)
   2D and 3D Transformations, coordinate system used in transformations, Homogeneous transformation, translation, rotation, scaling, reflection and shear transformation, concatenated transformations, 3D visualization.

4. **Curves** (8)
   Curve entities, curve representation, analytic curves – lines, circles, ellipses, parabolas, hyperbolas, conics, synthetic curves, hermite cubic spline, bezier curve and B-spline curve.

PART-B

5. **Surfaces** (6)
   Surface entities, representation and analysis, analytic surface, surface of revolution.

6. **Solids** (4)
   Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation.

7. **NC words** (4)
   Introduction, CNC, DNC and Adaptive Control, Classification of CNC machines, Coordinate Systems, Components of CNC machine, turning and machining center.

8. **NC part programming** (6)
   Introduction and basic terms of part programming, description of codes, G code, M code, programming for 2D and 3D jobs. Canned cycles, Loops and Subroutines programming, computer aided part programming.
Books Suggested:

3. Principles of Computer Aided design and Manufacturing by Farid Amirouche - Pearson publication

MEC-552: COMPUTER AIDED DESIGN AND MANUFACTURING

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1. CAD Modeling
   1. Simple machine parts and components construction using Inventor/ pro E/ other 3D modeling package
   2. Mechanical assembly of the parts.
2. Write code to generate a circle, an ellipse, a tabulated cylinder, surface of revolution.
3. Implement simple programmes for the graphics representation of
   a) Transformation,
   b) Projections,
   c) Cubic & splines curves
   d) Surfaces.
4. To generate computer aided part program and find out CL file as well as post processor file in terms of G & M code for different components.

MEC-503: ROBOTICS

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

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

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

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

Part-B

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

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

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.

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

**Books Suggested:**

**MEC-553: ROBOTICS**

1. Study of different types of robots based on configuration and application.
2. Study of different types 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-504: MECHANICAL MEASUREMENT AND METROLOGY**

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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** :
   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** :
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**:

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

4. **Functional elements**:

   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**:

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


6. **Temperature Measurement**:

   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**:

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


   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-554: MECHANICAL MEASUREMENT AND METROLOGY

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.
Measurement of water level by capacitive transducer

IBM-501: MARKETING MANAGEMENT

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 Marketing: Definition; Scope and Importance of Marketing; Key Customer Markets; Concepts/Philosophies of Marketing; Holistic Marketing Concept; Marketing Tasks; Marketing Mix

Marketing Environment: 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: 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: 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: Product characteristics; classifications; differentiation; packaging and labeling; Product Life Cycle.

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

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

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

References:
1. Principles of Marketing, Philip Kotler, Pearson
2. Marketing Management, R. Saxena, TMH

IBM-502: HUMAN RESOURCE MANAGEMENT

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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


Job analysis: Methods - IT and computerized skill inventory - Writing job specification - HR and the responsive organization.

Recruitment and selection process: Employment planning and forecasting – Building employee commitment: Promotion from within - Sources, Developing and Using application forms - IT and recruiting on the internet.
Employee Testing & selection: Selection process, basic testing concepts, types of test, work samples & simulation, selection techniques, interview, common interviewing mistakes, Designing & conducting the effective interview, small business applications, computer aided interview.

Part-B

Training & Development: Orientation & Training: Orienting the employees, the training process, need analysis, Training techniques, special purpose training, Training via the internet Performance appraisal: Methods - Problem and solutions - MBO approach – The appraisal interviews - Performance appraisal in practice.

Managing careers: Career planning and development - Managing promotions and transfers.


References:

MEC-506: FLUID MACHINERY

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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. 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) 5

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. 5

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 Reynolds, 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:**


**MEC-556: FLUID MACHINERY**

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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-557: 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 BACHELOR OF ENGINEERING (MECHANICAL) (SIXTH SEMESTER)

MEC-601: DESIGN OF MACHINE ELEMENTS–II

<table>
<thead>
<tr>
<th>PART-A</th>
<th>Lectures</th>
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<tbody>
<tr>
<td>1 Introduction:</td>
<td>(4)</td>
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<tr>
<td>Types of mechanical drives and their applications. factors influencing the choice of a mechanical drive.</td>
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<tr>
<td>2 Belt and Rope Drives:</td>
<td>(5)</td>
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<tr>
<td>Types of belt drives, design of flat belt drive, design of V-belt drive including selection of V-belt, design of wire rope drive including selection of rope, design of pulleys for a flat belt drive.</td>
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<tr>
<td>3 Chain Drives:</td>
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<tr>
<td>Design of chain drive including selection of chain.</td>
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<tr>
<td>4 Gear Drives:</td>
<td>(6)</td>
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<tr>
<td>Design details of spur, helical and bevel gear drives, design of worm and worm wheel drive.</td>
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<tr>
<th>PART-B</th>
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<tbody>
<tr>
<td>5 Bearings:</td>
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<tr>
<td>Classification of bearings, types of sliding contact bearings, properties requirements of sliding contact bearing materials, hydrodynamic lubricated bearings, terms used in hydrodynamic journal bearings, bearing characteristic number, bearing modulus, coefficient of friction, Sommerfield number and critical pressure for journal bearings, heat generated in a journal bearing, design of journal bearings, bearing caps and bolts, design of foot-step bearings. Types of rolling contact bearings, materials of ball and roller bearings, basic static load rating, static equivalent load, life of a bearing, basic dynamic load rating, dynamic equivalent load, dynamic load rating under variable loads, selection of radial ball bearings, lubrication of ball and roller bearings.</td>
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<tr>
<td>Comparison of sliding contact bearings and rolling contact bearings.</td>
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**Books Suggested:**

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<tbody>
<tr>
<td>1</td>
<td>Design of Machine Members</td>
<td>Vallance and Doughite, McGraw Hill, New York, 2005</td>
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<td>8</td>
<td>Elements of Machine Design</td>
<td>V.B.Bhandari, Tata McGraw Hill, New Delhi, 2005</td>
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**MEC-651: DESIGN OF MACHINE ELEMENTS-II**

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Note: Design assignments so as to cover the principles outlined in MEC-601 such as:

1. Design of flat belt drive.
2. Design of V-belt drive.
3. Design of rope drive.
4. Design of pulleys.
5. Design of chain drive.
6. Design of spur gear drive.
7. Design of helical gear drive.
8. Design of bevel gear drive.
10. Design of journal bearings.
11. Exercise on selection of rolling bearings.
12. Design of flywheels.
15. Design of helical springs.
16. Design of leaf springs

MEC-602: MECHATRONICS AND INDUSTRIAL AUTOMATION

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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. Mechanical Actuation Systems: Introduction to mechatronics, Measurement system, Control systems (open & closed), elements of closed loop system, Mechanical systems, types of motion, kinematic chains, cams, gear trains, ratchet and pawl, belt and chain drives, and bearings. (3)

2. Pneumatic and Hydraulic Systems: Introduction to pneumatic and hydraulic actuation systems, directional control valves, pressure control valves, cylinders, process control valves, rotary actuators. (5)

3. Types of controllers: Proportional, integral, derivative, PID, Hydraulic and Pneumatic controllers. (3)

4. Programmable Logic Controllers: Basic structure of PLC, introduction to ladder programming, basic programs, industrial applications of PLC, Data acquisition system. (4)

PART-B

5. Microprocessors: Introduction to micro-computer structure, 8085 pin diagram, architecture, Instruction set and basic program, I/O interfacing, Memory interfacing, A to D and D to A conversion fundamentals. (8)

6. Input/output systems: Interfacing, Input/output ports, interface requirements, peripheral interface adapters, serial communication interface and examples of interfacing. (5)

7. Applications: Applications of mechatronics to observe and control various mechanical systems: thermal systems, motion systems, pneumatic systems. Hydraulic systems. Case study of PLC based / Microprocessor based timed switch, windscreen wiper motion, bathroom scale, Pick and Place Robot, Car engine management (6)

BOOKS

1. Mechatronics by W Bolton, Pearson Education

REFERENCES:

1. Mechatronics by Dan Necsulescu, Pearson Education (Singapore) Pvt. Ltd
4. Introduction to Mechatronics & Measurement Systems by Alciatore et. al TMH
MEC-652: MECHATRONICS AND INDUSTRIAL AUTOMATION

1. To acquire signal from a sensor through A/D card on to a computer
2. To send data signal from computer to some actuator through D/A card
3. To carry out the position control of a geared DC motor using servo mechanism
4. To carry out the microprocessor based direction and speed control of a stepper motor and to observe the effect of external load
5. To study the DC speed control system built around a permanent magnet DC motor, an optical pick-up and a slotted disk to measure the speed of the motor for feedback control. To find the characteristics of the system when subjected to variable loading
6. To perform the PID control of an oven
7. To assemble a pneumatic sorting system by means of a single acting cylinder to sort a set of articles.
8. Use a pneumatic double acting cylinder to open and close the lid on a container.

MEC-603: MECHANICAL VIBRATIONS

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-653: MECHANICAL VIBRATIONS**

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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-604: HEAT TRANSFER**

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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. Numerical terminology must be in S.I. units only.

**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. **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. Equivalent 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.

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.

4. **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)

5. **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 exchangers, Heat Exchanger effectiveness, Calculation of number and length of tubes in a heat exchange by effectiveness- NTU method.

6. **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.

7. **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-654: HEAT TRANSFER**

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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.

**IBM-601: MANAGERIAL ECONOMICS**

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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 Managerial Economics and Demand Concepts: Nature Scope and Importance of Managerial Economics, opportunity costs, incremental principle, time perspective, Equi marginal principles, Individual Demand, Market Demand, Kinds of Demand, Determinants of Demand, Demand Functions and Law of Demand, Income and Price elasticity of demand, substitution effect


Production Function: Concept and types, Returns to Factor and Returns to Scale, Law of Variable Proportions, law of diminishing marginal returns

Cost concepts and Analysis: Concept of Cost, Short run and Long-run Cost Curves, Relationships among various costs

Revenue Curves: Concept and Types.

**Part B**

Perfect Competition: Characteristics, Equilibrium Price, Profit Maximizing output in Short Run and Long Run, Price Discrimination; Imperfect Competition, Monopolistic Competition, Oligopoly and Barriers to Entry.

Economic Environment of Business- Meaning of GDP, Monetary and Fiscal Policy, Deficit Financing, Inflation, Subsidies, Devaluation of Rupee, Liberalization, Privatization and Disinvestment

**References:**

1. Managerial Economics, Mote, Paul Gupta, Vikas Publisher, New Delhi
3. Microeconomics, Robert. Pindyck, Daniel Rubinfeld, Pearson

**IBM-602: CORPORATE LEGAL ENVIRONMENT**

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

Sales of Goods Act 1930: Meaning; Difference between Sale of Goods and Agreement to Sale, Essentials of Contract of Sale; Difference between Contract of Sale and Hire-Purchase Agreements; Conditions and Warranties; Transfer of property or ownership; Performance of Contract of Sale; Rights of Unpaid Seller; Auction Sale.

The Companies Act, 1956: Definition; Meaning; Features; Types of companies; Incorporation of a company; Memorandum of Association; Articles of Association and Prospectus; Doctrine of Indoor Management; Lifting of Corporate Veil; Registration and Incorporation of a company; Doctrine of Ultravires Transactions; Winding up of company.

Part B

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.

References:
2. An Introduction to Mercantile Laws- N.D. Kapoor, Sultan Chand & Sons

SYLLABUS FOR
BACHELOR OF ENGINEERING (MECHANICAL)
SEVENTH SEMESTER
MEC–701: REFRIGERATION & AIR CONDITIONING

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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 Concept
Natural and Mechanical refrigeration; Application of Refrigeration; Units of refrigeration and Coefficient of performance; Refrigeration effect, cooling capacity and COP of a refrigerator; heating effect, heating capacity and COP as heat pump; Reversed Carnot cycle and its limitations

2. Bell Coleman Cycle and Aircraft Refrigeration
Bell Coleman Cycle and its analysis; optimum COP and pressure ratio, necessity of air craft refrigeration - air cycle refrigeration systems and their comparison

3. Vapour Compression Refrigeration Cycle and Refrigeration
Vapour compression cycle on P-V, P-H and T-S diagrams; Deviation of actual cycle from theoretical cycle; Compressor capacity and volumetric efficiency, Analysis of theoretical and actual vapour compression cycles; Effect of suction pressure, discharge pressure, subcooling, super heating and pressure drop in valves on performance and cooling capacity. Compound compression with single and multiple expansion valves, water intercooling and flash intercooling; multiple load systems with single and multiple expansion valves

4. Vapour Absorption Refrigeration Cycle (No Mathematical Analysis)
Principle of absorption system; components of the system; Desirable properties of absorption system refrigerant and absorbent; Aqua - ammonia absorption refrigeration system; Lithium Bromide - water absorption system; Theory of mixtures; temperature concentration and enthalpy concentration diagrams; comparison between absorption and compression systems; Electrolux refrigeration system.

PART-B

5. Refrigerants
Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; comparative study of commonly used refrigerants and their fields of application; Azeotropes; Effect of moisture and oil miscibility; Refrigerants dying agents and antifreeze solution; leak detection and charging of refrigerants; environmental aspects of conventional refrigerants; Ecofriendly refrigerants and action plan to reduce ecological hazards.

6. Air Conditioning Concept, Psychometric Processes and Applications;
Psychometric properties of air; Dry bulb, wet bulb and dew point temperatures; Relative and specific humidity; degree of saturation adiabatic saturation temperature, enthalpy of air and water vapours; psychometric chart. Human requirement of comforts; effective temperature and comfort charts; Industrial and comfort air conditioning. Sensible heating and cooling, cooling with dehumidification; Heating with dehumidification; by-pass factor; chemical dehumidification; adiabatic mixing, air washer.

7. Calculations for Air –Conditioning Load:
Sources of heat load; sensible and latent heat load; sensible heat factor; apparatus dew point temperature; Rate and state of supply - air for air-conditioning of different types of premises.

8. Refrigeration and Air Conditioning Equipment
Brief description of compressors, condensers, evaporators and expansion devices; Cooling towers; Ducts; dampers; grills; air filters; fans; room air conditioners; split units; Package and central air conditioning plants.

**SUGGESTED BOOKS:**
1. Refrigeration and Conditioning by CP Arora, Tata McGraw Hill
2. Refrigeration and Conditioning by Manohar Prasad, Wiley Eastern Limited
3. Refrigeration and Conditioning by Jordan and Priester, Prentice Hall of India
5. A course on Ref. & Air Conditioning by Arora, Domkunder Dhanpat Rai & sons
7. Low temperature techniques by din F. and Cockett.

**MEC-751: REFRIGERATION AND AIR CONDITIONING**

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1. Study of various elements of a mechanical refrigerator system through cut sections models / actual apparatus
2. Study and performance of domestic refrigerator,
3. Study the performance of and Electrolux refrigerator
4. Study of an Ice plant and visit to a cold storage for study
5. Calculation/ Estimation of cooling load for large building
6. Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning
7. Study and performance of window type room air conditioner
8. Study and performance of Cooling Tower.
9. Study and performance of Air conditioning Trainer (Direct and Indirect type)
10. Study and performance of Air Washer Test bench.

**MEC-702: AUTOMATIC CONTROLS**

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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. **Introduction**
   Introduction, Types of control systems, Open or closed loop systems, Analog or Digital control systems, Regulators and servomechanism, Sequence control, typical block diagram, Performance analysis.

2. **Representation of processes and control elements**
   Mathematical modeling, Block diagram representation, Representation of systems or processes, Liquid, gas and thermal systems, Mechanical rotating systems, Geared systems, Hydraulic servomotor, Electric motors, Control valve, Comparison elements, Potentiometer-type comparator, Synchro-control transformer type error detector.
3. **Representation of feedback control systems**
   Block diagram and transfer function representation, Signal flow graphs, Mason’s formula.

4. **Types of controllers**
   Types of control action, Proportional, Integral, Derivative, On-off, Hydraulic controllers, Pneumatic controllers, Electronic controllers.

**Part-B**

5. **Transient and steady state response**
   Time domain representation, Laplace transform representation, Systems with proportional control, Transient response due to reference input, Steady state response, Response to load input, Proportional cum derivative control, Reference input, Load input, Proportional cum integral control, Reference input, Load input.

6. **Stability of control systems**
   Characteristic equation, Routh’s equation, Nyquist criterion.

7. **State space analysis of control systems**
   Generalised state equations, Techniques for deriving system state equations, Transfer function from state equations

8. **Introduction to virtual instrumentation**
   Graphical programming, Concept of sub-VI, Data acquisition and control using Labview software, Simulation of proportional, derivative, integral control actions

**MEC-752: AUTOMATIC CONTROLS**

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1. Perform two mode (P + I) controls on a temperature/flow control trainer.
2. Perform two mode (P + D) controls on a temperature/flow control trainer.
3. Perform three mode (P + I + D) controls on a temperature/flow control trainer.
4. Tune the temperature/flow control trainer using Zeigler-Nichols method.
5. Simulate first order system and second order systems on Labview software.
6. Acquire data from an analog sensor using PC and Labview software.
7. Control vibrations of a cantilevered beam using negative velocity feedback.

**MEC-703: ROBOTICS**

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

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

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

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

**Part-B**

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

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

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

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

**Books Suggested:**
1. Introduction to Robotics, J.J.Craig, Addison Wesley Publishing Co.
2. Robotic Engineering, Richard D. Klafter, Chmielewski, Negin Prentice-Hall
4. Fundamentals of Robotics, Robert J. Schilling, PHI.

**MEC-753: ROBOTICS**

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

**IBM-701: ACCOUNTING FOR MANAGERS**

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
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

Accounting and its functions; Basic Accounting Concepts and Accounting Conventions; Accounting Principles; Generally Accepted Accounting Policies (GAAP); Accounting Standards; Branches of Accounting: Financial Accounting; Cost Accounting; Management Accounting; Accounting Equation; Accounting Structure; Types of Accounts.
Rules regarding Journal Entries; Recording of Journal Entries; Ledger Posting; Trial Balance; Preparation of Final Accounts; Trading Account; Profit & Loss Account; Balance Sheet; Treatment of Adjustments into trial balance.
Meaning of Management Accounting; Nature; Scope; Objectives; Functions of Management Accounting; Relationship between Financial and Management Accounting; Tools and Techniques of Management Accounting; Limitations; Meaning of Financial Statement; Importance and Limitations of Financial Statement; Meaning and Objectives of Financial Statement Analysis; Limitation of Financial Analysis.
Ratio Analysis: Meaning of Ratio; Interpretation of Ratios; Significance of Ratio Analysis; Limitations of Ratio Analysis; Classification of Ratio; Analysis of Short-term financial position; Analysis of Long term financial position; Analysis of profitability.

Part-B

Fund Flow Analysis: Meaning and Concept of Funds; Meaning of Fund Flow; Meaning of Fund Flow Statement; Significance; Limitations; Procedure of Preparing Fund Flow Statement; Schedule Showing Change in working capital; Adjusted Profit & Loss Account; Statement of Sources and Applications of Funds. Treatment of Adjustment;
Cash Flow Analysis: Meaning; Classification of Cash Flow; Comparison between Fund Flow Statement and Cash Flow Statement; Difference between Cash Flow Statement and Cash Budget Limitations; Preparation of Cash Flow Statement (as per AS-3); Treatment of Adjustments.

References:
1. Managerial Accounting, Hilton, Ramesh, Jaidev, TMH

IBM-702: STATISTICS & RESEARCH METHODOLOGY

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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 Descriptive Statistics: Types of Data, Measures of Central Tendency; Measures of Dispersion- Range, Quartile Deviation, Mean Deviation, and Standard Deviation, Skewness & Kurtosis.

Probability: Basic probability concepts, Joint probability, Conditional probability, Bayes Theorem, Random Variables and Discrete Probability distributions: Poisson, Binomial and Normal, Normally distributed variables, areas under the standard normal curve.

Research Design: Meaning, Characteristics and various concepts relating to research design and classification of research design, Importance.

Measurement and Scaling: Data Types Nominal, Ordinal and Ratio scale; scaling techniques.

**Part B**

Formulation of Hypothesis: Confidence Intervals, Meaning, Characteristics and concepts relating to testing of Hypothesis (Parameter and statistic, Standard error, Level of significance, type-I and Type-II errors, Critical region, one tail and two tail tests); Procedure of testing Hypothesis. Numerical problems based on chi-square test, Hypothesis tests for one population mean: Z test, t-test, Wilcoxon Signed- Rank test, Inferences for two population means, Mann-Whitney Test, F-test.

Data Analysis & Interpretation: Introduction to Multivariate analysis- Multiple and partial correlation, Analysis of Variance (ANOVA)-One way and Two way ANOVA. Introduction to discriminant analysis and Factor Analysis.

**References:**
1. Business Research Methods, William G. Zikmund, Cengage Learning India
2. Business Research Methods, Cooper, D.R. & Schindler, Tata McGraw-Hill

**MEC-755: MINOR PROJECT**

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**MEC-757: VOCATIONAL TRAINING AFTER 6TH SEMESTER**

**SYLLABUS FOR**

**BACHELOR OF ENGINEERING (MECHANICAL)**

**EIGHTH SEMESTER**

**MEC-801: AUTOMOBILE ENGINEERING**

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Note: The examiner shall set 8 questions i.e. 4 in each of part A & B and student shall be required to attempt total of 5 questions with at least 2 questions from each part.

PART-A

1. **Introduction**
   Components of automobile, basic structure, classification of automobile, body styles, frame and frameless construction, power for propulsion, traction and tractive effort, relation between engine revolution and vehicle speed, road performance curves, calculation of equivalent weight, gear ratio for maximum acceleration.

2. **Automobile Engine**
   Engine Types, Piston, Piston rings, valves, cooling system, lubrication system, turbocharger, supercharger, fuel supply system for petrol and diesel engine, throttle body and multi point fuel injection system, battery coil ignition system.

3. **Clutches**
   Requirements of clutches, types of clutches, working of single plate, multiplate and centrifugal clutch, clutch operation, clutch plate, fluid flywheel.

4. **Transmission**
   Functions of transmission, necessity, types of transmission, sliding mesh, constant mesh, synchromesh, selector mechanism, transfer box, automatic transmission, torque converter, overdrive, propeller shaft, universal joint, final drive, differential, rear axle, rear axle drive.

PART-B

5. **Suspension**
   Basic classifications, types of suspension systems, leaf springs, shock absorbers, independent suspension, types of front wheel, independent suspension system, air suspension.

6. **Front Axle and steering**
   Front axle, wheel alignment, steering geometry, under-steer and over-steer, steering linkage, steering gears, steering ratio, reversibility, power steering.

7. **Brakes wheel and Tyres**
   Brake efficiency and stooping distance, fading of brakes, wheel skidding, types of brakes, drum and disk brakes, hydraulic and pneumatic brakes, servo brakes, antilock braking system, types of wheels, wheel dimensions, types of tyres, cross ply, radial ply and belted-bias type, tyre designation.

8. **Emission control**
   Automotive air pollution, emission control, crank case emission, evaporative emission control, exhaust emission control, catalytic converter.

**BOOKS SUGGESTED:**


MEC-851: AUTOMOBILE ENGINEERING

1. Study of various tools and working of various systems/components from an actual automobile/working model.
2. Removing the car tyres, repairing the tubes - their testing and fitting back.
3. Valve re-facing and valve seat grinding and checking the seat for leakage.
4. Checking of the cooling system, water pump, radiator, thermostat valve and its faults.
5. Checking of cylinders for wear and finding out the next possible over-size of the Piston replacing rings and studying methods of replacing piston after re-boring.
6. Overhauling the fuel pumps, cleaning the jets and testing on the engine.
7. Overhauling of the distributor, setting C.B. Points and spark plug gaps and study of the complete ignition circuit.
8. Study of Vehicle steering system and measuring steering geometry angles.
9. Replacing of car battery and casting of plate connectors, cell connectors etc.
10. Overhauling of breaking system, adjusting the brake shoes, bleeding the system and testing.
11. Engine trouble shooting.

MEC-802: OPERATION RESEARCH

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. Definition of Characteristics of O.R.
   Decision making, scientific decision making approach for scientific decision making in O.R. need & limitation of O.R. 2

2. Definition of Models
   Classification of models, Construction of models, Approximation in O.R. models 2

3. Allocation Models
   Analysis of industrial situations to find characteristics like key decision, objective possible alternatives & restrictions – Three categories of allocations type situations to be considered. General mathematical formulation for linear programming, feasible and optimal solutions. 4

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4. Graphical and simplex techniques to solve linear models, Modification of minimization
situations so as to be solvable by simplex method. Duality and degeneracy in simplex
method, application and limitations of linear optimization models.

Part-B

5. Network Models
   Transportation models, method of finding starting solution, Vogel’s approximation
   method to find feasible models, Hungarian method to find optimal solution in assignment
   models.

6. Cyclic shortest route models, traveling salesman ‘s problem and Branch and Bound
   method to solve it. A cyclic short route models and their solutions.

7. Queuing theory, various types of queuing situations and their solutions.

8. PERT & CPM
   Network situations where PERT & CPM can be applied, planning, scheduling &
   Control, work–breakdown structure.
   (a) PERT NETWORKS : Events and activities, constructions of network, forward
   & Backward planning, Fulkerson’s rule, optimistic, pessimistic & most likely
time Estimates, frequency distribution, mean, variance and standard deviation,
expected time , earliest expected time and latest occurrence time, definitions of
slack and critical path.
   (b) CPM NETWORKS : Similarity and difference of CPM & PERT, construction of
   network , earliest event time , latest occurrence time, float, total float, free float,
independent float , contracting the network so as to an optimum project schedule.

Books Suggested:


MEC-802: OPERATION RESEARCH

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1. Projects and case studies concerning the topics in theory.

MEC-803: COMPUTATIONAL FLUID DYNAMICS

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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. **Introduction**
   History of CFD; Comparison of the three basic approaches in engineering problem solving – Analytical, Experimental and Computational Methods. Recent Advances in Computational Techniques.  
   
   **(5 hrs)**

2. **Problem Formulation:**
   The standard procedure for formulating a problem Physical and Mathematical classification of problems; Types of governing Differential equations and Boundary conditions.  
   
   **(7 hrs)**

3. **Methods of Discretisation:**
   
   **(5 hrs)**

PART-B

4. **Numerical Solution to Heat Conduction Problems:**
   
   **(10 hrs)**

5. **Numerical Solution to Fluid Flow Problems**
   Types of fluid flow and their governing equations; Viscous Incompressible flows Calculation of flow field using the stream function-vorticity method; Calculation of boundary layer flow over a flat plate; Numerical algorithms for solving complete Navier-Stokes equations- MAC method; SIMPLE algorithm; Project problem.  
   
   **(13 hrs)**

Books Recommended:

2. Computational Fluid Dynamics by J. Anderson Publisher, McGraw Hill:
6. Introduction to CFD by P. Niyogi, Pearson Publications.

**MEC-853: COMPUTATIONAL FLUID DYNAMICS**

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1. Two dimensional heat conduction in a rectangular geometry.
2. To solve the temperature distribution for a fin.
3. To solve two dimensional incompressible viscous flow in a lid driven cavity.
4. Temperature distribution for a heated plate subjected to insulated boundary condition on one side.
5. Temperature distribution for a heated plate subjected to fixed boundary conditions

MEC-855: MAJOR PROJECT

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IBM-801: BUSINESS RESEARCH

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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

Research Design formulation, Exploratory, Descriptive and Casual Research, Exploratory Research Design- Secondary Data, Primary Data, Qualitative Research-Focus Group Interviews, Depth Interviews, Analysis of Qualitative Data, Survey and observation- Survey methods, Observation method, Casual Research Design- Experimentation, Validity in Experimentation, Extraneous variables, Statistical Designs-Randomized-Block Design, Latin Square Design, Factorial Design

Measurement and Scaling- Primary Scales of measurement, Comparative Scaling Techniques, Non comparative Scaling techniques-Likert, Semantic Differential Scale, Stapel Scale, Questionnaire Design- question content, structure and order

Part-B

Sampling Design: Meaning and need of Sampling, Probability and non-probability sampling design, simple random sampling, systematic sampling, stratified sampling, cluster sampling and convenience, sampling, judgement and quota sampling (non-probability), determination of sample size, Hypothesis Testing, Parametric and Non-Parametric Tests

Discriminant and Logit Analysis- Formulating the problem for Discriminant analysis, Multiple Discriminant Analysis, Logit model

Factor analysis, Cluster analysis and Multidimensional Scaling- Conducting Factor analysis, Cluster analysis and Multidimensional Scaling- Conjoint Analysis

2. Marketing Research-Text and Cases, Rajendra Nangundkar, TMH
3. Marketing Research –GC Beri, TMH
4. Marketing Research- Parshuram, Dhruv Grewal, R.Krishnan – Biztantra
IBM-802: FINANCIAL MANAGEMENT
OR
OPTION 2
MEC-856: INDUSTRIAL TRAINING FOR SIX (06) MONTHS DURATION.

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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 Financial Management: Meaning; Scope; Finance Function; Financial Goals; Agency Problem; Relationship of Finance with Accounts and Economics.

Sources of Finance: Features; Advantages and Limitations of Equity Shares; Preference Shares; Debentures; Term-Loans; Right Issue.

Cost of Capital: Meaning; Calculation of Cost of Debt Capital; Equity Capital; Preference Capital; Retained Earnings; Weighted Average Cost of Capital.

Capital Structure: Meaning; Determinants; Assumptions; Net Income and Operating Income Approach; Traditional Position; M-M Position; EBIT and EPS Analysis; Capital Structure and Taxation.

Leverage Analysis: Meaning; Types; Estimation of Financial; Operating and Combined Leverage; Relation of Financial Leverage with Risk and Return.

Management of Working Capital: Meaning of WC; Need of WC Management; Determinants of WC; Operating Cycle; Estimation of WC.

Part-B

Inventory Management: Meaning; Need to hold Inventory; Objective of Inventory Management; Inventory Investment Analysis; Inventory Control System.

Capital Budgeting: Meaning; Basic Principles of Costs and Benefits; Investment Criteria; Payback Method; Accounting Rate of Return Method; Net Present Value Method; Benefit-Cost Ratio; Internal Rate of Return; Capital Rationing; Introduction to Basic Techniques of Risk Analysis in Capital Budgeting.
Dividend Decisions: Meaning and Types of Dividend; Issues in Dividend Policy; Traditional Model; Walter Model; Gordon Model; Miller and Modigliani Model; Bonus Shares and Stock Splits.

References:
1. Financial Management, Van Horne ,PHI

BE-MBA INTEGRATED (MECHANICAL ENGINEERING)
NINTH SEMESTER

QUANTITATIVE TECHNIQUES FOR MANAGEMENT

Course: BE-MBA IX th Semester

Paper – Compulsory

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*Paper Code: IBM-901  
*Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50  
External Assessment: 100

**Part-A**

Linear Programming- Equation formulation, Graphical solution of two-variable linear programming problems, Simplex algorithm, Transportation and Assignment problems

Game theory- Game models, zero sum games, dominance rule, 2 x n and m x 2 games, solution of m x n games

Queuing: Single channel single-phase queuing system, multichannel single-phase queuing system, single channel multiphase queuing system

**Part-B**

Markov Chains – Markov processes, Markov analysis, input transition probabilities, input conditions, output- specific state probabilities, steady state probabilities, absorbing chains
Simple linear regression and multiple regression analysis (with two independent variables), specification of regression models and estimation of parameters, interpretation of results

Forecasting models- Moving- average forecast methods, Simple Exponential Smoothing, Holt’s method- Exponential Smoothing with trend, Winter’s Method- Exponential Smoothing with Seasonality

1. Business Forecasting : John.E.Hanke , Dean.W.Wichern , PHI
2. Statistics for Managers using Microsoft Excel : Levine, Stephan, Krehbiel, Brenson , PHI

BUSINESS RESEARCH

Course: BE-MBA IX th Semester

Paper – Compulsory

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Paper Code: IBM-902 Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50 External Assessment: 100

Part-A

Research Design formulation, Exploratory, Descriptive and Casual Research , Exploratory Research Design- Secondary Data ,Primary Data , Qualitative Research-Focus Group Interviews, Depth Interviews, Analysis of Qualitative Data, Survey and observation- Survey methods, Observation method, Casual Research Design- Experimentation, Validity in Experimentation, Extraneous variables, Statistical Designs-Randomized-Block Design, Latin Square Design, Factorial Design

Measurement and Scaling- Primary Scales of measurement, Comparative Scaling Techniques, Non comparative Scaling techniques-Likert ,Semantic Differential Scale, Stapel Scale, Questionnaire Design- question content, structure and order

Part-B

Sampling Design: Meaning and need of Sampling, Probability and non-probability sampling design, simple random sampling, systematic sampling, stratified sampling, cluster sampling and
convenience, sampling, judgement and quota sampling (non-probability), determination of sample size, Hypothesis Testing, Parametric and Non-Parametric Tests

Discriminant and Logit Analysis- Formulating the problem for Discriminant analysis, Multiple Discriminant Analysis, Logit model

Factor analysis, Cluster analysis and Multidimensional Scaling - Conducting Factor analysis, Cluster analysis and Multidimensional Scaling- Conjoint Analysis

6. Marketing Research- Text and Cases, Rajendra Nangundkar, TMH
7. Marketing Research – GC Beri, TMH
8. Marketing Research- Parshuram, Dhruv Grewal, R. Krishnan – Biztantra

SUPPLY CHAIN MANAGEMENT

Course: BE-MBA IX th Semester

Paper: Elective-Marketing

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Paper Code: **IBM-903**  
**Time: 3 Hours**

Course Duration: 45 Lectures of one hour each.

**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.

Internal Assessment: 50  
**Part -A**

Definition of Supply Chain Management and Logistics - Scope of Transportation, Relationship between transportation and other business functions, Transport Economics: Distance – volume-density, Freight Cost – Handling – Liability - market factors; Third party logistics (3 PL) & fourth party logistics service provider (4 PL), Logistics equipment; Reverse Logistics, Govt. rule & regulations related to Logistics; Documentation related to Transportation :- Bill of Lading, Freight Bill, Claims and F.O.B Terms of Sale, Legal Classification of carriers- Private, Contract carrier etc.

Inventory Control, Planning & Managing Inventories: Strategic role of stock, costs of holding stock, Economic Order Quantity (EOQ), uncertainty in demand and costs, models for known demand: price discount from suppliers, planned shortages and back-orders, models for uncertain lead time demand
Material Handling & Wastage Control; Packing & Packaging; Order Management; Competitive advantage through logistics and supply chain management; Responsive Supply Chain, RFID applications in Supply Chain.

**Part –B**

Network Design and Facility Location – Facility location analysis, Optimization models, Heuristic Modeling – Grid Technique. Information systems for Supply Chain Management: Contemporary Logistics Information Technologies, e-enabled logistics management and tracking systems.

Planning & Sourcing in Supply Chain; Planning demand and supply: Demand forecasting – Type and Time horizon of forecast and category of forecasting, aggregate planning; Strategic sourcing; Sourcing decision in Supply Chain- selection of source, technical up-gradation of vendor, vendor performance evaluation, vendor rationalization.

References:
1. Designing & Managing the Supply Chain, Simchi-Levi, David, TMH
2. Inventory Control and Management, Donald Waters, Wiley

**SERVICES MARKETING**

Course: BE-MBA IXth Semester

**Paper: Elective-Marketing**

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**Paper Code: IBM- 904**

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

**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.

Internal Assessment: 50

External Assessment: 100

**Part-A**

Marketing of services - Introduction - Growth of the Service Sector - The Concept of Service - Characteristics of Services-Classification of Services - Designing the Service-Blueprinting, Using Technology, Developing Human Resources, Building Service Aspirations.

Strategic Marketing Management for Services - Matching Demand and Supply through Capacity Planning and Segmentation - Internal Marketing of a Service - External versus Internal Orientation of Service Strategy.

Part -B

Delivering Quality Services - Causes of Service-Quality Gaps: The Customer Expectations versus Perceived Service Gap, Factors and Techniques to Resolve this Gap


Marketing of Services with special reference to (a) Financial Services (b) Health Services (c) Hospitality Services including Travel, Hotels and Tourism. (d) Professional Services (e) Public Utility Services (f) Communication Services (g) Educational Services


ADVERTISING AND SALES MANAGEMENT

Course: BE-MBA IX th Semester

Paper: Elective-Marketing

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Paper Code: **IBM- 905**

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50

External Assessment: 100

Part-A

Advertising: As an element in Marketing Mix, its role and importance; Advertising as a means of communication, Setting advertising objectives, DAGMAR approach to setting objectives. Preparing advertising plan, Developing message, writing copy, advertising appeals and per-testing and post-teaching copy

Media decisions, media strategy and scheduling decisions; Planning and managing advertising campaigns; Different types of advertising, public relations; Industrial advertising; advertising budget and relevant decisions; Advertising agencies; their role and importance; management problems of agencies; client-agency relations; advertising in India, problems and prospects.

Part-B

Sales Management: Size of the sales force, sales organization based on customer, geography, product and combinations and current trends – sales training programs and motivating the sales force – sales force compensation, sales incentives and sales force evaluation – controlling the
sales effort – sales quotas, sales territories, sales audit, selecting channel members, setting distribution objectives and tasks – Target markets and channel design strategies.

Product, Pricing and Promotion issues in Channel Management and Physical Distribution - Motivating channel members – Evaluating channel member performance – Vertical marketing systems – Retail co-operatives, Franchise systems and corporate marketing systems.

E-commerce and e-retailing as a channel of distribution, Electronic intermediaries, Disintermediation and Re-intermediation

**INDIAN FINANCIAL SYSTEM**

Course: BE-MBA IX th Semester

**Paper: Elective-Finance**

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*Paper Code: IBM- 906*  
*Time: 3 Hours*

Course Duration: 45 Lectures of one hour each.

**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.

Internal Assessment: 50  
External Assessment: 100

**Part-A**

Commercial Banking-Evolution, Financial Services, Fiduciary Services, Off-balance Sheet Activities, Analysis of Assets and Liabilities of Scheduled Commercial Banks; Reserve Bank of India-Central Banking- Introduction to Central Banking, Instruments of Monetary Control, Public Debt, Secondary Debt Market, REPO's, Reserve Requirements, Selective Credit Controls, Advances to Priority Sector, Supervision System; Regional Rural Banks- Objectives, RBI Assistance, Evaluation of RRB's.

Cooperative Credit- Introduction, Role of RBI, Organizational Structure, National Bank for Agriculture and Rural Development (NABARD), Reforms in Cooperative Credit.

Non-banking Finance Companies - Introduction, Definition of Non-banking Finance Company, Financial Sector Reform, Liberalization Measures for NBFC's, Regulations for NBFC's Accepting Public Deposits, Limits on Acceptance of Deposits, Size of Non-banking Companies, Deposits, Distribution of Deposits, Comparison of NOF and Deposits, Capital Issues by Finance Companies, FCNR Deposits for NBFC's, Assets of NBFC's, Investment Norms for NBFC's, Deployment of Funds, Funds Mismatch of HP/Leasing Companies.
Part-B


MANAGEMENT OF FINANCIAL SERVICES

Course: BE-MBA IX th Semester

Paper: Elective-Finance

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Paper Code: IBM- 907 Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50 External Assessment: 100

Part-A

Financial Services - Meaning, types and their importance, Securities Trading - Online Vs Offline Trading, Demat and Remat, Depository - Introduction, Concept, depository participants, functioning of depository systems, process of switching over to depository systems, benefits, depository systems in India, SEBI regulation.

Insurance Services- Introduction, Principles of insurance, Types of Insurance, Life Insurance Products- Traditional and ULIPs, Credit rating - the concept and objective of credit rating, various credit rating agencies in India and International credit rating agencies, factors affecting credit rating & procedural aspects.

Part-B

Leasing - concept and development of leasing, business, difference between leasing & hire purchase, types of leasing business, advantages to lessor and lessee.
Venture capital - concepts and characteristics of venture capital, venture capital in India, guidelines for venture capital.

Call money market, Treasury bill market, Commercial Bill market, Market for CPs and CDs, Discount market and market for financial guarantees, Factoring - Development of factoring types & importance, procedural aspects in factoring, financial aspects, prospects of factoring in India.

Plastic Money - Concept and different forms of plastic money - credit and debit cards, pros and cons. Credit process followed by credit card organizations. Factors affecting utilization of plastic money in India.

2. Nalini P T Financial Instruments and services PHI

**CORPORATE TAX PLANNING**

Course: BE-MBA IX th Semester

**Paper: Elective-Finance**

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*Paper Code: IBM- 908*  
*Time: 3 Hours*

Course Duration: 45 Lectures of one hour each.

**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.

Internal Assessment: 50  
External Assessment: 100

**Part -A**

Basic framework of direct and indirect taxes in India, Concept of Tax Planning, Meaning, importance and scope, Tax planning versus Tax avoidance and Tax evasion, Methods of Tax Planning, Areas of Tax Planning, Scale of business / Nature of business and its relation to Tax Planning.

Taxation of companies in India, Assessment of Business and other incomes of Joint Stock Companies, Tax planning and managerial considerations with reference to newly established Industrial Undertakings in certain specified areas like E.P.Z and E.O.U’s. Tax Planning with reference to amalgamations, Foreign collaborations and joint venture agreements.

Tax Planning and Financial management – Tax planning with reference to capital structure, capital budgeting and management of working capital, Tax considerations in issue of bonus, shares and dividend policy.

**Part-B**

Tax Planning with regard to specific management decisions like Make of Buy, own on Lease repair, renewal, replace, closure or continuance, Maintenance of proper records of complying with requirement of tax laws, deductions of Tax at source, advance payment of tax, time for
payment and filing of income tax returns, types of assessments and procedure, defaults and penalties.
Tax planning in respect of excise duty, custom duty and sales tax, maintenance of proper records for complying with the requirements of indirect tax laws, filing of returns under different indirect tax laws, details and penalties under indirect tax laws.

1. Singhania . V.K  Direct Taxes :Planning and Maintenance (Tax Man publications)
2. Lakhotia.R.N , Corporate Tax Planning
3. Bhagwati Prasad , Corporate Taxation –A Hand Book (Tax Man)

E-COMMERCE

Course: BE-MBA IX th Semester

Paper: Elective-IT

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3 0 0

Paper Code: IBM-909 Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

Part-A

Ecommerce terminology: Blogs, Message boards, Newsgroups, Banner Advertising, Spiders / crawlers/ robots , hacking, SSL / SET protocols , Escrow, Podcast , webcast, web beacons , spyware , Adware, RSS feed, Spam , Web agents, cookies, search engine, worms

Planning for a E-commerce: Value chain analysis, SWOT analysis, studying trends and current technology, government incentives, hardware and software assessment for building a web store, intermediaries in Ecommerce

Characteristics of E-Business markets : Various business models, Business model design, pricing and distribution of digital products, bundling, building customer traffic, subscription vs paid model, bricks and clicks business model, call centre integration in ecommerce, affiliate marketing, viral marketing

Part-B

Security in ecommerce transactions: Public key infrastructure, process of getting a digital signature in India , types of digital signatures, role of intermediaries like Verisign

Internet audience: study of internet audience, online consumer behavior , Online research : Click stream analysis , Search log analysis, emails, pop-ups, online focus group

Online payment systems: On-Line Electronic Cash, Electronic Payment Schemes, Credit card secure electronic transaction, e-cheque, accumulating balance payment system, stored value payment system, digital wallets
References

1. E-commerce Management, Text and cases, Sandeep Krishna Murthy, Cengage
3. Ecommerce, Strategy, Technology and Implementation, Gary.P.Schneider, Cengage
4. Web commerce Technology Handbook, Daniel Minoli, Emma Minoli, TMH

IT PROJECT MANAGEMENT

Course: BE-MBA IX th Semester

Paper: Elective-IT

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Paper Code: **IBM-910**

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

**Part-A**

Software development process: waterfall model, prototyping, spiral model, software configuration management process, process management- capability maturity model

Software requirement analysis and specification: problem analysis, data flow diagram, entity-relationship modeling, decision tables, creating a requirement document

Planning a software project: cost estimation-COCOMO model, schedule and milestones, personnel plan, software quality assurance plans, configuration management plans, project monitoring plans, risk management

**Part-B**

Function-Oriented design: Modularity, Top-down and bottom-up strategies, structure charts, first-level factoring, design heuristics, Metrics- network metrics, stability metrics, information flow metrics

Object oriented design (OO): classes and objects, encapsulation, inheritance and polymorphism, OO design notation and specification, dynamic modeling, metrics- Weighted Methods per Class (WMC), Depth of Inheritance (DIT), Number of Children (NOC), Coupling Between Classes (CBC)
Software testing: error, fault and failure, top-down and bottom-up approaches, test cases and test criteria, functional testing- equivalence class partitioning, cause-effect graphing, structural testing-control based criteria, data flow based criteria

Software delivery: models, managing IT project teams

References:
1. Software Engineering, Ian Sommerville, Addison-Wesley
2. Software Engineering Project Management, R. Thayer, Wiley

DECISION SUPPORT SYSTEMS

Course: BE-MBA IX th Semester
Paper: Elective-IT

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Paper Code: IBM-911

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

Part-A

Distinction between Transaction Processing System (TPS), Management Information System (MIS), Expert System (ES) and Decision Support System (DSS)

Architectures of DSS system: components, classifications, backend and front end components of DSS, Web based DSS, Group Decision Support System (GDSS), technologies and infrastructure for group decision making, distributed computing

Modeling for DSS: the decision making modeling process, Intelligence, design and choice phases, design under certainty, risk and uncertainty, sensitivity analysis, what-if, goal-seek and scenario analysis with spreadsheets

DSS design to support operational, tactical and strategic decision making

DSS design methodology for Healthcare, Insurance, Manufacturing and Education sectors

Part-B

Enterprise Decision Support System (EDSS): Characteristics and capabilities of EDSS, integrating DSS and EDSS, Computerized systems like CRM, ERP, MRP and their design basics, EDSS and supply chain, Corporate Enterprise portals and their design, Electronic Document Management (EDM) systems
Importance of Knowledge Management Systems (KMS) and its integration with DSS, Design of Knowledge Management System for different sectors, Artificial Intelligence based DSS systems.

Reference

1. Decision Support Systems and Intelligent Systems, E.Turban, J.E.Aronson, Pearson

TRAINING AND DEVELOPMENT

Course: BE-MBA IXth Semester

Paper: Elective-HR

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Paper Code: IBM-912  
Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50  
External Assessment: 100

Part-A

National Training Interventions: Training as an economic instrument, achievements and challenges, National initiatives: 1964 to the present day, the European scene, which way forward.

Attitudes Towards Education and training: Education, training and work, changes in attitudes to training and development, Philosophies of training. Learning and Training: What do we understand by learning, Reinforcement theories, cybernetic and information theories, cognitive theories and problem solving, experimental learning, Learning to learn and self-development, Mental process, other horizons.

The Learner and the Organization: The learner, the organization as a learning environment, the learning organization. Approaches to Training Interventions: Organization learning systems, Generalized approaches, Planned training interventions, the costs and benefits of training interventions.

Part-B

The Training Function in Organizations: The training function, Management's responsibility for training, Creating and appropriate structure, The training of training staff, Ethical standards

Assessing Organizational Training Needs: The levels of organizational needs, types of organizational reviews, before starting the review, reasons for an organizational review, carrying out an organization-wide review.
Training Policy, Plans and Resources: Training policy, policy development, annual training plan, training resources, from policy to training plan and budget, Assessing Training Needs-the job and the individual: Job training analysis, Analytical techniques, Carrying out an individual training needs analysis, assessing performance.

Determining and evaluating training interventions: Training interventions, determination of training objectives, determination of the appropriate training strategy, planning and implementation of the training, evaluation of the programme.

ORGANIZATIONAL CHANGE AND DEVELOPMENT STRATEGIES

Course: BE-MBA IX th Semester

Paper: Elective-HR

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Paper Code: IBM-913 Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50 External Assessment: 100

**Part-A**


Values, Assumption, And Beliefs in OD- Chronology of Events in Management and organization Thought, early Statement of OD values and assumptions, A Values Study.


OD Interventions: Thinking about OD Interventions, Classifying OD Interventions.

**Part-B**

Intergroup and Third-Party Peacemaking Interventions: Intergroup Team-Building Interventions, Third party Peacemaking Interventions, organization Mirror Interventions, Partnering.


INDUSTRIAL PSYCHOLOGY

Course: BE-MBA IX th Semester

**Paper:** Elective-HR

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**Time:** 3 Hours

Course Duration: 45 Lectures of one hour each.

**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.

Internal Assessment: 50

External Assessment: 100

**Part-A**

Nature and scope of Industrial Psychology: Psychology and management, contributions of Freud and post Freudian development of Psychology

Factory organization: industrial bureaucracy, formal and informal groups, status system, balancing of social power, union and employer’s organizations

Psychology of leadership, understanding and motivating employees, industrial morale and job satisfaction, counseling, Psychology of industrial conflict, stress management
Part-B

Personality: Idiographic approach, Nomothetic approach, psychoanalytical perspectives, levels of awareness, defence mechanism, projective tests, Rorschach test, Thematic Appreciation Test (TAT), Role playing or visualization, stereotyping, brand personality

Trait perspective: Allport’s trait categories, Catell’s 16 PF test, personality tests, personality questionnaire, Type perspective- four humours, Sheldon’s typology, Eysenck’s typology, Factor theory, Jung’s typology, Allport’s typology

Intelligence: models, Stanford-Binet intelligence scale, Wechsler scale, Emotional intelligence

References:
1. Psychology in Organizations, S. Alexander Haslam, Sage publications

BE-MBA INTEGRATED (MECHANICAL ENGINEERING)
TENTH SEMESTER

STRATEGIC MANAGEMENT

Course: BE-MBA X th Semester

Paper – Compulsory

Paper Code: IBM-1001

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50
External Assessment: 100

Part -A

Definition, nature, scope, and importance of strategy; and strategic management (Business policy), Strategic decision-making. Process of strategic management and levels at which strategy operates, Role of strategists, Defining strategic intent: Vision, Mission, Business definition, Goals and Objectives.

Environmental Appraisal—Concept of environment, components of environment (Economic, legal, social, political and technological).

Environmental scanning techniques- ETOP, QUEST and SWOT (TOWS) PEST.
Internal Appraisal – The internal environment, organisational capabilities in various functional areas and Strategic Advantage Profile. Methods and techniques used for organisational appraisal (Value chain analysis, Financial and non financial analysis, historical analysis, Industry standards and benchmarking, Balanced scorecard and key factor rating). Identification of Critical Success Factors (CSF).

**Part -B**

Corporate level strategies—Stability, Expansion, Retrenchment and Combination strategies.

Corporate restructuring, Concept of Synergy, Business level strategies—Porter’s framework of competitive strategies, Conditions, risks and benefits of Cost leadership, Differentiation and Focus Strategies. Location and timing tactics. Concept, Importance, Building and use of Core Competence.


Strategic Management of Technology and Innovation- Licensing new technology, imbibing new technology, searching for strategic partners in new business areas, Internal and external sources of technology, linking new technology and novel customer needs, building competence through new product development, technological innovation and strategy

Recommended Text Books

**GLOBAL MARKETING**

Course: BE-MBA Xth Semester

**Paper: Elective-Marketing**

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*Paper Code: IBM- 1002  
Time: 3 Hours*

Course Duration: 45 Lectures of one hour each.

**Part-A**

Global Marketing: Development of Global Marketing, market characteristics, Industry conditions, marketing infrastructure, regulatory framework, basis for trade- absolute vs comparative advantage, protectionism and trade restrictions, tariffs, quotas, GATT
Selecting markets: list of selection criteria, market index for country selection, grouping global markets, consumer market, business market and government market, categorizing global marketing mindsets, global market entry strategies- exporting, local production, ownership

Pricing for global markets: transportation cost, tariffs, taxes, local production costs, channel costs, market and environmental factors affecting price, determining transfer prices, dealing with parallel imports or gray markets, sources of finance- commercial banks, government sponsored financing

**Part-B**

Developing new products for global markets: three strategic choices – extension, adaptation, invention, role of foreign subsidiaries in R&D, acquisitions as a route to new products, joint venture route to new products, concept test, test marketing

Developing a global distribution strategy: distribution density, channel length, channel alignment, distribution logistics, locating and selecting channel partners

Planning and controlling global marketing: selecting control metrics, resolving conflicts between headquarters and subsidiaries

**References:**

2. Global Marketing, Johny.K.Johansson, TMH

**CONSUMER BEHAVIOR**

Course: BE-MBA Xth Semester

**Paper: Elective-Marketing**

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*Paper Code: IBM-1003 Time: 3 Hours*

Course Duration: 45 Lectures of one hour each.

**Part-A**

Current trends in Consumer Behavior (CB), Consumer empowerment through the web, Information bank for understanding CB, consumer need arousal, need recognition, consumer psychological set, consumer information search and processing, Brand evaluation, Purchase and post purchase behavior

Consumer learning, Habit and Brand Loyalty, unplanned purchase behavior, strategic implications of low-involvement decision making, situational influences, use of situational
variables in marketing strategy, consumer perception, perception interpretation, price perception, Attitude development for change, lifestyle and personality

Part-B

Group and culture influences, culture values, cross-culture values, subculture influences, reference group influences, House-hold decision making, group communication – word of mouth as diffusion process, Market segmentation and Micromarketing

Marketing communication process – source effects in marketing communication, message effects, media effects, consumer decoding of marketing communication, Alternatives evaluation and selection- how consumers make choices, evaluation criteria , decision rules for Attribute based choices

Consumer Rights and Social responsibility

1. Consumer Behavior – Insights from Indian Market, Majumdar, PHI
2. Consumer Behavior – A Strategic Approach , Henry Assael , Biztantra (Dreamtech)

INVESTMENT ANALYSIS AND PORTFOLIO MANAGEMENT

Course: BE-MBA X th Semester

Paper: Elective-Finance

Paper Code: IBM- 1004

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50 External Assessment: 100

Part-A


Risk and Return: Concept of Risk, Components of Investment Risk, Measurement of Risk through Standard Deviation, Regression Equation, Covariance, Concept of Return, Expected Yield, Actual Yield, Holding Period Yield, Relationship between Risk and Return


Part-B


References:
2. Investment Management - Lofthouse, Stephen , John Wiley & Sons Publications

INTERNATIONAL FINANCIAL MANAGEMENT
Course: BE-MBA Xth Semester

Paper: Elective-Finance

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Paper Code: IBM- 1005  Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.
Internal Assessment: 50  External Assessment: 100

**Part-A**
Global Financial markets and interest rates: domestic and offshore markets, Euromarkets, Interest rates in the global money markets, money market instruments
Foreign exchange market: types of transactions and settlement dates, exchange rate quotations and Arbitrage, exchange rate determination and forecasting
Forwards, Swaps and Interest parity: Swaps and deposit markets, interbank forward dealing, option forwards, Exchange Rate Agreements and Foreign Exchange Agreements (FXA), Forward currency markets in India

**Part-B**
Currency and Interest rate futures: futures contracts, markets and trading process, future prices expected spot prices and forward prices, option pricing models, Over the Counter (OTC) market prices
Hedging, Speculation and Management of Transaction exposure: Hedging with money market, currency options, currency futures, internal hedging strategies
Management of Interest Rate Exposure: Forward Rate Agreements (FRAs), Interest

**STRATEGIC FINANCIAL MANAGEMENT**
Course: BE-MBA X th Semester

**Paper: Elective-Finance**

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*Paper Code: IBM- 1006  Time: 3 Hours*

Course Duration: 45 Lectures of one hour each.

**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.

Internal Assessment: 50  External Assessment: 100

**Part-A**
Options, Futures and Corporate finance: call options, put options, valuing options, option – pricing formula, stocks and bonds as options, capital structure policy and options
Warrants and convertibles: difference between warrants and call options, warrant pricing and Black-Scholes model, value of convertible bonds
Derivatives and Hedging risk: forward contracts and futures contracts, interest-rate futures contracts, duration hedging

**Part-B**
International Corporate Finance: Foreign exchange markets and exchange rates, law of one price and purchasing-power parity, interest rates and exchange rates, interest rate parity, international bond marketing

References:
1. Mergers, Restructuring and Corporate Control, Weston, Chung, Hoag, PHI
2. Corporate Finance, Ross, Westerfield, Jaffe, TMH

ERP

Course: BE-MBA  X th Semester

Paper: Elective-IT

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Paper Code: IBM- 1007  

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

Part-A

ERP Package selection: Need assessment, Justifying ERP implementation, cost benefit analysis, ERP package evaluation and selection, make or buy decision

ERP systems development process: ERP implementation life cycle, planning, requirement analysis, reengineering vs customizing, transition strategies- big bang, phased, parallel, hybrid, implementation-hidden costs

ERP systems: Sales and Marketing- sales and distribution, sales forecasting, product pricing systems, billing systems ERP and Customer Relationship Management (CRM), Accounting and Finance- cash management process, capital budgeting process, financial accounting and management accounting Production and Materials management- MRP system, capacity planning process, manufacturing execution systems, Human Resources-compensation and benefits administration

Part-B

Managing an ERP project: Risks in ERP implementation, managing large scale ERP projects, project team selection, user training, technological challenges, operation and up gradation issues

Role of consultants and vendors: maintenance of ERP system, future trends and directions in ERP, open source ERP systems

References
1. Enterprise Resource Planning, Mary Sumner, Pearson
2. Enterprise Resource Planning, Alexis Leon, TMH
DATA WAREHOUSING & DATA MINING

Course : BE-MBA   X th Semester

Paper: Elective-IT

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Paper Code: IBM-1008        Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

Part-A

Data Warehousing (DW): components of DW, DW and data marts, planning for DW, specifying business requirements, DW and Meta Data, dimensional modeling, slowly changing dimensions type 1, 2 and 3, factless fact tables, aggregate fact tables, data extraction, transformation and loading (ETL), ETL tools, indexing the DW, DW and OLAP

Data mining: preprocessing data for data mining, descriptive data summarization, data cleaning, prediction modeling with simple linear regression and multiple regression, logistic regression

Classification data mining modeling: classification by decision tree induction, tree pruning, Bayesian classification, classification by back propagation in Neural networks

Part-B

Mining frequent patterns and associations: market basket analysis, Apriori Algorithm, web mining, web log analysis, text mining

Cluster analysis: interval scaled variables and binary variables, cluster analysis by partitioning, hierarchical methods, density based methods, clustering based on distance

Open source data mining software and proprietary software

References:

1. Data Mining –Concepts and Techniques, J.Han, Micheline Kamber, Elsevier
2. Data Mining –Methods and Models, Daniel .T.Larose, Wiley
3. Data Mining- Galit Shimuli , Wiley

STRATEGIC HUMAN RESOURCE MANAGEMENT
Course: BE-MBA Xth Semester

Paper: Elective-HR

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Paper Code: IBM-1009

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50

External Assessment: 100

Part-A

Introduction to Strategic Human Resource Issues, Challenges of Career development, Diverse work force development, self development, Pay-for-performance systems, Types of Pay-for-performance plans - individual based, team based, plant wide and corporate level

Hofstede’s cultural orientation model, FIRO-B questionnaire, Johari Window questionnaire, HR metrics and importance, Factor analysis in HR Research, competency mapping models and framework

Part-B

Determining the mix of Host-country and expatriate employees, the challenges of expatriate assignments, selective training, career development and compensation of expatriate employees, developing a global HR system and pay system, international staffing managing diversity, off shoring, equal employment opportunities, repatriation – problems and solutions, HR strategies and orientation for Mergers

Managing employee separation, Downsizing and outplacement, cost and benefits of employee separation, types of early separation (voluntary and Involuntary), features of early retirement policies, managing layoffs, alternatives to layoffs, the goals of outplacement.

3. Human Resource Research methods, Dipak Kumar Bhattacharyya, Oxford
MANPOWER PLANNING & PERFORMANCE APPRAISAL

Course: BE-MBA  X th Semester

Paper: Elective-HR

Paper Code: IBM-1010

Time: 3 Hours

Course Duration: 45 Lectures of one hour each.

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.

Internal Assessment: 50 External Assessment: 100

Part-A

Manpower planning: setting up objectives, aligning manpower planning with strategic business goals, Role analysis, job analysis, job specification, job description

Recruitment and selection: recruitment and legislation, fair employment practices, recruitment, hiring procedure, forecasting human resource requirements, managing growth and replacement of top executives

Part-B

Performance appraisal: need for performance appraisal, parameters of performance appraisal, computerized performance appraisal systems, self appraisal questionnaire, 360 degree performance appraisal systems

Comparing performance appraisal and performance management, graphic rating scales, paired comparison method, forced distribution, critical incident, behavioral anchored rating scales, web-based performance appraisals, conducting appraisal interviews