



Year:4 Session: 2012 – 2013

Scheme and Evaluation Pattern

S.No	Course No.	Subject	Periods			Evaluation			External Exam	Total Marks
			L	T	P	Sessional				
						CT	TA	Total		
Semester: 7th										
Theory										
1.	EAU-701	Advanced IC Engine	3	1	0	30	20	50	100	150
2.	EAU-702	Vehicle Body Engineering And Safety	3	1	0	30	20	50	100	150
3.	EAU-703	Automotive Air Pollution And Control	3	1	0	30	20	50	100	150
4.		ELECTIVE-I	3	1	0	30	20	50	100	150
5.		Open Elective	3	1	0	30	20	50	100	150
Practical/Design										
1.	PAU-751	Project	0	0	4	0	0	50	50	100
2.	*PAU-752	Industrial Interaction and LMV driving Training	0	0	2	0	0	25	25	50
3.	PAU-753	SERVICE AND RECONDITIONING LAB	0	0	2	0	0	25	25	50
4.	PAU-754	Seminar	0	0	2	0	0	50	0	50
Semester: 8th										
Theory										
S.No	Course No.	Subject	Periods			Evaluation			External Exam	Total Marks
			L	T	P	Sessional				
						CT	TA	Total		
1.	TAE – 801	Autotronic	3	1	0	30	20	50	100	150
2.	TAE-802	Simulation Of IC Engine Processes	3	1	0	30	20	50	100	150
3.		ELECTIVE-II	3	1	0	30	20	50	100	150
4.		ELECTIVE-III	3	1	0	30	20	50	100	150
Practical/Design										
1.	PAU-851	Project	0	0	6	0	0	100	200	300
2.	PAU-854	CAD Lab	0	0	2	0	0	25	25	50
3.	PAU-805	Discipline	0	0	2	0	0	50	0	50

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. 8

UNIT-II

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. 6

UNIT-III

Equilibrium charts:

Charts for burnt mixture, charts for unburned Mixture, transition from unburned to burnt mixture, nonequilibrium Problems covering the above. 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. 6

UNIT-IV

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. 6

UNIT-V

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.

3

REFERENCE BOOKS:

1. Internal Combustion Engines Fundamentals - John B. Heywood, McGraw Hill International Edition,
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

EAU-702: VEHICLE BODY ENGINEERING AND SAFETY**UNIT-I****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

5

UNIT-II**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.

4

UNIT-III**Aerodynamic****s:**

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

8

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.

6

UNIT-IV**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.

8

UNIT-V

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. 4

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.

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, energyabsorbent foams, laws of mechanisms applied to safety. 4

REFERENCE BOOKS:

1. Sydney F page, "Body Engineering" Chapman & Hall Ltd, London, 1956
2. John Fenton, "Vehicle body layout and analysis", Mechanical Engg. Publication ltd, London.
3. Automotive chassis by P.M. Heldt, Chilton & Co, 1970
4. Vehicle Safety 2002, Cornwell press, Townbridge, UK, ISBN 1356 -1448.

EAU-703:AUTOMOTIVE AIR POLLUTION AND CONTROL

UNIT-I

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

UNIT-II

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 CORBONMONOXIDE 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

8

UNIT-III

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

5

Influence of Fuel Properties

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

3

UNIT-IV

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.

4

Effect of air pollution

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

3

UNIT-V

Sampling procedures

Combustion gas sampling: continuous combustion, combustion in a cylinder

Particulate sampling: soot particles in a cylinder, soot in exhaust tube, Sampling

Methodssedimentations, and filtration, and impinge methods- electrostatic precipitation thermal precipitation, centrifugal methods Determination of mass concentration, analytical methods- volumetric-gravimetric-calorimetric methods etc. 6

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 smokemeter. 6

REFERENCE BOOKS;

1. Automobiles and pollution - Paul degobert (SAE)
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

PAU-753:SERVICE AND RECONDITIONING LAB

1. Inspection of vehicles and preparation of test charts.
2. Tuning of Engines: Check for ignition timing, valve tappet clearance, Radiator flushing and check for leaks etc.,
3. Study and practice on
 - Connecting rod alignment
 - Cylinder reboring machine
 - Valve refacing machine
 - Nozzle grinding machine
 - Brake drum skimming machine
4. Servicing of components like FIP, Carburetor, Fuel pump, Exhaust pipes and Silencer, Lubricating system, Air compressor, shock absorber, Calibration of FIP.
5. Study and practice of wheel alignment (Mechanical and computerized) and wheel balancing
6. Testing of Two wheeled vehicles on chassis dynamometer
7. Study of tyre retreading and vulcanizing
8. Study and practice on body repairs – tinkering and painting
9. Head light focusing test and visibility test

EAU-801:AUTOTRONICS

UNIT 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. 5

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. 4

UNIT II

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. 5

Signal Conditioning

Introduction to Signal conditioning, Operational amplifiers, Protection, filtering –Wheatstone bridge , Digital signals , Multiplexer. Data acquisition, Introduction to Digital signal processing, Pulse modulation. 5

UNIT III

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. 5

UNIT IV

Organization & Programming a Microprocessor

Organization of Intel 8085 microprocessor , Instruction set of the 8085, programming the 8085, Assembly language programming , programming examples 4

UNIT V

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 4

Applications of Mechatronics

A temperature monitoring system, Automotive applications

3

REFERENCE 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. *Mecharonics* by Prof. H.D.Ramachandra , M/S Sudha publications, Bangalore
4. “*Mechatronics*” principles, concepts and applications – by Nitaigour & Premchand Mahalik, TATA McGraw Hill - 2003

EAU-802: SIMULATION OF IC ENGINE PROCESSES

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

SYSTEM AND ENVIRONMENT

components of a system-discrete and continuous systems. Models of a system-a variety of modeling approaches. 5

UNIT-II-

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS

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

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS

Variance reduction techniques. Antithetic variables. Variables verification and validation of simulation models. 4

UNIT-III

COMBUSTION PROCESS – GENERAL

Heat of reaction – Adiabatic flame temperature – Temperature change due to fuel vaporization 5

UNIT-IV

COMBUSTION AND HEAT TRANSFER IN ENGINES

Combustion in diesel engines – Heat transfer in engines – Heat Transfer correlations. 5

UNIT-V

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. 6

TWO STROKE ENGINE SIMULATION

Engine and porting geometry, gas flow, Scavenging. 4

ReferenceBooks:

1. V.Ganesan, " ComputerSimulation of Spark Ignition Engine Processes", Universities Press,1995..
- 2.NARSINGH DEO, "System Simulation with digital Computer", prentice Hall Of India,1979 .. 3.
- J.I.Ramos,. "Internal Combustion Engine Modeling" Hemisphere Publishing Corporation, 198

LIST OF ELECTIVE FOR VII SEM

EAU011: VEHICLE TRANSPORT MANAGEMENT

L T
3 1 0

UNIT-

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

2

UNIT-II

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 scaleoverhaul 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

6

Organization and Management:

Forms of ownership, municipal undertaking, company undertaking, traffic, secretarial and engineering departments, management, principle of transport, - internalorganization-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.

6

UNIT-III

Route planning:

Source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary scheduletest 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 frequencyTiming, Bus working and Schedules: Time table layout, uses of flat graph method of presentation, preparation ofvehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle runningnumbering determination of vehicle efficiency checking efficiency of crew, duty arrangements 8

UNIT-IV

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. 8

UNIT-V

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. 6

Reference books:

1. Bus operation - L.D. Kitchen, Iliffe & Sons, London
2. Bus & coach operation - Rex W. Faulks, Butterworth Version Of 1987, London
1. Compendium of transport terms - Cirt, Pune
2. M.V. Act 1988 - Central Law Agency, Allahabad
3. The elements of transportation - R.J. Eaton

EAU012: TWO AND THREE WHEELED VEHICLES

L T P
3 1 0

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. 5

UNIT II:

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, 6

UNIT III:

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.

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. 8

UNIT IV:

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. 2

UNIT V:

Two wheelers and Three wheelers:

Case study of major Indian models of major motor cycles, scooters, scooterettes 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.

4

References Books:

1. P.E.IRVING, "Motor cycle engines", Temple Press Book, London, 1992
2. Motor cycles -Michel M Griffin
3. William H. Crouse and Donald L. Anglin, "Motor cycle Mechanics",
 1. "The cycle Motor manual", Temple Press Ltd, 1990
 2. Bryaut R. V. "Vespa maintenance and repairseries.
 3. "Encyclopedia of Motor Cycling 20 volumes", Marshall Cavendish, New York and London, 1989

EAU013 NON – TRADITIONAL MACHINING

L T P
3 1 0

Unit 1:

Introduction:

History, Classification, comparison between conventional and Non-conventional machining process Selection 2

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. 3

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 6

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. 6

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. 5

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 . 4

Laser Beam Machining (LBM):

Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations. 2

Reference Books:

1. **Modern machining process**, by PANDEY AND SHAN, TATA McGraw Hill 2000
2. New technology by BHATTACHARAYA 2000
3. **Production Technology**, by HMT TATA McGraw Hill. 2001
4. Modern Machining Process by ADITYA. 2002

EAU014 COMPUTER INTEGRATED MANUFACTURING

L T P
3 1 0

Unit 1:

Computer Integrated Manufacturing Systems :

Introduction, Automation definition, Types of automation, CIM, processing in manufacturing, Production concepts, Mathematical Models-Manufacturing lead time, production rate, components of operation time, capacity, Utilization and availability, Work-in-process, WIP ratio, TIP ratio, Problems using mathematical model equations. 4

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. 4

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. 3

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. 4

Unit 4:

Automated Assembly Systems:

Design for automated assembly systems, types of automated assembly system, Parts feeding devices-elements of parts delivery system-hopper, part feeder, Selectors, feed back, escapement and placement analysis of Multistation Assembly machine analysis of single station assembly. 3

Automated Guided Vehicle System:

Introduction, Vehicle guidance and routing, System management, Quantitative analysis of AGV's with numerical problems and application. 4

Unit 5:

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.

4

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

EAU015: TOTAL QUALITY MANAGEMENT

Unit 1:

Overview of TQM:

Introduction-Definition, Basic Approach, And Contribution of Gurus – TQM framework, Historical Review, Benefits of TQM, TQM organization. 4

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. 4

Unit II:

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. 4

Unit III:

Building and sustaining Total Quality Organizations:

Making the commitment to TQ, Organizational culture and Total Quality, Change management, sustaining the quality organization. 3

Unit IV:

Tools and techniques in TQM:

7 basic tools of quality control, Kaizen, Re-engineering, 6 sigma, Benchmarking, Definition, Process of benchmarking, 5S, Yoke. 2

Unit V:

Quality management systems:

Quality management systems, ISO-9000 series of standards, Overview of ISO-14000, Overview of TS 16959. 3

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. 4

Reference 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
3. Total Quality Management for Engineers: M. Zairi, ISBN: 1855730243, Publisher: Woodhead

EAU 016: NON DESTRUCTIVE TESTING

L T P
3 1 0

UNIT-1

Introduction to ND testing:

Selection of ND methods, visual inspection, leaks testing, liquid penetration inspection, its advantages and limitations.

Magnetic particle inspection:

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

UNIT-II

Eddy current inspection:

Principles, operation variables, procedure, inspection coils, and detectable discounts by the method.

Microwave inspection:

Microwave holography, applications and limitations. 6

UNIT-III

Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection. 4

UNIT-IV

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. 4

UNIT-V

Radiography inspection: Principles, radiation source-Rays and gamma rays-rays tubes, radio graphic 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. 4

UNIT-VI

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. 4

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.

UNIT-I: MATERIALS

Structural materials: Aluminum alloy sheet, extrusion and casting, Austenitic and Ferritic stainless steels, alloy steels. Different types of composites, FRP & metal Matrix Composites. Structural timbers properties designing in GRP and high strength composites different manufacturing techniques of composites. Thermo plastics, ABS and styrenes. Load bearing plastics, semi rigid PUR foams and sandwich panel construction

UNIT-II: ERGONOMICS AND CONTROLS

Shaping and packaging: Product design and concepts, Aesthetics and industrial design, formal aesthetics and shape, computer aided drafting, surface development, interior ergonomics, ergonomics system design, dashboard instruments, advances in electronic display, CV legal dimension. CV-cab ergonomics, mechanical package layout. Body Fitting and I Controls: Driver's seat, window winding mechanism, Door lock mechanism, other interior mechanisms, driver's visibility' and tests for, visibility, minimum space, requirements and methods or improving space in cars, electric wiring and electronic control systems, advanced body electronics, networking or body systems controls.

UNIT-III: AERODYNAMICS AND FORCE ANALYSIS

Aerodynamics: Basics, aerofoils, aerodynamics drag lift, pitching, yawing and rolling moments, determination of aerodynamic coefficients (wind tunnel testing), racing car aerodynamics, bluff body aerodynamics, local air flows. Load Distribution: Types of load carrying structures -closed, integral, open, flat types. Calculation of loading cases-static, asymmetric, vertical loads. Load distribution, stress analysis of structure, body shell analysis.

UNIT-IV-. STRUCTURAL DYNAMICS

Noise, Vibration, Harshness: Noise and vibration basics, body structural vibrations, chassis bearing vibration, designing against fatigue, rubber as an isolator. CV body mountings, automatic enclosures, sandwich panels, structure dynamics applied, surety under impact: Impact protection basics, design for crash worthiness, occupant and cargo restraints. Passive

restraint systems, slide impact analysis, bumper system, energy absorbant foams, laws of mechanisms applied 10 safety. Vehicle stability: Steering geometry vehicle and a curvilinear path, and lateral stability, effects of tyre factors, mass distribution and engine location on stability.

UNIT-V: TYPES OF VEHICLES

Vans, trucks and buses: Types of mini coach with trailers, single and double deckers, design criteria based on passenger capacity, goods to be transported and distance to be Covered, constructional details: weights and dimensions, conventional and integral type.

Advanced Transmission Systems Early and later Warner synchronizer, Vauxhall synchronizer- gear materials lubrication, multistage and polyphase torque converters, coupling-blade angle and fluid flow, converter fluid. **Chevrolet "turbo glide"** transmission, early and modified Ward-Leonard system

TEXTBOOKS:

1. Body Engineering - Sydney F Page
2. Vehicle body engineering - Giles J Pawlowski,

REFERENCES:

1. Automotive chassis - P.M. Heldt. Chilton & Co
2. Handbook on vehicle body design - SAE Publications.

LIST OF ELECTIVE VIII

EAU020ENGINEERING SYSTEM DESIGN

L T P
3 1 0

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. 4

UnitII:

Identification And Analysis Of Need:

Preliminary need statement, analysis of need, specifications, and standards of performance and constrains. 2

Origination Of Design Concept:

Process of idealization, mental fixity, and some design methods like morphological analysis, AIDA, brain storming etc. 3

UnitIII:

Preliminary Design:

Mathematical modeling for functional design: concept of sensitivity, compatibility and stability analysis. 3

UnitIV:

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

UnitV:

Reliability Considerations in Design:

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

Economics andOptimization in Engineering design:

Economics in Engineering Design, Fixed and variable costs, break-even analysis. (Numerical) 6

REFERENCE BOOKS:

1. An introduction to engineering design method, by V. Gupta and P. Murthy, Tata McGraw Hill.

2000

2. Introduction of Engineering Design by T. Woodson, McGraw Hill. 2001

3. Design & Planning of Engineering systems by D.D. Meredith, K.W. Wong, R.W. Woodhead & K.K. Worthman. 2000

4. Introduction to Design by M.A. Asimov-Prentice Hall. 1996

5. Design Methods - Seeds of Human Futures-Wiley Inter Science. 1970.

EAU021: ROBOTICS

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 T B, 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

8

Unit II:

Kinematics of Serial Manipulators

Direct kinematics of 2R, 3R, RRP, RPR manipulator, puma560 manipulator, SCARA manipulator, Stanfordarm, Inverse kinematics of 2R, 3R manipulator, puma560 manipulator.

Unit III:

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.

5

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

5

Unit IV:

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

5

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

4

Unit V: Actuators

Types, Characteristics of actuating system: weight, power-to-weight ratio, 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 **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. 5

Reference Books:

- 1. Fundamental Concepts and analysis**, Ghosal A., Robotics, Oxford, 2006
- 2. Introduction to Robotics Analysis, Systems, Applications**, Niku, S. B., Pearson Education, 2008
- 3. Introduction to Robotics: Mechanics and Control**, Craig, J. J., 2nd Edition, Addison-Wesley, 1989.
- 4. Fundamentals of Robotics, Analysis and Control**, Schilling R. J., PHI, 2006

EAU022: TRIBOLOGY

L T P
3 1 0

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. 4

Unit-II

Hydrodynamics Lubrication:

Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings. 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.. 5

Unit-III

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 . 4

Unit IV

Hydrostatic Lubrication

Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing. 4

Unit-V

Bearing Materials

Commonly used bearing 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. 5

Behavior of tribological components

Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. 4

Tribological measures: Material selection, improved design, surface engineering 2

REFERENC 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.
3. Fuller, D., Theory and Practice of Lubrication for Engineers, New York company 1998
4. Moore, Principles and applications of Tribology, Pergamon press 1998
5. Srivastava S., Tribology in industries, S Chand and Company limited, Delhi 2002

EAU023: HYDRAULICS AND PNEUMATICS

L T P
3 1 0

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. 5

UNIT II:

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 4

Control Components in Hydraulic Systems

Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. 4

UNIT III:

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. 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 . 5

UNIT IV:

Introduction to Pneumatic control

Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. 4

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 5

UNIT V:

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. 8

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.

4

Reference Books

1. Fluid Power with applications: Anthony Esposito, Fifth edition Pearson Education, Inc. 2000.
2. Pneumatics and Hydraulics: Andrew Parr. Jaico Publishing Co. 2000.
3. Oil Hydraulic Systems – Principles and Maintenance: S.R. 2002 Majumdar, Tata Mc Graw Hill publishing company Ltd. 2001.
4. Pneumatic systems by S.R. Majumdar, Tata Mc Graw Hill publishing Co., 1995.
5. Industrial Hydraulics: Pippenger, Hicks, McGraw Hill, New York.

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.

6

UNIT-II:

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.

4

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.

4

UNIT-III:

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.

4

UNIT-IV:

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.

4

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 ofhythaneandHCNG.DME,DEE,BTL,GTL,CTL,Syngas,producer gas, P-series, Eco-friendly plastic fuel, wood pyrolysis oil, Magnegas,Tyre pyrolysis oil.

5

UNIT-V:

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.

4

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

REFERENCES

1. S.S.Thipse "Alternative Fuels". JAICO Publishing House.
2. G.D.Rai "Non-Conventional Energy Sources" Khanna Publishing New Delhi.
3. Alternative fuels for vehicle book by M.poulton
4. Alternativefuels guide book by R. Bechtold.SAE

EAU030HYBRID VEHICLES

L T P

3 1 0

UNIT 1

HYBRID VEHICLES

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

4

PROPULSION METHODS

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

4

UNIT II

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.

5

UNIT III

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.

4

UNIT IV

SIZING THE DRIVE SYSTEM

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

8

UNIT V

ENERGY STORAGE TECHNOLOGY

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

8

REFERENCEBOOKS :

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.

Unit 1:

Introduction:

Definitions and concept of automatic controls, classification of control system - open and closed loop systems, concepts of feedback, requirements of an ideal control system. 4

Unit II:

Mathematical Modeling:

Transfer function, modeling of mechanical systems, electrical systems, electromechanical systems, thermal systems, hydraulic and pneumatic systems, and Analogous systems: Force voltage, Force current. 4

Unit III:

Block Diagrams and Signal Flow Graphs:

Block diagram representation, functional block, block diagram reduction, Signal flow graphs, Mason's gain formula. 4

Transient and Steady State Response Analysis:

Introduction, Standard test inputs, concept of time constant and its importance in speed of response, analysis of first order and second order systems, Transient response specifications, System stability analysis – Routh - Hurwitz Criterion. 4

Unit IV:

Frequency Response Analysis using Nyquist Plots:

Polar plots, Nyquist Stability Criterion, Stability Analysis, Relative stability concepts, phase and gain margin, M & N circles. 4

Frequency Response Analysis using Bode Plots:

Bode attenuation diagrams, Stability Analysis using Bode plots, and Simplified Bode Diagrams, phase and gain margin. 4

Unit V:

Control Action and System Compensation:

Types of controllers – Proportional, Integral, Proportional Integral, Proportional Derivative, Proportional Integral Derivative controllers (Basic concept only), Series and feedback compensation, Physical devices for system compensation. 8

References:

1. **Control Engineering**, Uday A. Bakshi and Varsha U. Bakshi, Technical Publications, Pune
2. **Control Engineering**, D. Ganesh Rao and K. Channa Venkatesh, Sanguine Technical Publishers, Bangalore
3. **Feedback and Control Systems**, Joseph J. Distefano, Allen R. Stubberud and Ivan J. Williams, Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. **Modern Control Engineering**, Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., New Delhi
5. **Control Systems Principles and Design**, M. Gopal, Tata McGraw Hill Publishing Co. Ltd., New Delhi
6. **Control Systems Engineering**, I. J. Nagrath and M. Gopal, New Age International publishers, New Delhi

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

Historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications. 4

Unit II:**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. 4

Unit III:**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. 8

Unit IV:**Self-assembled Monolayers**

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

Gas Phase Clusters – history of clusterscience – formation and growth – detection and analysis – type and properties of clusters – bonding in clusters. 8

Unit V:**Monolayer-protected Metal Nanoparticles**

Method of preparation – characterization – functionalized metal nanoparticles – applications – superlattices. 2

Core-shell Nanoparticles – types – characterization – properties – applications. 2

Nanoshells – types – characterization – properties – applications. 2

Nanobiology – Interaction between biomolecules and nanoparticle surfaces – materials used for synthesis of hybrid nanobioassemblies – biological applications – nanoprobe for analytical applications – nanobiotechnology – future perspectives. 3

Nanomedicines – approach to development – nanotechnology in diagnostic and therapeutic applications. 2

Nanotribology – studying tribology on the nanoscale – applications. 2

References:

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

EAU033MAINTENANCEAND SAFTY ENGINEERING**L T P
3 1 0****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, 6

UNIT - II

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

UNIT - III

Maintenance Planning: Planning of maintenance junctures manpower allocation, long range planning, short range planning. Planning techniques and procedures. Estimation of maintenance work. Maintenance control. 5

UNIT-IV

Computers in maintenance: Features and benefits of Computer aided maintenance. Application of computersto maintenance work. Industrial Safety: Economic importance of accidents,Types of safety organizations, Analysis of accidentrecords, accident investigations, Analysis of accident Safety standards for Mechanical equipment. 6

UNIT- V

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. 5

REFERENCE BOOKS:

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

Maintenance Engineering Hand book - Morrow.

3Hand book of Maintenance Management - Frank Herbaty

4Hand book of Industrial Engg & Management - W. Grant Lreson & Eugene L-Grant 5 Industrial Pollution Control Handbook • LUND A. Industrial Maintenance - H P Garg

6 Maintenance Engineering Hand book- Lindrey Higgins, Mc Graw Hill, fth edition, 2003 7 Plant Engineering Hand book – Staniar

TME-034MECHANICAL VIBRATION**L T P**

UNIT- I

INTRODUCTION: Periodic motion, harmonic motion, superposition of simple harmonic

motions, beats, fourier analysis. Single Degree Freedom System: Free vibration, Natural frequency, Equivalent Systems, Energy method for determining natural frequency, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers. 8

UNIT- II

Single Degree Freedom: Forced Vibration Forced vibration, Harmonic Excitation with viscous damping, Steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments- Displacement, Velocity, Acceleration and Frequency measuring instrument. 6

UNIT- III

Two Degree Freedom System: Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled System, Undamped dynamic, vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper. 6

UNIT- IV

Multidegree Freedom System: Exact Analysis Undamped free and forced vibrations of multidegree system, Influence numbers, Reciprocal Theorem, Torsional vibration of multi rotor system, Vibration of geared system, Principal coordinates, Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circular shafts, Lateral vibration of beams. 8

UNIT- V

Multidegree Freedom System: Numerical Analysis Rayleigh's, Dunkerley's, Holzer's and Stodola's methods, Rayleigh – Ritz method. Critical Speed of Shafts: Shafts with one disc with and without damping, Multi-disc shafts, Secondary critical speed. 8

Reference Books :

1. Mechanical Vibration – P. Srinivasan – TMH
2. Mechanical Vibration – G. K. Grover – Jain Bros. Roorkee.
3. Mechanical Vibration – W.T. Thomson Age Publishers.
4. Mechanical Vibration Practice with Basic Theory – V. Rama Murthy – Narosa Publishers.