

OPERATIONS RESEARCH

Sub Code: 10AU71

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART –A

Unit 1: Introduction:

Linear programming, Definition, scope of Operations Research (O.R) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution methods.

06 Hrs

Unit 2: Linear Programming Problems:

The simplex method - slack, surplus and artificial variables. Concept of duality, two phase method, dual simplex method, degeneracy, and procedure for resolving degenerate cases.

07 Hrs

Unit 3: Transportation Problem:

Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems.

07Hrs

Unit 4: Assignment Problem: Formulation, unbalanced assignment problem, traveling salesman problem.

06 Hrs

PART –B

Unit 5: Sequencing:

Johnson's algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs n machines without passing sequence. 2 jobs n machines with passing. Graphical solutions

06 Hrs

Unit 6: Game Theory:

Formulation of games, two person-Zero sum game, games with and without saddle point,

Graphical solution ($2 \times n$, $m \times 2$ game), dominance property.

06 Hrs

Unit 7: Queuing Theory:

Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analyzing of M/M/1 and M/M/C queuing model.

06 Hrs

Unit 8: PERT-CPM Techniques:

Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks.

8 Hrs

Text Books:

1. Taha H. A. - Operations Research and Introduction, Macmillan edition
2. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, Wiley India ltd, 2nd Edition 2007.

Reference Books:

1. AM Natarajan, P.Balasubramani , ATamilaravari “Operation research” Pearson 2005
2. Hiller and Lieberman, Introduction to operation research. Mc Grew Hill. 5th edition 2001.
3. S. D. Sharma – Operations Research Kedarnath Ramnath & Co 2002.

VEHICLE BODY ENGINEERING AND SAFETY

Sub Code: 10AU72

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART-A

UNIT-1

Introduction:

Classification of coachwork type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, Vans and Pick ups. Terms used in body building construction, Angle of approach, Angle of departure, Ground clearance, Cross bearers, Floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets

8Hrs

UNIT-2

Vehicle Body Materials:

Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention.

6 Hrs

UNIT-3

Aerodynamics:

Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles

7Hrs

UNIT-4

Load distribution:

Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

6Hrs

PART-B

UNIT-5

Interior Ergonomics:

Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.

6Hrs

UNIT-6

Vehicle Stability:

Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

7 Hrs

UNIT-7

Noise and vibration:

Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

6 Hrs

UNIT_8

Safety:

Impact protection basics, Physics of impact between deformable bodies, Design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.

6Hrs

TEXT BOOKS:

1. Sydney F page, "Body Engineering" Chapman & Hall Ltd, London, 1956
2. "Giles J Pawlowski", Vehicle body engineering Business books limited, 1989
3. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.

REFERENCE BOOKS:

1. Hand book on vehicle body design – SAE publication
2. Automotive chassis by P.M. Heldt, Chilton & Co, 1970
3. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 -1448.
4. Redesign of bus bodies – part I & part II – CIRT pune (Report), 1983
5. Ed W.H. Hucho, Aerodynamics of Road Vehicles, 4th Edition, Butter worth's 1987
6. Scibor-Rylski A.J, Road Vehicle Aerodynamics, Pentech press, London 2nd Edition 1984
7. Rae W.H & Pope A, Low Speed Wind Tunnel Testing Wiley & Sons, USA 1984 out of print
8. Noel W. Murray, "when it comes to the Crunch: The Mechanics of the Car Collisions" (Body work maintenance and repair) by Paul and Browne

Vehicle Transport Management

Sub Code: 10AU73

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART - A

UNIT-1

Introduction:

Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies. Motor vehicle act 1988. 6 Hrs

UNIT-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

UNIT-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

UNIT-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

UNIT-5

Fare collections & Fare structure:

Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bellgraphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, Vero meter, 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

UNIT-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

UNIT-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

UNIT-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

AUTOMOTIVE AIR POLLUTION AND CONTROL

Sub Code: 10AU74

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART-A

UNIT-1

Laws and regulations:

Historical background, regulatory test procedure (European cycles), Exhaust gas pollutants (European rail road limits), particulate pollutants, European statutory values, inspection of vehicle in circulation (influence of actual traffic conditions and influence of vehicle maintenance)

4 hrs

UNIT-2

Mechanism of pollutant formation in Engines

INTRODUCTION:

NITROGEN OXIDES, formation of nitrogen oxides, kinetics of NO formation, formation of NO₂, NO formation in spark ignition engines, NO_x formation, in compression ignition engines

CARBON MONOXIDE

UNBURNED HYDROCARBON EMISSIONS

Back ground, flame quenching and oxidation fundamentals, HC emissions from spark ignition engines, HC emission mechanisms in diesel engines

PARTICULATE EMISSIONS

Spark ignition engine particulates, characteristics of diesel particulates, soot formation fundamentals, soot oxidation.

Crankcase emissions, piston ring blow by, evaporative emissions

10 hrs

UNIT-3

Pollution control techniques:

Pollution control measures inside SI Engines & lean burn strategies, measures in engines to control Diesel Emissions

Pollution control in SI & CI Engines, Design changes, optimization of operating factors and Exhaust gas recirculation, fuel additives to reduce smoke & particulates

Road draught crankcase ventilation system, positive crankcase ventilation system, fuel evaporation control

8 hrs

UNIT-4

Influence of Fuel Properties

Effect of petrol, Diesel Fuel, Alternative Fuels and lubricants on emissions

5 hrs

PART -B

UNIT-5

Post combustion Treatments

Available options, physical conditions & exhaust gas compositions before treatment, Catalytic mechanism, Thermal Reactions, Installation of catalyst in exhaust lines, catalyst poisoning, catalyst light-off, NO_x treatment in Diesel Engines, particulate traps, Diesel Trap oxidizer.

8 hrs

UNIT-6

Effect of air pollution

Effect of air pollution on Human Health, Effect of air pollution on animals, Effect of air pollution on plants

4 hrs

UNIT-7

Sampling procedures

Combustion gas sampling: continuous combustion, combustion in a cylinder

Particulate sampling: soot particles in a cylinder, soot in exhaust tube, Sampling Methods- sedimentations, and filtration, and impinge methods- electrostatic precipitation thermal precipitation, centrifugal methods

Determination of mass concentration analytical methods- volumetric-gravimetric-calorimetric methods etc.

4 hrs

UNIT-8

Instrumentation for pollution measurements

NDIR analyzers, Gas chromatograph, Thermal conductivity and flame ionization detectors, Analyzers for NO_x, Orsat apparatus, Smoke measurement, comparison method, obscuration method, ringelmann chart, Continuous filter type smoke meter, Bosch smoke meter, Hart ridge smoke meter

9 hrs

TEXT BOOKS:

1. Automobiles and pollution - Paul degobert (SAE)
2. Internal combustion engine fundamentals – john B. Heywood

REFERANCE BOOKS;

1. Air pollution – M.N. Rao, and H. V. Rao
2. Internal combustion engines: V. Ganesan
3. Crouse William, Automotive Emission Control, Gregg Division /McGraw-Hill. 1980
4. Ernest, S., Starkman, Combustion Generated Air Pollutions, Plenum Press, 1980.
5. George, Springer and Donald J.Patterson, Engine emissions, Pollutant Formation and Measurement, Plenum press, 1972.
6. Obert, E.F., Internal Combustion Engines and Air Pollution, Intext Educational Publishers, 1980.

Mechanical Vibrations and Vehicle Dynamics

Sub Code: 10AU751

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART -A

UNIT_1

Introduction:

Types of vibration, Simple harmonic motion and definition of some terms of vibration, Vector method and complex form of representing harmonic motions, addition of simple harmonic motions. 5 Hrs

UNIT-2

Undamped free vibration:

Introduction, Newton's second law of motion method, D'Alembert's principle, Energy method, Rayleigh's method, Single degree of freedom systems, Natural frequency of free vibration, equivalent stiffness of springs, effect of spring mass. 8 Hrs

UNIT-3

Damped free vibration:

Single degree of freedom systems, types of damping, concept of critical damping and its importance, study of viscous damped systems - under damping, critical damping and over damping, logarithmic decrement, structural and coulomb damping. 6 Hrs

UNIT-4

Forced vibration:

Single degree of freedom systems, steady state solution with viscous damping due to harmonic force, concept of frequency response, reciprocating and rotating unbalance, vibration isolation and transmissibility, energy dissipated by damping, equivalent viscous damping, Structural damping, sharpness of resonance, base excitation. 7Hrs

PART- B

UNIT-5

Vibration measuring instruments and Whirling of shafts:

Vibrometer, Accelerometer and frequency measuring instruments, whirling of shafts with and without air damping, discussion of speeds above and below critical speeds. 6Hrs

UNIT-6

Two degree of freedom systems:

Introduction, principle and normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, orthogonality principle, Lagrange's equation, semi-definite systems, forced vibrations, harmonic excitation. Applications: Vehicle suspension, Dynamic vibration absorber, dynamics of reciprocating engines. 6 Hrs

UNIT-7

Vehicle vibration and human comfort:

Vehicle vibration with single degree of freedom - free vibration, forced vibration - vibration due to road roughness, vibration due to engine unbalance, transmissibility of engine mounting, vibration with two degrees of freedom - free vibration - compensated suspension system, forced vibration - vibration due to road roughness, vibration absorber. 6 Hrs

UNIT-8

Multi degree of freedom systems:

Introduction, influence coefficients, Maxwell's reciprocal theorem, orthogonality principle, Dunker ley's equation, determination of natural frequencies using matrix iteration method, Holzer's method for systems with free, fixed free and fixed ends, strodola method, Rayleigh's method for beam vibration 8 Hrs

Text Books:

1. Mechanical Vibrations, G. K. Grover and S. P. Nigam, Nemchand and Brothers, Roorkee
2. **Mechanical Vibrations:** V.P. Singh, Dhanpat Rai and Sons, New Delhi
3. **Theory and Problems of Mechanical Vibrations**, William W. Seto, McGraw Hill International Book Co., Singapore (Schaum's outline series)

References:

1. **Vibration, Theory and Applications**, William I Thomson, Prentice Hall
2. **Mechanical Vibration**, Church, A. W., John Wiley and Sons, USA
3. **Automobile Mechanics** (Through Problems), N. K. Giri, Khanna Publishers, Delhi
4. **Mechanical Vibration Analysis**, P. Srinivasan, TMH
5. **Vibration and Noise for Engineers**, Kewal Pujara and R.S. Pujara, Dhanpat Rai and Sons, Delhi
6. **Mechanical Vibrations:** S. S. Rao, Pearson Education Inc.,
7. **Mechanical Vibrations**, S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill Publishing Co. Ltd., New Delhi
8. **Theory and Practice of Mechanical vibrations**, J. S. Rao and K. Gupta, New Age International Publications, New Delhi
9. **Elements of Vibrations Analysis:** Leonard Meirovitch, Tata McGraw Hill, New Delhi
10. **Vibrations**, Tse F. S., Morse I. E. and Hinkle T., CBS Publishers and Distributors, Delhi
11. **Mechanical vibrations**, Den Hertog, McGraw Hill

Two and Three Wheeled Vehicles

Sub Code: 10AU752

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART - A

UNIT 1: The Power Unit:

Types of engines for two wheelers, advantages and disadvantages of two stroke and four stroke engines, engine components, constructional details, materials, symmetrical and unsymmetrical port timing diagrams, valve actuating mechanisms, valve timing diagrams. Rotary valve engine, Advantages and disadvantages of diesel engines for two wheelers, power plant for electric bikes, exhaust systems. 8Hrs

UNIT 2: Fuel, Lubrication and Cooling system:

Layout of fuel supply system, fuel tank construction, carburetor types, construction, working and adjustments. Types of cooling systems, advantages of air cooling system. Lubrication types, Lubrication of parts, grades of lubricating oils 6Hrs

UNIT 3: Transmission system:

Primary drive and Clutch: Motor cycle power train, Primary drives, Types of primary drives, Chain drive, Gear drive, Construction and operation of motorcycle clutches, Clutch release mechanism.

Gear boxes and Transmission: Introduction to motorcycle transmission, Sprockets and chain, Gears and Dogs in motor cycle transmission, Gear and Gear ratios, Sliding gear transmissions, Shifting fork mechanisms, Constant mesh transmissions, lubrication, Final drive: Introduction to motorcycle final drives, Fundamentals of chain drive, Chain lubrication and lubricators, Shaft drives, Drive shaft couplings, Final drive gear case, 6Hrs

UNIT 4: Frames and suspension:

Types and constructional details of frames, advantages and limitations, frame materials, frame stresses, frame building problems, frame components, Front and Rear suspension systems, shock absorber construction and working, Panel meters and controls on handle bar, body manufacture and painting. 6Hrs

PART -B

UNIT 5: Brakes and Wheels:

Front and rear braking systems, disc and drum brakes, merits and demerits. Types of wheels, loads on wheels, construction and materials for wheels, wheels designation. Tyre designation, inflation, types of tyres, construction details. 6Hrs

UNIT 6: Electrical system:

Types of ignition system, their working principles, wiring diagram for Indian vehicles, spark plug construction, indicators and gauges used in two wheelers, lighting systems. 6Hrs

UNIT 7: Two wheelers and Three wheelers:

Case study of major Indian models of major motor cycles, scooters, scooteretts and mopeds.

Case study of Indian models of three wheelers, Front mounted engine and rear mounted engine types, Auto rickshaws, pick up van, delivery van and trailer, Bijili electric vehicles.

8Hrs

UNIT 8: Maintenance:

Importance of maintenance, Decarburizing procedure for engine and silencer, periodic inspection, maintenance schedules, trouble diagnosis charts, safety precautions, Lubrication charts

6 Hrs

TEXT BOOKS:

P.E.IRVING, "Motor cycle engines", Temple Press Book, London, 1992

Motor cycles --Michel M Griffin

William H. Crouse and Donald L. Anglin, "Motor cycle Mechanics",

References Books:

"The cycle Motor manual", Temple Press Ltd, 1990

Bryaut R. V. "Vespa maintenance and repair series.

"Encyclopedia of Motor Cycling 20 volumes", Marshall Cavendish, New York and London, 1989

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.

NON – TRADITIONAL MACHINING

Sub Code: 10AU753

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART - A

Unit 1: Introduction:

History, Classification, comparison between conventional and Non-conventional machining process selection. **03 Hrs**

Unit 2: Ultra sonic machine(USM):

Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM. **08 Hrs**

Unit 3: Abrasive Jet Machining (AJM):

Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean No. abrasive particles per unit volume of the carrier gas, work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining : Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery **09Hrs**

Unit 4: Electrochemical machining (ECM):

Introduction , study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations. **06 Hrs**

PART – B

Unit 5: Chemical Machining (CHM) :

Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM: ;material removal rate accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM. **06 Hrs**

Unit 6: Electrical discharge machining (EDM):

introduction, machine, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear , EDM tool design choice of machining operation electrode material selection, under sizing and length of electrode , machining time. Flushing pressure flushing suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy surface finish, Heat affected Zone. Machine tool selection, Application EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

08 Hrs**Unit 7: Plasma Arc Machining (PAM):**

Introduction, equipment non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations.

05 Hrs**Unit 8: Laser Beam Machining (LBM):**

Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

Electron Beam Machining (EBM): Principles, equipment, operations, applications, advantages and limitation of EBM.

07 Hrs**Text Books:**

1. **Modern machining process**, by PANDEY AND SHAN, TATA McGraw Hill 2000
2. New technology by BHATTACHARAYA 2000

Reference Books:

1. **Production Technology**, by HMT TATA McGraw Hill. 2001
2. Modern Machining Process by ADITYA. 2002
3. **Non-Conventional Machining** by P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
4. Metals Handbook: Machining(Hardcover) volume 16
by [Joseph R. Davis](#) (Editor), [American Society of Metals](#) (ASM)

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 INTEGRATED MANUFACTURING

Sub Code: 10AU754

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART - A

Unit 1: Computer Integrated Manufacturing Systems :

Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations. **08 Hrs**

Unit 2: High Volume Production System:

Introduction Automated flow line-symbols, objectives, Work part transport-continuous, Intermittent, synchronous, Pallet fixtures, Transfer Mechanism-Linear-Walking beam, roller chain drive, Rotary-rack and pinion, Ratchet & Pawl, Geneva wheel, Buffer storage, control functions-sequence, safety, Quality, Automation for machining operation. **06 Hrs**

Unit 3: Analysis of Automated Flow line & Line Balancing :

General terminology and analysis, Analysis of Transfer Line with Out storage-upper bound approach, lower bound approach and problems, Analysis of Transfer lines with storage buffer, Effect of storage, buffer capacity with example problem, Partial automation-with numerical problem example, flow lines with more than two stage, Manual Assembly lines line balancing problem. **06 Hrs**

Unit 4: Minimum rational work element:

work station process time, Cycle time, precedence constraints. Precedence diagram, balance delay methods of line balancing-largest candidate rule, Kilbridge and Westers method, Ranked positional weight method, Numerical problems covering above methods and computerized line balancing. **06 Hrs**

PART - B

Unit 5: Automated Assembly Systems:

Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feed back, escapement and placement analysis of Multistation Assembly machine analysis of single station assembly.

Automated Guided Vehicle System:

Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application. **08 Hrs**

Unit 6: Computerized Manufacturing Planning system :

Introduction, Computer Aided process planning, Retrieval types of process planning , Generative type of process planning, Material requirement planning, Fundamental concepts of MRP inputs to MRP, Capacity planning. **06 Hrs**

Unit 7: CNC Machining Centers:

Introduction to CNC, elements of CNC, CNC machining centers, part programming, fundamental steps involved in development of part programming for milling and turning **06 Hrs**

Unit 8: Robotics:

Introduction to Robot configuration, Robot motion, programming of Robots end effectors, Robot sensors and Robot applications. **06 Hrs**

Text Books:

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

Reference Books:

1. **Computer Integrated Manufacturing**, J.A.Rehg & Henry.W. Kraebber.
2. **CAD/CAM by Zeid**, Tata McGraw Hill.

Scheme of Examination:

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.

TOTAL QUALITY MANAGEMENT

Sub Code: 10AU755

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART –A

Unit 1: Overview of TQM:

Introduction-Definition, Basic Approach, And Contribution of Gurus – TQM framework, Historical Review, Benefits of TQM, TQM organization. **05 Hrs**

Unit 2: Leadership, Customer Satisfaction and Employee Involvement:

Characteristics of quality leaders, Customers satisfaction, Customer perception of quality, Feedback, Using customers complaints, Employee involvement - Introduction, Teams, Cross functional teams, Quality circles, Suggestion system, Benefits of employee involvement. **07 Hrs**

Unit 3: Human Resource Practices:

Scope of Human Resources Management, leading practices, designing high performance work systems-work and job design, Recruitment and career development, Training and education, Compensation and recognition, Health, safety and employee well-being, performance appraisal. **08 Hrs**

Unit 4: Building and sustaining Total Quality Organizations:

Making the commitment to TQ, Organizational culture and Total Quality, Change management, sustaining the quality organization. **06 Hrs**

PART –B

Unit 5: Tools and techniques in TQM:

7 basic tools of quality control, Kaizen, Re-engineering, 6 sigma, Benchmarking, Definition, Process of benchmarking, 5S, Yoke. **08 Hrs**

Unit 6: Quality management systems:

Quality management systems, ISO-9000 series of standards, Overview of ISO-14000, Overview of TS 16959. **06 Hrs**

Unit 7: Product Acceptance Control:

Product acceptance control through IS 2500 part 1 and part 2. **06 Hrs**

Unit 8: Quality Function Deployment and Failure Modes Effects Analysis:

Introduction to QFD and QFD process, Quality by design, Rationale for implementation of quality by design, FMEA, Design FMEA and process FMEA. **06 Hrs**

Text Books:

1. Total Quality Management: Dale H. Besterfield, Publisher - Pearson Education India, ISBN: 8129702606, Edition 03/e Paperback (Special Indian Edition)
2. The management and control of Quality: James R. Evans and William M.Lindsay, ISBN: 981-243-552-0 , Publisher - Thomson South-Western, Edition –6

Reference Books:

1. Total Quality Management for Engineers: M. Zairi, ISBN: 1855730243, Publisher: Woodhead Publishing.
2. 100 Methods for Total Quality Management: Gopal K. Kanji and Mike Asher , ISBN: 0803977476, Publisher: Sage Publications, Inc.; Edition – 1

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.

NON DESTRUCTIVE TESTING

Sub Code: 10AU761

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

Part – A

UNIT-1

Introduction to ND testing: selection of ND methods, visual inspection, leaks testing, liquid penetration inspection, its advantages and limitations. **(06 Hrs)**

UNIT-2

Magnetic particle inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids – steps in inspection – application and limitation. **(08 Hrs)**

UNIT-3

Eddy current inspection: principles, operation variables, procedure, inspection coils, and detectable discounts by the method. **(08 Hrs)**

UNIT-4

Microwave inspection: Microwave holography, applications and limitations. **(06 Hrs)**

Part – B

UNIT-5

Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection. **(04 Hrs)**

UNIT-6

inspection methods pulse echo A, B, C scans transmission, resonance techniques transducer elements, couplets, search units, contact types and immersion types inspection standard-standard reference blocks, inspection of products like casting, extrusions, rolled product, weld set. **(08 Hrs)**

UNIT-7

Radiography inspection: Principles, radiation source-Rays and gamma rays-rays tubes, radiographic films, scenes and filters, image intensifiers, techniques charts, industrial radiography, image quality, radiography sensitivity, Peneamotors, electron, neural radiology, application of ICT. Thermal inspection principles, equipment inspection methods applications. **(08 Hrs)**

UNIT-8

Optical Holography: Basics of Holography, recording and reconstruction-info metric techniques of inspection, procedures of inspection, typical applications. Acoustical Holography: systems and techniques applications. Indian Standard for NDT. **(08 Hrs)**

REFERENCE BOOKS:

1. McGonnagle JJ “Non Destructive testing” – Garden and reach New York
2. Non destructive Evolution and quality control” volume 17 of metals hand book 9 edition Asia internal 1989
3. Davis H.E Troxel G.E Wiskovil C.T the Testing instruction of Engineering materials Mc graw hill.

Engineering Economics and Automotive Cost Estimation

Sub Code: 10AU762

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART-A

UNIT-1

Introduction:

Definition of various economic terms such as economic goods, utility, value, price, wealth, Attributes of wealth and its classification, wants and their characteristics, Classification of wants, standard of living, rent and profit, Factors of Production: Land, Lab our, Capital, Organization.

Demand and Supply: Law of diminishing utility, marginal and total utility, Demand, Demand Schedule, Law of demand, Elasticity of demand, Factors governing the elasticity of demand, Law of substitution and its application, Supply, Law of supply, supply schedule, elasticity of supply, theory of value, equilibrium price, Laws of returns.

Wages: Nominal and real wages, Factors affecting real wages, Wages, efficiency and standard of living, theory of wages, difference in wages, methods of wage payment

8 Hrs

UNIT-2

Money and Exchange:

Definition and function of money, Qualities of a good money, classification of money, value of money, index numbers, appreciation and depreciation of money, Gresham's Law and its limitations. Theory of exchange, barter, stock exchange, Speculation

Taxation and Insurance:

Principle of taxation, characteristics of a good taxation system, kinds of taxes and their merits and demerits, Vehicle Insurance and loss Assessment

6Hrs

UNIT-3

Interest:

Introduction, theory of interest, interest rate, interest rate from lender's and borrower's view point, simple and compound interest, Cash Flow Diagram, Interest formulas (discrete compounding, discrete payments), Nominal and effective interest rates, Numerical problems.

6Hrs

UNIT-4

Depreciation:

Need for depreciation, Causes of depreciation, Life and salvage value, Methods of calculating depreciation and their merits and demerits, Numerical problems. 6Hrs

PART-B

UNIT-5

Costs and Cost Accounting: Standard cost, estimated cost, First cost, Fixed cost, Variable cost, Incremental cost, Differential cost, Sunk and marginal cost, Breakeven and minimum cost analysis. Objectives of cost accounting, elements of cost: material cost, labor cost, and expenses, allocation of over heads by different methods, Numerical problems.

8Hrs

UNIT-6

Basis for Comparison of alternatives: Present worth, equivalent annual worth, future worth, rate of return, payback period, capitalized cost comparison, and capital recovery with return methods, Numerical problems.

Replacement analysis: Basic reasons for replacement, present asset and its replacement, consideration leading to replacement, installation and removal cost, Numerical problems.

6Hrs

UNIT-7

Book Keeping and accounts:

Introduction, Necessity of book keeping, single entry and double entry system, Classification of assets, Journal, Ledger, Trial balance, Final accounts, trading, profit and loss account, Balance sheet, Numerical problems.

4Hrs

UNIT-8

Cost Estimation:

Introduction, importance, objectives and functions of estimating, principle factors in estimating, Functions and qualities of an estimator, estimating procedure. Estimation of material cost and manufacturing cost of simple automotive components, Estimation of cost of overhauling and servicing of automotive components - cylinder, valves, valve seats, crankshaft, FIP, Brake drum, body building, different types of repairs, Numerical problems.

8Hrs

TEXT BOOKS:

1. **Engineering Economics**, Tara Chand, Nem Chand and Brothers, Roorkee
2. **Engineering Economy**, Thuesen, G. J. and Fabrycky, W. J., Prentice Hall of India Pvt. Ltd.
3. **Mechanical Estimating and Costing**, T. R. Banga and S. C. Sharma, Khanna Publishers, Delhi

REFERENCE BOOKS:

1. **Industrial Organization and Engineering Economics**, T. R. Banga and S. C. Sharma, Khanna Publishers, New Delhi
2. **Mechanical Estimating and Costing**, D. Kannappan et al., Tata McGraw Hill Publishing Company Ltd., New Delhi
3. **A Text Book of Mechanical Estimating and Costing**, O. P. Khanna, Dhanpat Rai Publications Pvt. Ltd., New Delhi
4. **Industrial Engineering and Management**, O. P. Khanna, Dhanpat Rai and Sons, New Delhi
5. **Financial Management**, I. M. Pandey, Vikas Publishing House Pvt. Ltd., New Delhi
6. **Engineering Economics**, James L. Riggs, David D. Bedworth and Sabah U. Randhawa, Tata McGraw-Hill Publishing Co. Ltd., New Delhi
7. **Engineering Economy**, Paul DeGarmo, Macmillan International Inc., New York

ADVANCED I.C.ENGINES

Sub Code: 10AU763

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART-A

UNIT-1

Combustion in Spark Ignition Engines

Thermodynamic analysis of SI engine Combustion: Burned and unburned mixture states. Analysis of cylinder pressure data, Combustion process characterization, Flame structure and speed; flame structure, laminar burning speeds, flame propagation relations, Cyclic variations in combustion, partial burning and misfire: definitions, causes of cycle – by – cycle and cylinder to cylinder variations, partial burning, misfire and engine stability. Spark Ignition: Ignition fundamentals, conventional ignition systems, alternative ignition systems, alternative ignition approaches, Abnormal Combustion: knock and surface ignition, knock fundamentals, fuel factors.

13 Hrs

UNIT-2

Combustion in Compression Ignition Engines

Types of diesel combustion systems: Direct injection systems, indirect injection systems, comparison of different combustion systems, Analysis cylinder pressure data; combustion efficiency, DI engines, IDI engines, Fuel spray behaviour: Fuel injection, overall spray structure, atomization, spray penetration, droplet size distribution and spray evaporation, Ignition delay: definitions and discussion, fuel ignition quality, auto ignition fundamentals, physical properties affecting delay, effect of fuel properties.

13 Hrs

PART-B

UNIT-3

Equilibrium charts:

Charts for burnt mixture, charts for unburned Mixture, transmission from unburned to burnt mixture, non-equilibrium Problems covering the above.

4 Hrs

UNIT-4

Modern Developments in I.C.Engines:

Lean burn engines, ceramic and adiabatic engines, Multi-valving, Tuned manifolding, camless valve gearing, variable valve timing, Turbo and supercharging – Waste gating, EGR, Part-load charge stratification in GDI systems. Sports vehicle engines, Stirling engines, MPFI engines – operation and performance. 10Hrs

UNIT-5

Special types of Engines;

Introduction to working of stratified charged engines, Wankel engine, variable compression engine, Surface ignition engines, free piston engines, Current engines and future trends (e.g. Convergence of SI and CI engine technology, Control developments, fuel quality), Effect of air cleaners and silencers on engine performance. 8Hrs

UNIT-6

Gas Turbine combustion:

Simple brayton cycle, working of a gas turbine, modification of the simple cycle, intercooling reheat and regeneration, determination of efficiency and power output, numerical problems. **4 Hrs**

TEXT BOOKS:

1. Internal Combustion Engines Fundamentals - John B. Heywood, McGraw Hill International Edition,
2. A course in I.C. Engines - Mathur & Sharma, Dhanpat Rai & sons, New Delhi, 1994

REFERENCE BOOKS:

1. I.C.Engines by Taylor, MIT Press England 1989
2. I.C.Engines By Lichty., McGraw Hill
3. Fuels & Combustion By Smith & Stinson., McGrawHill
4. Motor Vehicle Engines by M.Khovakh., Mir Publishers
5. I.C. Engines by V.Ganesan, Tata Mc Graw Hill, 1994

Engineering System Design

Sub Code: 10AU764

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART – A

Unit1: Introduction:

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

Morphology of Design: The three phases of design projects, the structure of design process, decision making and iteration. **08 Hrs**

Unit2: Identification And Analysis Of Need:

Preliminary need statement, analysis of need, specifications, and standards of performance and constrains. **06 Hrs**

Unit3: Origination Of Design Concept:

Process of idealization, mental fixity, and some design methods like morphological analysis, AIDA, brain storming etc. **06 Hrs**

Unit4: Preliminary Design:

Mathematical modeling for functional design: concept of sensitivity, compatibility and stability analysis. **06 Hrs**

Part – B

Unit5: Evaluation Of Alternatives And Design Decisions:

Physical realizability, DESIGN TREE: Quality of design, Concept of utility, multi criteria decisions, decisions under uncertainty and risk (Numerical) **08 Hrs**

Unit6: Reliability Considerations in Design:

Bath tub curve, exponential reliability function, system reliability concept. (Numerical) **07 Hrs**

Unit7: Economics and Optimization in Engineering design:

Economics in Engineering Design, Fixed and variable costs, break-even analysis. (Numerical)

Optimization: Introduction to LPP. **06 Hrs**

Unit8: Man-Machine Interaction:

Designing for use and maintenance, Man-Machine Cycle, Design of displays and controls. Factors influencing displays and controls. **05 Hrs**

TEXTBOOKS:

1. An introduction to engineering design method, by V. Gupta and P. Murthy, Tata McGraw Hill. 2000
2. Introduction of Engineering Design by T. Woodson, McGraw Hill. 2001

REFERENCE BOOKS:

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

ROBOTICS

Sub Code: 10AU765

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART - A

Unit 1: Introduction and Mathematical Representation of Robots: History of Robots, Types of Robots, Notation, Position and Orientation of a Rigid Body, Some Properties of Rotation Matrices, Successive Rotations, Euler Angles For fixed frames X-Y-Z and moving frame ZYZ. Transformation between coordinate system, Homogeneous coordinates, Properties of ${}^A_B T$, Types of Joints: Rotary, Prismatic joint, Cylindrical joint, Spherical joint, Representation of Links using Denavit-Hartenberg Parameters: Link parameters for intermediate, first and last links, Link transformation matrices, Transformation matrices of 3R manipulator, PUMA560 manipulator, SCARA manipulator
07 Hrs

Unit 2: Kinematics of Serial Manipulators: Direct kinematics of 2R, 3R, RRP, RPR manipulator, puma560 manipulator, SCARA manipulator, Stanford arm, Inverse kinematics of 2R, 3R manipulator, puma560 manipulator.
06 Hrs

Unit 3: Velocity and Statics of Manipulators: Differential relationships, jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R maipulators, Statics of serial manipulators, Static force and torque analysis of 3R manipulator, Singularity in force domain.
07 Hrs

Unit 4: Dynamics of Manipulators: Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian, Newton-Euler formulation
06 Hrs

PART - B

Unit 5: Trajectory planning: Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning
07Hrs

Unit 6: Control: Feedback control of a single link manipulator- first order, second order system, PID control, PID control of multi link manipulator, Force control of manipulator,

force control of single mass, Partitioning a task for force and position control- lever, peg in hole Hybrid force and position controller

08 Hrs

Unit 7: Actuators: Types, Characteristics of actuating system: weight, power-to-weight, operating pressure, stiffness vs. compliance, Use of reduction gears, comparison of hydraulic, electric, pneumatic, actuators, Hydraulic actuators, proportional feedback control, Electric motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics

06 Hrs

Unit 8: Sensors: Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor- encoders, tachometers, Acceleration sensors, Force and Pressure sensors – piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.

05 Hrs

Text Books:

1. **Fundamental Concepts and analysis**, Ghosal A., Robotics, Oxford, 2006
2. **Introduction to Robotics Analysis, Systems, Applications**, Niku, S. B., Pearson Education, 2008

Reference Books:

1. **Introduction to Robotics: Mechanics and Control**, Craig, J. J., 2nd Edition, Addison-Wesley, 1989.
2. **Fundamentals of Robotics, Analysis and Control**, Schilling R. J., PHI, 2006

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 Workshop (Testing and Servicing)

Sub Code: 10AUL77

IA Marks: 25

Hrs/Week: 03

Exam Hrs: 03

Total Lecture Hrs: 42

Exam Marks: 50

1. Testing of Single Cylinder, Twin Cylinder and multi cylinder SI / CI engines for performance, calculate BP, Thermal, volumetric efficiencies, and BSFC with emission testing.
2. Study one engine performance by changing parameters like valve timing, ignition timing, carburetor nozzle jet.
3. Conduct Morse test for finding FP, IP, Indicated thermal efficiency and Mechanical efficiency.
4. Study of engine performance using alternate fuels like alcohol blends/ bio diesel / LPG.
5. Performance test on computerized IC engine test rig.
6. Study and testing on MPFI Engine and Variable compression Engine.
7. Tuning of engines. Study and practice on computerized engine analyzer.

Scheme of Examination

ONE Question from Chapter 1, 2, 3, & 4	25 Marks
ONE Question from Chapter 5, 6 & 7	15 Marks
Viva-Voce	10 Marks

CAD/CAM/CAE LAB

Sub Code: 10AUL78

Hrs/Week: 03

Total Lecture Hrs: 42

IA Marks: 25

Exam Hrs: 03

Exam Marks: 50

1. Modeling – Introduction.
Development of 2D and 3D geometric modeling using anyone parametric software.
Exercises on automotive components - 3D modeling (1 – 4 components)
Software's – Pro-E, CATIA, UNIGRPHICS etc.
2. Analysis – FEA (Preprocessor, solver, post processor)
 - a) Exercise involving simple structures.
 - b) Exercise involving automotive components modeled in chapter 1. (Tensile, Compressive, Torsion or Combined loading, thermal loading) – Static and dynamic loading conditions.
Software's – Ansys/ Unisys/ Nastran/ Patran and LS Dyna. Etc.
 - c) Validation of result with analytical solution.
3. Introduction to CNC programming(G codes & M codes)
 - a.) Turning b) Milling
Simple Exercises (2 – 4 exercises) using CNC Simulator.

EARTHMOVING EQUIPMENTS & TRACTORS

Sub Code: 10AU81

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART - A

UNIT-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**

UNIT-2

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

UNIT-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**

UNIT-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. **6 Hrs**

PART-B

UNIT-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**

UNIT-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**

UNIT-7

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

UNIT-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

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
- 3.Moving the earth by Herbert Nicholas
- 4.On and with the earth by Jagman Singh, W.Newman and Co. culkatta

AUTOTRONICS

Sub Code: 10AU82

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART-A

Chapter 1 : *Introduction to Mechatronic system*

Definition of Mechatronics, Objective, Evolution of Mechatronics, An overview of Mechatronics systems, Measurement & Control systems their elements & functions. Need of Mechatronics in Industries , Advantages & disadvantages of Mechatronics, Microprocessor based controllers, Working principle of Engine management system.

08 hours

Chapter 2 : *Transducers and sensors*

Definition and classification of Transducers. Definition and classification of sensors. Working Principle and applications of Light sensors, Proximity sensors and Hall effect sensors.

06 hours

Chapter 3 : *Electrical Actuation Systems*

Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches. Concept of bouncing, Methods of preventing bouncing of mechanical switches. Solenoids, Relays , Solid state switches - Diodes, Thyristors, Triacs, Transistors, Darlington pair. Electrical actuator, Principle, Construction and working of AC, DC motors, Stepper motors, Permanent magnet motors, servomotors, servo systems and control.

06 hours

Chapter 4: *Signal Conditioning*

Introduction to Signal conditioning, Operational amplifiers, Protection, filtering – Wheatstone bridge , Digital signals , Multiplexer. Data acquisition, Introduction to Digital signal processing, Pulse modulation.

06 hours

PART-B

Chapter 5 : *Introduction to Microprocessors*

Basic concepts, evolution of microprocessors, organization of microcomputers, microprocessor programming, Boolean algebra , Logic gates and Gate networks, Digital number system, Binary and Decimal number systems, memory representation of positive and negative integers , Maximum and minimum integers , Conversion of real numbers , Floating point notation, Representation of floating point numbers , Accuracy and range in floating point representation , Overflow and underflow , addition of floating point numbers , Character representation.

08 hours

Chapter 6 : *Organization & Programming a Microprocessor*

Organization of Intel 8085 microprocessor , Instruction set of the 8085, programming the 8085, Assembly language programming , programming examples

07 hours

Chapter 7 : *Microprocessor Timings & Interfacing memory & I/O devices*

Microprocessor Timings : Timing & Control unit, Timings of Intel 8085.

Interfacing memory & I/O devices : Address space partitioning , memory interfacing

06 hours

Chapter 8 : Applications of Mechatronics

A temperature monitoring system, Automotive applications

05 hours

Text books:

1. "*Mechatronics*" – by W. Bolton, Longman Pearson publications ., 2nd Ed , 2007, Third Edition.
2. "Microprocessor Architecture, Programming – by R.S.Gaonkar, Wiley Eastern and Applications" with 8085/8085A
3. *Mecharronics* by Prof. H.D.Ramachandra , M/S Sudha publications, Bangalore

Reference books:

1. "*Mechatronics*" principles, concepts and applications – by Nitaigour & Premchand Mahalik TATA McGraw Hill - 2003
2. "Introduction to Microprocessors" – by Adithya P.Mathur., TMH Publication , III edition , 2000.
3. "Fundamentals of Microprocessors and Microcomputers"– by B.Ram., Dhanpat Rai Pub.,1999.

Tribology

Sub Code: 10AU831

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

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 Tribiology, PHI 2006
2. Mujumdar B. C., Introduction to Tribiology bearings, Wheelers and company pvt. Ltd 2001.

REFERENEC BOOKS:

1. Fuller, D., Theory and Practice of Lubrication for Engineers, New York company 1998
2. Moore, Principles and applications of Tribiology, Pergamaon press 1998
3. Srivastava S., Tribiology in industries, S Chand and Company limited, Delhi 2002
4. Redzimovskay 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.

Simulation of IC Engine Processes

Sub Code: 10AU832

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART-A

UNIT-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

UNIT-2

SYSTEM AND ENVIRONMENT: components of a system-discrete and continuous systems. Models of a system-a variety of modeling approaches. 4 Hrs

UNIT-3

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS:

Variance reduction techniques. Antithetic variables. Variables verification and validation of simulation models. 6 Hrs

UNIT-4

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS:

Variance reduction techniques. Antithetic variables. Variables verification and validation of simulation models. 6 Hrs

UNIT-5

COMBUSTION PROCESS – GENERAL

Heat of reaction – Adiabatic flame temperature – Temperature change due to fuel vaporization 4Hrs

PART-B

UNIT-6

COMBUSTION AND HEAT TRANSFER IN ENGINES

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

4 hrs

UNIT-7

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

UNIT-8

TWO STROKE ENGINE SIMULATION

Engine and porting geometry, gas flow, Scavenging.-

8 Hrs

UNIT-9

SIMULATIONEXERCISES:

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

8Hrs

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 IWlnterbone," The Thermodynamics and Gas Dynamlcs of Internal Combustion Engines, Vol.I & II ", Clarendon Press, 1986.

4.Gordon P. Blair, The Basic Design of two-Stroke engines, SAE Publications, 1990.

HYDRAULICS AND PNEUMATICS

Sub Code: 10AU833

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 output 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.

Alternative Energy Sources for Automobiles

Sub Code: 10AU834

IA Marks: 25

Hrs/Week: 04

Exam Hrs: 03

Total Lecture Hrs: 52

Exam Marks: 100

PART-A

UNIT-1: Introduction. Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels and drive trains. Scenario of conventional auto fuels, oil reserves of the world. Fuel quality aspects related to emissions. Technological up gradation required business driving factors for alternative fuels. Implementation barriers for alternative fuels. Stakeholders of alternative fuels, roadmap for alternative fuels. **7 Hrs**

UNIT-2: Solar energy

Solar energy geometry, solar radiation measurement devices. Solar energy collectors, types of collectors. Direct application of solar energy, solar energy storage system. P.V. effect solar cells and characteristics. Application of solar energy for automobiles. **8 Hrs**

UNIT-3: Wind energy

Introduction, principle of wind energy conversion. Types of wind machines, applications of wind energy. Site selection considerations. Advantages and disadvantages of WEC systems. **5 Hrs**

UNIT-4: Gaseous alternative fuels.

Hydrogen, properties and production of hydrogen. Storage, Advantages and disadvantages of hydrogen. Hydrogen used in SI and CI engines. Hazards and safety systems for hydrogen, hydrogen combustion. Emission from hydrogen. CNG, LNG, ANG, LPG and LFG. **6 Hrs**

PART-B

UNIT-5: Biomass energy

Biogas or Biomethane. History, properties and production of Biogas, classification of biogas plants, biogas storage and dispensing system. Advantages of biogas, hazards and emissions of biogas. Methanol, Ethanol, Butanol, Straight vegetable oil, Biodiesel. **7 Hrs**

UNIT-6: Synthetic Alternative fuels

History, properties and production of hythane and HCNG, storage and dispensing of hythane and HCNG. Advantages, disadvantages, fuel kit, combustion process of HCNG and hythane. Emissions of hythane and HCNG. DME, DEE, BTL, GTL, CTL, Syngas, producer gas, P-series, Eco-friendly plastic fuel, wood pyrolysis oil, Magnegas, Tyre pyrolysis oil. **8 Hrs**

UNIT-7: Reformulated conventional fuels

Introduction. Production of coal water slurry, properties, as an engine fuel, emissions of CWS. RFG, Emulsified fuels. Hydrogen-enriched gasoline. Future Alternative Fuels, PMF, Ammonia, Liquid-Nitrogen, Boron, Compressed Air, Water. **6 Hrs**

UNIT-8: Introduction to alternative power trains, components of an EV. EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, what is a hybrid EV? HEV drive train components, advantages of HV. History of dual fuel technology, Applications of DFT. Dual fuel engine operation. Advantages and disadvantages of dual fuel technology. **5 Hrs**

TEXT BOOKS

1. S.S.Thipse "Alternative Fuels". JAICO Publishing House.
2. G.D.Rai "Non-Conventional Energy Sources" Khanna Publishing New Delhi.

REFERENCES

1. **Alternative fuels for vehicle book by M.poulton**
2. **Alternative fuels guide book by R. Bechtold.SAE**
3. **Internet website www.siamindia.com**
4. **Internet website www.wikipedia.com**
5. **Internet website www.iac.com**
6. **Internet website www.shell.com**
7. **A Primer on Hybrid Electric vehicles**
8. **Article from Dr.Harry Viterna, NASA Lewis centre 1997.**
9. **Perdue University, Solar racing car guide.**

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: 10AU841

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART - A

UNIT 1

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

4 Hrs

UNIT 2 & 3

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

12 Hrs

UNIT 4

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.

8 Hrs

PART -B

UNIT 5

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

UNIT 6

SIZING THE DRIVE SYSTEM: Matching electric drive and ICE, sizing the propulsion motor, sizing power electronics

4 Hrs

UNIT 7

ENERGY STORAGE TECHNOLOGY: Battery basics, lead-acid battery, different types of batteries, battery parameters.

6 Hrs

UNIT 8

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.

10 Hrs

TEXTBOOKS:

1. **The Electric Car: Development & Future of Battery, Hybrid & Fuel-Cell Cars** - Dr Mike Westbrook, M H Westbrook, British library Cataloguing in Publication Data, UK, ISBN0 85296 0131.
2. **Electric and Hybrid Vehicles** - Robin Hardy, Iqbal Husain, CRC Press, ISBN 0-8493-1466-6.

3. **Propulsion Systems for Hybrid Vehicles** - John M. Miller, Institute of Electrical Engineers,London,ISBN0 863413366.

REFERENCEBOOKS:

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

Maintenance Engineering

Sub Code: 10AU844

Hrs/Week: 04

Total Lecture Hrs: 52

IA Marks: 25

Exam Hrs: 03

Exam Marks: 100

PART-A

UNIT -1

Introduction to Maintenance System: Definition, Scope, Objective, functions and Importance of maintenance system, Type of maintenance system, Break down maintenance system. Preventive maintenance, Predictive maintenance, design out maintenance, corrective maintenance, planned maintenance, total productive maintenance, condition monitoring. Problems on selection of methods like preventive or breakdown maintenance, **9 Hrs**

UNIT - 2

Economics in Maintenance: Repair, replacement, Repair complexity, Finding out most optimal preventive maintenance frequency. Numerical treatment required, **8 Hrs**

UNIT - 3

Maintenance of Machinery: Causes of machine failure, performance evaluation, complete overhauling of Machines tools. Maintenance planning and scheduling. Repair order control manpower requirement, Maintenance job analysis spare parts control. **6 Hrs**

UNIT - 4

Maintenance Planning: Planning of maintenance junctures manpower allocation, long range planning, short range planning. Planning techniques and procedures. Estimation of maintenance work. Maintenance control. **4 Hrs**

PART-B

UNIT-5

Computers in maintenance: Features and benefits of Computer aided maintenance. Application of computers to maintenance work. **6 Hrs**

UNIT- 6

Industrial Safety: Economic importance of accidents, Types of safety organizations, Analysis of accident records, accident investigations, Analysis of accident Safety standards for Mechanical equipment. **7 Hrs**

UNIT- 7

Safety standards: Safety standards for Electrical equipment and systems. Chemical hazards, material handling, exhaust systems, welding, Plant house keeping-building, Aisles, passages, floors, tool cribs, washrooms, canteens. **6 Hrs**

UNIT - 8

Industrial Pollution Control: Dust control -Fibre collectors, mechanical dust collectors, wet type collectors, Electro static precipitators, Noise pollution Control - Noise measurement and control. Industrial vibration and its control. **6 Hrs**

TEXT BOOKS:

1. Maintenance Engineering and Management - R.C.Mishra and K.Pathak, Prentice Hall of India, 2002
2. Maintenance Engineering Hand book - Morrow.

REFERENCE BOOKS:

1. Hand book of Maintenance Management - Frank Herbaty
2. Hand book of Industrial Engg & Management - W. Grant Lreson & Eugene L-Grant
3. Industrial Pollution Control Handbook • LUND A. Industrial Maintenance - H P Garg
5. Maintenance Engineering Hand book- Lindrey Higgins, Mc Graw Hill, ffth edition, 2003
6. Plant Engineering Hand book - Staniar