

## VIII SEMESTER

### VEHICLE TRANSPORT MANAGEMENT

Sub Code: 06AU81

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

#### PART - A

##### 1. Introduction:

Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies.

**Motor vehicle act 1988.**

**6 Hrs**

##### 2. The Infrastructure:

Road, Highway network, traffic control, Bus priorities, pedestrianization, out town shopping centers, Bus-stops, shelters, Bus stations-drive through type, head on type, facilities for passengers, bus garages, requirement, layout of premises, size, function, location, design, equipment, use of machinery, garage organization, large scale overhaul conveyance of staff, requirement of facilities at depot., legal provisions for depot. Layouts.

**Maintenance** - preventive, breakdown, overhauling - major, minor, repair schedules & workshop, facilities, documentation, analysis & corrective maintenance schedules

**7 Hrs**

##### 3. Organization and Management:

Forms of ownership, municipal undertaking, company undertaking, traffic, secretarial and engineering departments, management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training, drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety.

**7 Hrs**

##### 4. Route planning:

Source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency

**Timing, Bus working and Schedules:** Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running

numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements

**7 Hrs.**

#### PART -B

##### 5. Fare collections & Fare structure:

Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bellgraphic system, reduced ticket stocks willbrew system, mechanical ticket machines, T.I.M and straight machines, verometer, one-man operation, two stream boarding, pre paid tickets, lenson parason coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control.

**Fare structure:** Basis of fares, historical background, effects of competition and control, calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand co-ordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges.

**6 Hrs**

##### 6. Operating cost and types of vehicles:

Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, life of vehicles, sinking fund, factor affecting cost per vehicles mile incidence of wages and overheads, 100 seats miles basis, average seating capacity, vehicles size and spread overs, types of vehicle economic considerations authorization of trolley, bus services, statutory procedure taxes and hire car.

**7 Hrs**

##### 7. Public relations divisions:

Dissemination of information, maintaining goodwill- handling complaints, traffic advisory committees- local contractors co-operation with the press news and articles- facilities for visitors- forms of publicity - importance of quality - inter departmental liaison advertisements, signs, notice and directions general appearance of premises, specialized publicity.

**Prevention of accidents:** Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers.

**6 Hrs**

##### 8. Vehicle design:

Buses & coaches, types & capacities, basic features, entrances & exits, comfort & capacity, steps & staircases, miscellaneous arrangements & fitments, articulated buses, standardization.

**The future:** a projection from the past, future demand, environmental and social issues, the energy situation, new technology, hybrid, battery/trolley bus, other types of hybrid, lead acid battery bus, advanced battery bus

**6 Hrs.**

#### Text books:

1. Bus operation - L.D.Kitchen, Iliffe & Sons , London

2. Bus & coach operation - Rex W. Faulks, Butterworth Version Of 1987, London

**Reference books:**

1. Compendium of transport terms - Cirt,Pune
2. M.V. Act 1988 - Central Law Agency, Allahabad
3. The elements of transportation - R.J. Eaton
4. Goods vehicle operation - C.S. Dubbar
5. Road transport law - L.D. Kitchen
6. Automobile engineering-G B S Narang, Khanna Publications
7. Automobile engineering-H B Keshwani
8. Automobile engineering-R B Gupta, satyaprakashan, New Delhi

**Scheme of Examination:**

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

**AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS**

**Sub Code: 06AU82**

**IA Marks: 25**

**Hrs/Week: 04**

**Exam Hrs: 03**

**Total Lecture Hrs: 52**

**Exam Marks: 100**

**PART - A**

**1.Storage Battery;**

principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, voltmeter, effect of temperature on electrolyte, its specific gravity, capacity and efficiency, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries. Recent development in batteries

**6 Hrs**

**2. Generator/ Alternator:**

Principle of generation of direct current, generator details, shunt, dynamos, armature reaction, action of three brush generator and battery in parallel, setting of third brush, voltage and current regulators, cutout - construction, working and adjustment. Construction of A.C. systems.

**6 Hrs**

**3. Starter Motor & Drives:**

Battery motor starting system, condition at starting, behaviour of starter during starting series motor and its characteristics, consideration affecting size of motor, types of drives, starting circuit.

**6Hrs**

**4. Ignition systems :**

Ignition fundamentals, Types of solid state ignition systems, components, construction and operating parameters high energy ignition distributors, Electronic spark timing and control.

**6 Hrs**

**PART-B**

**5. Wiring and Lighting system:**

Earth return and insulated systems, 6volts and 12 volts system, fusing of circuits, low and high voltage automobile cables, diagram of typical wiring system. Principle of automobile illumination, head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, signaling devices, electrical fuel pump, fuel, oil and temperature gauge(Dash board instruments)

**6Hrs**

**6. Heating and Air conditioning:**

Conventional heating and ventilation, Air conditioning theory and systems, seat heaters.

**6 Hrs**

**7. Engine management Systems:**

Combined ignition and fuel management systems. Exhaust emission control, Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Complete vehicle control systems, Artificial intelligence and engine management. Hybrid vehicles and fuel cells.

**8Hrs**

**8. Chassis Electrical systems:**

Antilock brakes (ABS), Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners.

**8 Hrs**

**TEXT BOOKS:**

1. Tom Denton, “Automobile Electrical and Electronic systems” SAE publication, 2000.
2. P.M. Kohli, ‘Automotive Electrical Equipment”, Tata McGraw Hill, New Delhi.

**REFERENCE BOOKS:**

- 1.Heinz Heisler, Advanced Engine Technology. SAE Publications, 1995.
2. Ulrich Adler, “Automotive Electronic Systems”, Robert Bosch, GMBH, 1995
- 3 Bosch Technical Instruction Booklets
4. A.P. Young & Griffiths, “Automobile Electrical Equipment” , ELBS & Newnes Butterworths, London

1. W. Judge, "Modern Electrical Equipment"
2. Electrical Equipment for Automobiles by Parker and Smith S.

**Scheme of Examination:**

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

**TRIBIOLOGY**

**Sub Code: 06ME831**

**IA Marks: 25**

**Hrs/Week: 04**

**Exam Hrs: 03**

**Total Lecture Hrs: 52**

**Exam Marks: 100**

**Unit –1 Introduction to Tribology:**

Properties of oils and equation of flow: Viscosity, Newton's of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants.

**06 Hrs**

**Unit-2 Hydrodynamics Lubrication:**

Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings.

**06 Hrs**

**Unit-3**

Mechanism of pressure development in an oil film, Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.

**07 Hrs**

**Unit- 4**

Slider / Pad bearing with a fixed and pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.

**07 Hrs**

**PART-B**

**Unit-5 Oil flow and thermal equilibrium of journal bearing:**

Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings.

**06 Hrs**

**Unit 6 Hydrostatic Lubrication:**

Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.

**06 Hrs**

**Unit-7 Bearing Materials:**

Commonly used bearings materials, properties of typical bearing materials. **Wear:** Classification of wear, wear of polymers, wear of ceramic materials, wear measurements, effect of speed, temperature and pressure. **07 Hrs**

**Unit -8 Behavior of tribological components:**

Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. **Tribological measures:** Material selection, improved design, surface engineering **07 Hrs**

**TEXT BOOKS:**

1. Basu S K., Sengupta A N., Ahuja B. B., Fundamentals of Tribology, PHI 2006
2. Mujumdar B. C., Introduction to Tribology bearings, Wheelers and company pvt. Ltd 2001.

**REFERENC BOOKS:**

1. Fuller, D., Theory and Practice of Lubrication for Engineers, New York company 1998
2. Moore, Principles and applications of Tribology, Pergamon press 1998
3. Srivastava S., Tribology in industries, S Chand and Company limited, Delhi 2002
4. Redzimoskay E I., Lubrication of bearings – theoretical principles and design, Oxford press company 2000

**Scheme of Examination:**

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## EARTHMOVING EQUIPMENTS & TRACTORS

**Sub Code: 06AU832**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### PART - A

#### 1. EQUIPMENTS AND OPERATION:

Different types of earth moving equipments and their applications. Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments. **9 hrs**

#### 2. ENGINE:

All systems of engine and special features like Automatic injection timer, turbochargers, after coolers etc **4 hrs**

#### 3. UNDER CARRIAGE AND SUSPENSION:

Tyre and tracked vehicles, advantages and disadvantages, under carriage components like, tracks, roller frames, drive sprockets, track rollers, track chains and track shoes. SUSPENSION: rubber spring suspension and air spring suspension **6 hrs**

#### 4. TRANSMISSIONS AND FINAL DRIVES:

Basic types of transmissions, auxiliary transmission, compound transmission, twin & triple countershaft transmissions and planetary transmission, constructional and working principles, hydroshift automatic transmission and retarders. FINAL DRIVES: types of reductions like, single reduction, double reduction final drives and planetary final drives, PTO shaft. **6Hrs**

### PART-B

#### 5. HYDRAULICS:

Basic components of hydraulic systems like pumps (types of pumps), control valves like flow control valves, directional control valves and pressure control valves, hydraulic motors and hydraulic cylinders. Depth & draft control systems. **7 Hrs**

#### 6. STEERING AND BRAKES

Power steering types like, linkage type power steering, semi integral power steering & integral power steering. STEERING OF TRACKED VEHICLES: Skid steering, articulated steering, clutch /brake steering system, controlled differential steering system and planetary steering system. BRAKES: Types of brakes like, disc brake, engine brakes etc. **6 Hrs**

**7. EARTH MOVING EQUIPMENTS MAINTENANCE & SAFETY:** Types of maintenance schedules purpose and advantages, organization set ups, documentation. Safety methods for earth moving equipments. **6Hrs**

#### 8. METHODS OF SELECTION OF EQUIPMENTS

- 1) Selection of machines
- 2) Basic rules of equipments including the nature of operation
- 3) Selection based on type of soil
- 4) Selection based on haul distance
- 5) Selection based on weather condition

#### CALCULATION OF OPERATING CAPACITY

- 1) Methods of calculating operating capacity
- 2) Calculation of productivity of a bull dozer

**8 Hrs**

#### TEXT BOOKS:

1. Diesel equipment- volume I and II by Erich J. Schulz
2. Construction equipment and its management By S.C. Sharma, Dhanpath Rai & Sons, New Delhi

#### REFERENCE BOOKS:

1. Farm machinery and mechanism by Donald R. Hunt and L. W. Garner
2. Theory of ground vehicles by J.Y. Wong, John Wiley and Sons, 1978
3. Moving the earth by Herbert L. Nicholas, Galgotia Publishing House, New Delhi
4. On and with the earth by Jagman Singh, W. Newman and Co. Calcutta

#### Scheme of Examination:

4 Question to be set from part-A

4 Question to be set from part-B

Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## SIMULATION OF I.C. ENGINE PROCESSES

**Sub Code: 06AU833**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### PART – A

#### 1.INTRODUCTION

Principle of computer modeling and simulation, Monte Carlo simulation, Nature of computer modeling and simulation. Limitations of simulation, areas of application

**6 Hrs**

#### 2. SYSTEM AND ENVIRONMENT:

Components of a system-discrete and continuous systems. Models of a system-a variety of modeling approaches.

**4Hrs**

#### 3.DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS:

Variance reduction techniques. antithetic variables. variables verification and validation of simulation models.

**6Hrs**

#### 4.COMBUSTION PROCESS – GENERAL

Heat of reaction – Adiabatic flame temperature – Temperature change due to fuel vapourisation

**4Hrs**

#### 5. COMBUSTION AND HEAT TRANSFER IN ENGINES

Combustion in diesel engines – Heat transfer in engines – Heat transfer correlations.

**4Hrs**

### PART-B

#### 6. C.I. AND S.I. ENGINE SIMULATION

Simulation of Otto cycles under full load and part load and supercharged conditions. Progressive combustion, Exhaust and intake process analysis.

**12Hrs**

#### 7. TWO STROKE ENGINE SIMULATION

Engine and porting geometry, gas flow, Scavenging.-

**8 Hrs**

#### 8. SIMULATIONEXERCISES:

Simulation exercises using computers- MATLAB SimuLink, ProE / ICEM, CFD Analysis, FE Analysis and Validation of models.

**8 Hrs**

#### TextBooks:

1. V.Ganesan," ComputerSimulation of Spark Ignition Engine Processes", Universities Press,1995.
2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities Press, 2002.
- 3.NARSINGH DEO, "System Simulation with digital Computer", prentice Hall Of India,1979 ..
4. J.I.Ramos,. "Internal Combustion Engine Modeling" Hemisphere Publishing Corporation, 1989

#### ReferenceBooks:

- 1..Ashley S. Campbell, Thermodynamic Analysis of Combustion Engines, John Wiley and Sons, 1980.
- 2.J.N.Mattavi and C. A. Amann,. Combustion Modeling in Reciprocating Engines", Plenum Press,1980.
- 3.Horlockan and IWInterbone," The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol.I & II ", Clarendon Press, 1986.
- 4.Gordon P. Blair, The Basic Design of two-Stroke engines, SAE Publications, 1990.

#### Scheme of Examination:

4 Question to be set from part-A

4 Question to be set from part-B

Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## NANOTECHNOLOGY

**Sub Code: 06ME834**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### Part A

#### Unit 1: An overview of Nanoscience & Nanotechnology

Historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications.

**5 Hrs**

#### Unit 2: Experimental Techniques and Methods

For investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes – light scattering – x-ray diffraction.

**7 Hrs**

#### Unit 3: Fullerenes

Discovery, synthesis and purification – chemistry of fullerenes in the condensed phase – orientational ordering – pressure effects – conductivity and superconductivity – ferromagnetism – optical properties.

**Carbon Nanotubes** – synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties applications.

**7 Hrs**

#### Unit 4: Self-assembled Monolayers

Monolayers on gold – growth process – phase transitions – patterning monolayers mixed monolayers – applications.

**Gas Phase Clusters** – history of cluster science – formation and growth – detection and analysis – type and properties of clusters – bonding in clusters.

**7 Hrs**

### Part B

#### Unit 5: Semiconductor Quantum Dots

Synthesis – electronic structure of nanocrystals – how quantum dots are studied – correlation of properties with size – uses.

**5 Hrs**

#### Unit 6: Monolayer-protected Metal Nanoparticles

Method of preparation – characterization – functionalized metal nanoparticles – applications – superlattices.

**Core-shell Nanoparticles** – types – characterization – properties – applications.

**Nanoshells** – types – characterization – properties – applications. **8 Hrs**

#### Unit 7: Nanobiology –

Interaction between biomolecules and nanoparticle surfaces – materials used for synthesis of hybrid nano-bio assemblies – biological applications – nanoprobe for analytical applications – nanobiotechnology – future perspectives.

**Nanosensors** – what make them possible – nanoscale organization for sensors – characterization – nanosensors based on optical properties – nanosensors based on quantum size effects – electrochemical sensors – sensors based on physical properties – nanobiosensors – sensors of the future.

**Nanomedicines** – approach to development – nanotechnology in diagnostic and therapeutic applications. **8 Hrs**

#### Unit 8: Molecular Nanomachines –

Covalent and non-covalent approaches – molecular motors and machines – other molecular devices – single molecular devices – practical problems involved.

**Nanotribology** – studying tribology on the nanoscale – applications. **5 Hrs**

#### Textbook:

1. NANO: The Essentials – Understanding Nanoscience and Nanotechnology; T Pradeep (Professor, IIT Madras); Tata McGraw-Hill India (2007)

#### References:

1. Nanotechnology: Richard Booker & Earl Boysen; Wiley (2005).
2. Introduction to Nanoscale Science and Technology [Series: Nanostructure Science and Technology]: Di Ventra, et al (Ed); Springer (2004)
3. Nanotechnology Demystified: Linda Williams & Wade Adams; McGraw-Hill (2007)
4. Introduction to Nanotechnology: Charles P Poole Jr, Frank J Owens, Wiley India Pvt. Ltd., New Delhi, 2007.

#### Scheme of Examination:

4 Question to be set from part-A

4 Question to be set from part-B

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## HYDRAULICS AND PNEUMATICS

**Sub Code: 06AU835**

**IA Marks: 25**

**Hrs/Week: 04**

**Exam Hrs: 03**

**Total Lecture Hrs: 52**

**Exam Marks: 100**

### PART – A

#### Unit 1: Introduction to Hydraulic Power:

Pascal's law and problems on Pascal's Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System. **The Source of Hydraulic Power:** Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps. **8 Hrs**

#### Unit 2: Hydraulic Actuators and Motors:

Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance **6 Hrs**

#### Unit 3: Control Components in Hydraulic Systems:

Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. **5 Hrs**

#### Unit 4: Hydraulic Circuit Design and Analysis :

Control of single and Double – acting Hydraulic cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits. **7 Hrs**

### PART – B

#### Unit 5: Maintenance of Hydraulic systems :

Hydraulic oils – Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in

hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting. **6 Hrs**

#### Unit 6: Introduction to Pneumatic control:

Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. **Pneumatic Actuators:** Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod – less cylinders – types, working advantages. Rotary cylinder types construction and application. Design parameters – selection **6 Hrs**

#### Unit 7: Directional Control valves:

Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. **Simple Pneumatic Control:** Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve. **Signal processing elements:** Use of Logic gates – OR and AND gates pneumatic applications. Practical examples involving the use of logic gates. Pressure dependent controls types construction –practical applications. Time dependent controls – Principle, construction, practical applications. **7 Hrs**

#### Unit 8: Multi-cylinder applications:

Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro-Pneumatic control:** Principles-signal input and out put pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. **Compressed air:** Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout. **7 Hrs**

#### Text Books:

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

#### Reference Books:

1. Oil Hydraulic Systems – Principles and Maintenance: S.R. 2002 Majumdar, Tata Mc Graw Hill publishing company Ltd. 2001.
2. Pneumatic systems by S.R.Majumdar, Tata Mc Graw Hill publishing Co., 1995.

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

**Scheme of Examination:**

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

**COMPUTER GRAPHICS**

**Sub Code: 06ME836**

**IA Marks: 25**

**Hrs/Week: 04**

**Exam Hrs: 03**

**Total Lecture Hrs: 52**

**Exam Marks: 100**

**PART – A**

**Unit-1**

Scan Conversion and Clipping Representation of points, lines, Line Drawing Algorithms: DDA algorithm, Bresenham's integer line algorithm, Bresenham's circle algorithm, Polygon filling algorithms: scan conversion, seed filling, scan line algorithm. Viewing transformation, Clipping –points, lines, text, polygon, Cohen-Sutherland line clipping, Sutherland-Hodgmen algorithm. **7 Hrs**

**Unit-2**

Two Dimensional Transformations Representation of points, Transformations: Rotation, Reflection, Scaling, Combined Transformations, Translations and Homogeneous Coordinates, A geometric interpretation of homogeneous coordinates, Over all scaling, Points at infinity, rotation about an arbitrary point, Reflection through an arbitrary line. **6 Hrs**

**Unit-3**

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

**Unit-4**

Plane and Space Curves Curve representation, Nonparametric curves, parametric curves, parametric representation and generation of line, circle, ellipse, parabola, hyperbola, generation of circle, ellipse, parabola, hyperbola, Cubic spline, normalized cubic splines, Bezier curves: blending function, properties, generation, B-spline curves- Cox-deBoor recursive

formula, properties, open uniform basis functions, Non-uniform basis functions, periodic B-spline curve. **7 Hrs**

**PART-B**

**Unit-5**

Types and Mathematical Representation of Solids Solid Models, Solid entities, Solid representation, Solid modeling- set theory, regularized set operations, set membership classification, Half spaces, Half spaces of plane, cylinder, sphere, conical half-space, Boundary representation, Constructive Solid Geometry- basic elements, Building operations. **7 Hrs**

**Unit-6**

Visual Realism-I Introduction, hidden line removal- visibility of object views, Visibility techniques: minimax test, containment test, surface test, Silhouettes, Homogeneity test, Sorting, Coherence, Hidden line priority algorithm, Hidden surface removal- Z-buffer algorithm, Warnock's algorithm, Hidden solid removal- ray tracing algorithm. **6 Hrs**

**Unit-7**

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

**Unit-8**

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

**Text Books:**

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

**Reference Books:**

1. Xiang z, Plastock, R. A., Computer Graphics, Schaums outlines, McGraw Hill. 2007.
2. Foley, Van- Damn, Finner and Hughes, "Computer Graphics", principles nad practice, Addison Wesley. 2000
3. Sinha A. N., Udai A. D., Computer Graphics, Tata McGraw Hill, 2008.

**Scheme of Examination:**

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## FOUNDRY TECHNOLOGY

**Sub Code: 06ME838**

**IA Marks: 25**

**Hrs/Week: 04**

**Exam Hrs: 03**

**Total Lecture Hrs: 52**

**Exam Marks: 100**

### PART - A

#### Unit-1. Foundry Metallurgy:

Oxidation of liquid metals, gas dissolution in liquid metals, methods of degassing, fluidity, factors affecting fluidity, fluidity tests, hot tearing, shrinkage of liquid and metals. **06 Hrs**

#### Unit – 2. Casting design:

Introduction to casting design, redesign considerations, design for minimum casting stresses, design for directional solidification, design for metal flow, cast weld design, safety factors, design for low pattern cost and minimum manipulation, model making as an aid in design. **06 Hrs**

#### Unit – 3 Solidification of castings:

Crystallization and development of cast structure - nucleation, growth and dendritic growth. Structure of castings - significance and practical control cast structure, grain shape and orientation, grain size, refinement and modification of cast structure. Concept of progressive and direction solidification, solidification time and derivation of Chvorinov's equation, influence on mold characteristics and cast metal. **07 Hrs**

#### Unit – 4 Riser and Gating:

The reason for risering, requirement of a riser, riser size and directional solidification, riser location and directional solidification, atmospheric pressure and risering, insulation, moldable exothermic sleeves, exothermic riser compounds, internal chills and chaplets, external chills, molding materials of different chill capacities, padding, riser shape, size and contact area, side and blind risers, location of risers, general considerations of risering, riser size, riser treatment, riser feeding distance, risering of alloys, Gating system, theoretical considerations of gating, turbulence in the gating system, velocity calculations, the tapered sprue, velocity calculations in real gating systems, problems. **07Hrs**

### PART – B

#### Unit – 5 Modern Moulding :

Modern moulding process like vacuum moulding, flaskless moulding, nobake moulding.

**Cupola:** Developments in cupola melting like, secondary tyers, uniblast cupola, balanced blast cupola, hot blast cupola, water cooled cupola, cupola charge calculations. **07 Hrs**

#### Unit – 6 Foundry refractories:

Introduction, classification of refractories, refractory raw materials, forms of refractories and refractory materials, structure of refractories, general considerations of acid refractories, fireclay and other alumina-silica refractories, silica refractories, general considerations of basic and neutral refractories, refractories in the acid cupola, refractories in the basic cupola, open-hearth steel furnaces, induction and direct-arc furnaces for ferrous melting, ladle refractories for iron and steel, refractories in the non-ferrous foundry, molding materials. **06 Hrs**

#### Unit – 7 Ferrous Foundry:

Manufacturing of steel ingots, casting, Structure, properties, production and application of Grey cast iron, malleable iron and spheroidal graphite iron. **07 Hrs**

#### Unit – 8 MODERNIZATION OF MECHANIZATION OF FOUNDRY:

Need for modernization area mechanization, moulding and core making, melting, pouring, shake out equipment and fettling dust and fume control, material handling equipments for sand moulds and cores, molten metal and castings, reclamation of sands. **06Hrs**

#### Text Books:

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

#### References:

1. R.K.Jain 'Foundry Technology'
2. P.N.Rao 'Foundry Technology'
3. Radha Krishna 'Manufacturing process – III
4. Hein Coper & Rosenthal 'Principles of metal cutting' TMH - 2005

#### Scheme of Examination:

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## INDUSTRIAL MANAGEMENT

**Sub Code: 06AU841**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### Part – A

#### Unit 1:Introduction:

Historical perspective, contribution of Taylor, Henry Fayol, Gilbert, Charles Babbage, HL Gantt and others to the evolution of management science in the Indian context. Ownership of Industries Proprietorship, partnership, joint stock companies, public and private undertakings, co-operative organizations.

**6 Hrs**

#### Unit 2:Management Functions:

Planning: corporate objectives, policies, strategies need for planning, responsibilities and types of plans, modern toll of planning, selection of alternatives and process of decision making, case studies.

Organization: Basic requirement, types, structures and merits, Departmentation, vertical and horizontal growth, span of control, authority and responsibility, centralization and decentralization, formal and informal organizations, case studies.

**07 Hrs**

#### Unit 3: Staffing:

Appraisal of needs, executive development schemes, performance appraisal and managerial mobility.

Directing: Types of instructions and characteristics of good order, communication follow of instructions motivation and leadership.

Controlling: process of control, requirements of effective controlling, controlling techniques.

**07 Hrs**

#### Unit 4:Work study, incentives, Health and safety :

Method study and time study, Foundations of work study, Job evaluation systems, Multi skilling , Incentive schemes, Training and Development, Safety Regulations and safe practice

**06 Hrs**

### Part - B

#### Unit 5: Management and Behavioral Approach:

Contribution of Elton Mayo and skinner and others to behavior sciences. Skills of a manager at various levels in an organization and inter-related systems, understanding past behavior, predicting future behavior, directing, changing and controlling behavior.

**06 Hrs**

#### Unit 6: Motivation and Behavior:

Maslow's hierarchy of needs, pretence of needs and satisfaction of needs, goal oriented behavior, integration of organizational goals and needs of employee. Hawthorn's studies and its findings theory X and theory Y, immaturity theory, motivation hygiene theory.

**06 Hrs**

#### Unit 7: Process Management:

Definition of process management. Major process decisions-process choice, vertical integration, resource flexibility, customer involvement, capital intensity, relationships between decisions, service operation relationships between decisions, service operation relationships, economics of scoop and gaining focus. Designing process-process rearranging and process improvement.

**07 Hrs**

#### Unit 8: Management of Technology:

Meaning and role of technology-primary areas of technology management, management of technology and its role in improving business performance. Creating and applying technology-R and D stages and technology fusion. Technology strategy. Implementation guidelines.

**07 Hrs**

#### TEXT BOOKS:

1. Koontz Odonnel,"Principles of Management",Mc.Graw Hill Intl.Book Co.
2. S.N Chery, Production and operations Management, TATA McGraw Hill

#### REFERENCE BOOKS:

1. Koontz Weirich,"Essentials of management",TATA McGraw Hill Intl. Book Co., 7<sup>th</sup> Edition.
2. Hersey Paul and Kenneth H,"Management of Organizational Behaviour" PHI.
3. Lee J.Krajewski and Larry P. Ritzman, "Operations management-strategy and analysis", Fifth Edition Addison-Weley.

#### Scheme of Examination:

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

### ALTERNATE ENERGY SOURCES FOR AUTOMOBILES

**Sub Code: 06AU842**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### PART - A

**Chapter 1: Introduction:**

Types of energy sources, their availability, need of alternative energy sources, availability merits and limitations of solar energy, wind energy, ocean energy, biomass and hydrogen energy. **6Hrs**

**Chapter 2: Solar energy:**

Solar energy geometry, solar radiation measurement devices, solar energy collectors, types of collectors, direct application of solar energy, solar energy storage systems, P-V effect solar cells and characteristics. Application of solar energy for automobiles. **10Hrs**

**Chapter 3: Biomass energy:**

Definition of biomass, types of biomass, biomass conversion techniques, bio gas, biogas generation processes, types of biogas plants, construction and working, application of biogas for IC engines, modifications needed. Vegetable oils, Types - Properties – Biodiesel Esterification – Performance in Engines **10Hrs**

**PART-B****Chapter 4: Wind energy:**

Introduction, principle of wind energy conversion, types of wind mills, relative advantages and limitations, factors considered for site selection, application of wind energy. **5Hrs**

**Chapter 5: Hydrogen energy:**

Properties and thermodynamics of water splitting, Hydrogen production methods, problems associated in use of hydrogen fuel, Storage and Transportation methods, Precautions and safety for use. combustion, emission and performance characteristics of hydrogen engine, engine modifications required.

Fuel cells, types of fuel cells, their characteristics, requirements and applications of fuel cells. **8Hrs**

**Chapter 6:**

Properties of alcohols, production of ethanol and methanol, performance of IC engines using ethanol and methanol blends, production and properties of natural gas and LPG. Advantages and disadvantages of using natural gas and LPG as fuel in IC engine. Comparison with respect to conventional fuel. **7Hrs**

**Chapter 7: Electric vehicles:**

Requirements, features of different electric vehicles available in India, design of electric vehicle, components, types of batteries and power plant. Advantages, disadvantages and future prospects of electric vehicles. **6Hrs**

**TEXT BOOK**

1. Osamu Hirao and Richard K. Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988.
2. G.D. Rai, Non conventional energy sources – Khanna Pub, New Delhi
3. William Hamilton Electric Automobiles, PHI

**REFERENCES**

1. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990.
2. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997.
3. Sukatme, “Solar energy”, Tata McGrawHill

**Scheme of Examination:**

- 4 Question to be set from part-A
- 4 Question to be set from part-B

Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

**DESIGN OF AUTOMOTIVE ENGINE COMPONENTS****Sub Code: 06AU843****IA Marks: 25****Hrs/Week: 04****Exam Hrs: 03****Total Lecture Hrs: 52****Exam Marks: 100****PART - A****1. General Considerations in Engine Design:**

Preliminary analysis, choice of cycle, speed, fuel, bore and stroke, cylinder arrangement, choice of material, stress and fatigue considerations. **4 Hrs**

**2. Design of major Components:**

Detailed design procedure for piston assembly, connecting rod, crankshaft, poppet valve, valve gear, cylinder, cylinder head and crank case. **10 Hrs**

**3. Design of other Components:**

Inlet and exhaust manifolds, Engine foundations and mountings, gaskets, bearings, Flywheel, Turbocharger, Supercharger, Fuel injection system.

**10 Hrs**

**PART-B**

**4. Design of Fuel Supply System**

S.I Engines- Carburetor design.

C.I Engines - Fuel pump, fuel injector

**8 Hrs**

**5. Design of Lubricating Systems :**

Oil pump, oil filter, oil cooler

**4 Hrs**

**6. Design of Cooling System Components**

Water pump, Radiator, Cooling fan.

**4Hrs**

**7.Design of Two – Stroke Engines:**

Design of Inlet and Exhaust ports, piston assembly, intake and exhaust system, scavenging, application to automotive gasoline and marine diesel engines.

**12 Hrs**

**TextBooks:**

- 1.. A.KolchinandV.Demidov, "Design of Automotive Engines", Mir Publishers, Moscow1984
2. Gordon P. Blair. "Basic design of Two stroke Engines", SAE 1992
3. V.L. Maleev, ." Internal-Combustion Engines: Theory and Design ", McGraw-Hill Book Company, Inc. 1994.

**ReferenceBooks:**

1. Engine Design- Giles J. G., Iliffe Book Ltd.
2. Gordon P. Blair ."Advanced concepts of Two-stroke Engines – SAE -1990
3. John Fenton, " Engine Design", University Press Cambridge, Great Britain, 1986
4. D.E. Winterbone and R.J. Pearson, "Design techniques for Engine Manifolds. Wave action methods for I.C. Engines", Professional engineering Publishing Ltd, UK, 2000
5. Crouse, 'Engine Design" Tata McGraw Publication, delhi.
6. SAE Handbooks

**Scheme of Examination:**

4 Question to be set from part-A

4 Question to be set from part-B

Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

**HYBRID VEHICLES**

**Sub Code: 06AU844**

**IA Marks: 25**

**Hrs/Week: 04**

**Exam Hrs: 03**

**Total Lecture Hrs: 52**

**Exam Marks: 100**

**PART - A**

**1. Hybrid Vehicles**

Performance characteristics of road vehicles, calculation of road load, predicting fuel economy, Grid connected hybrids.

**4Hrs**

**2. Propulsion methods**

DC motors-series wound, shunt wound. Compound wound and separately excited motors AC motors - induction, synchronous, brushless DC motor, switched reluctance motors.

**12Hrs**

**3. Hybrid architecture**

Series configuration- locomotive drives, series parallel switching, load tracking architecture. Pre transmission parallel and combined configurations-Mild hybrid, power assist, dual mode, power split, power split with shift, Continuously Variable transmission (CVT). wheel motors.

**8Hrs**

**PART –B**

**4. Hybrid power plant specifications**

Grade and cruise targets. launching and boosting, braking and energy recuperation, drive cycle implications, engine fraction-engine downsizing and range and performance, usage requirements.

**8 Hrs**

**5. Sizing the drive system**

Matching electric drive and ICE, sizing the propulsion motor, sizing power electronics.

**4Hrs**

**6. Energy storage technology**

Battery basics, lead-acid battery, different types of batteries, battery parameters.

**7.Fuel cells:**

Fuel cell characteristics, fuel cell types - alkaline fuel cell, proton exchange membrane, direct methanol fuel cell, phosphoric acid fuel cell, molten

carbonate fuel cell, solid oxide fuel cell, hydrogen storage systems, reformers, fuel cell EV, super and ultra capacitors, flywheels. **10Hrs**

***TextBooks:***

1. Dr Mike Westbrook, M H Westbrook, "The Electric Car: Development & Future of Battery, Hybrid & Fuel-Cell Cars", British library Cataloguing in Publication Data, UK, ISBN0 85296 0131.
2. Robin Hardy, Iqbal Husain, "Electric and Hybrid Vehicles.", CRC Press, ISBN 0-8493-1466-6.
3. John M. Miller, "Propulsion Systems for Hybrid Vehicles" Institute of Electrical Engineers, London, ISBN0 863413366.

***ReferenceBooks:***

1. Energy Technology Analysis Prospects for Hydrogen and Fuel Cells, International Energy Agency, France.
2. Hamid A Taliyat, Gerald B Kliman, "Hand book of Electric Motors", Merce Dekker Inc., US, ISBN0-8247-4105-6.

**Scheme of Examination:**

4 Question to be set from part-A

4 Question to be set from part-B

Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## DATABASE MANAGEMENT SYSTEMS

**Sub Code: 06ME845**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### PART – A

#### Unit – 1 Database and Database Users:

Introduction, characteristics of database approach, intended uses of a DBMS, advantages and implementation of database approach. **06 Hrs**

#### Unit – 2 Database Systems concepts and Architecture:

Data models, schemes and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of database management systems. **06 Hrs**

#### Unit – 3 Data Modeling:

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

**08 Hrs**

#### Unit – 4 Record Storage and primary file organizations :

Secondary storage devices, buffering of the blocks, placing file records on the disk, operations on files, heap files and sorted files, hashing techniques.

**06 Hrs**

### PART - B

#### Unit – 5 Relational data model and relational algebra:

Brief discussion on code rules, relational model concepts, constraints and schemas. Update operation on relations, basic and additional relational algebra operations. And queries in relational algebra. **07 Hrs**

#### Unit – 6 Structural Query Language (SQL):

Data definition etc., in SQL2. Basic and complex queries in SQL, Inset, Delete, ; Update statements, and views in SQL, embedded SQL. **07 Hrs**

#### Unit – 7 Database Design:

Design guidelines for relational schemas, functional dependencies, normalization 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> ;normal forms. Database design process, factors influencing physical database design guidelines , and guidelines for relational systems. **07 Hrs**

#### Unit–8 System implementation:

System catalogue for RDBMSs, transaction processing, and system concepts, properties of transaction, brief discussion on concurrency control and recovery techniques, database security and authorization. **05 Hrs**

#### Text Books:

1. Fundamentals of database systems, Ramez Elmasri and Shanmkanth B. Navathe, 3<sup>rd</sup> Edition, Addison Pearson.
2. Database management system by Raghu Ramakrishnan, Tata Mc Graw Hill, 3<sup>rd</sup> Edn. 2002.

#### Reference Books:

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

#### Scheme of Examination:

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## ARTIFICIAL INTELLIGENCE

**Sub Code: 06ME846**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### PART – A

#### Unit-1 Artificial Intelligence:

Introduction, definition, underlying assumption, importance of AI, AI and related fields. **6 Hrs**

#### Unit-2 Space Representation:

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

#### Unit-3– Knowledge Representation Issues

Representations and Mappings, Types of knowledge – Procedural Vs Declarative, Logic programming. Forward Vs Backward reasoning, Matching. **7 Hrs**

#### Unit-4:

Use of Predicate Logic – Representing simple facts, Instance and Is-a relationships, Syntax and Semantics for Propositional logic, FQPL and properties of Wffs, Conversion to Clausal form, Resolution, Natural deduction. **6 Hrs**

### PART-B

#### Unit-5:

Statistical and Probabilistic Reasoning- Symbolic reasoning under uncertainty, Probability and Bayes' theorem, Certainty factors and Rule based systems, Bayesian Networks, Shafer Theory, Fuzzy Logic. **7 Hrs**

#### Unit-6:

Expert Systems, Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition Learning

classification patterns, recognizing and understanding speech. Introduction to knowledge Acquisition, Types of Learning. **7 Hrs**

#### Unit-7 Typical Expert Systems:

MYCIN, Variants of MYCIN, PROSPECTOR, DENDRAL, PUFF, ETC. **6 Hrs**

#### Unit – 8; Introduction to Machine Learning :

Perceptrons, Checker Playing Examples, Learning Automata, Genetic Algorithms, Intelligent Editors. **6 Hrs**

#### Text Books:

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

#### Reference Books:

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

#### Scheme of Examination:

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

## DESIGN OF EXPERIMENTS

**Sub Code: 06ME847**

**Hrs/Week: 04**

**Total Lecture Hrs: 52**

**IA Marks: 25**

**Exam Hrs: 03**

**Exam Marks: 100**

### PART-A

#### **Unit 1: Introduction:**

Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments. **05 Hrs**

#### **Unit 2: Basic Statistical concepts:**

Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples. **07 Hrs**

#### **Unit 3: Experimental Design:**

Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples. **07 Hrs**

#### **Unit 4: Analysis and Interpretation methods:**

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples. **07 Hrs**

### PART - B

#### **Unit 5: Quality by Experimental Design :**

Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples. **06Hrs**

#### **Unit 6: Experiment Design using Taguchi's Orthogonal Arrays:**

Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples. **08 Hrs**

#### **Unit 7: Signal to Noise Ratio:**

Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the -better-type, Larger-the-better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples. **06 Hrs**

#### **Unit 8: Parameter and Tolerance Design:**

Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples. **06 Hrs**

#### **TEXT BOOKS:**

1. **Design and Analysis of Experiments:** Douglas C. Montgomery, 5<sup>th</sup> Edition Wiley India Pvt. Ltd. 2007
2. **Quality Engineering using Robust Design:** Madhav S. Phadke, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632, 1989.

#### **REFERENCE BOOK:**

1. **Quality by Experimental Design:** Thomas B. Barker, Marcel Dekker, Inc ASQC Quality Press.1985.
2. **Experiments Planning, analysis, and parameter Design optimization.** By C.F.Jeff Wu Michael Hamada, John Wiley Editions. 2002.
3. **Reliability Improvement by Experiments:** W.L. Condra, Marcel Dekker, Inc ASQC Quality Press.1985.
4. **Taguchi Techniques for Quality Engineering:** Phillip J. Ross, 2<sup>nd</sup> Edn. McGraw Hill International Editions, 1996.

#### **Scheme of Examination:**

One question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

