

MEC-701 MECHANICAL VIBRATION AND NOISE ENGINEERING

Unit I

Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.

Undamped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

Unit II

Damped Free Vibrations: Viscous damping; coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

Unit III

Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments). Whirling Motion and Critical Speed : Whirling motion and Critical speed : Definitions and significance .Critical - speed of a vertical. Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Unit IV

Systems With Two Degrees of Freedom : Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Unit V

Noise Engineering -Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging,

Noise: Sources, Isolation and Control: Major sources of noise on road and in industries, noise due to construction equipments and domestic appliances, industrial noise control, strategies- noise control at source (with or without sound enclosures),

References Book :

- 1- Ambekar A.G., ' Mechanical Vibrations and Noise Engineering; PHI
- 2- Meirovitch Leonard; Element of Vibration Analysis; TMH
- 3- Dukikipati RV Srinivas J Text book of Mechanical Vibrations; PHI
- 4- Kelly SG and kudari SK; Mechanical Vibrations; Schaum Series;TMH

- 5- Thomson , W.T., Theory of Vibration with Applications , C.B.S Pub & distributors .
Grading System 2013 - 14
- 6- Singiresu Rao, "Mechanical Vibrations , Pearson Education .

List of Experiments:-

- 1-** To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account .
- 2-** To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.
- 3-** To find out natural frequency and damped free frequency of a torsion pendulum and , hence to find out coefficient of damping of the oil ;
- 4-** To observe the phenomenon of whirl in a horizontal light shaft and to determine the critical speed of the shaft.
- 5-** To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.
- 6-** To demonstrate the principle of tuned Undamped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies ;
- 7-** To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter.

MEC-702 AUTOMOBILE ENGINEERING

Unit-I:

Chassis & Body Engg : Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, drivers visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, drivers cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

Unit-II

Steering System: front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe out, condition for true rolling motion, center point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

Unit-III

Transmission System: Function and types of clutches, single plate, multi-plate clutch, roller & spring clutch, clutch lining and bonding, double declutching, types of gear Boxes, synchroniser, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction.

Unit-IV

Suspension system : Basic suspension movements, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and braking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energisation, airbleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres & tubes.

Unit-V

Electrical and Control Systems: storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers. importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.

Unit-VI

Emission standards and pollution control: Indian standards for automotive vehicles- Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.

References Books:

1. Crouse , Automotive Mechanics TMH.
2. Srinivasan S; Automotive engines; TMH
3. Gupta HN; Internal Combustion Engines; PHI;
4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.
5. Kripal Singh, Automotive Engineering Khanna Pub.
6. Newton & Steeds , Automotive Engineering
Emission standards from BIS and Euro I and Euro-III

List of Experiments

1. To study the working principles and operation of the chassis,
2. To study the working principles and operation of the suspension,
3. To study the working principles and operation of the steering mechanisms,
4. To study the working principles and operation of the transmission,
5. To study the working principles and operation of the gear-box,
6. Differential systems, and electrical systems of various light and heavy automotive vehicles;

MEC-703 DESIGN OF HEAT EXCHANGERS

Unit I

Introduction: Types of heat exchangers heat transfer laws applied to heat exchangers convection Coefficients, resistance caused by the walls and by fouling, overall heat transfer coefficient.

Unit II

Thermal & hydraulic design of commonly used heat exchangers : LMTD & NTU Methods, correction factors, Double pipe heat exchangers , shell and tube heat exchangers, condensers , Evaporators ,Cooling and dehumidifying coils, cooling towers, evaporative condensers ,design of air washers, desert coolers.

Unit III

TEMA standard: Tubular heat exchangers TEMA standard heat-exchanger nomenclature, selection criteria for different types of shells and front and rear head ends; geometrical characteristics of TEMA heat exchangers.

Unit IV

Review of mechanical Design, Materials of Construction, corrosion damage, testing and inspection.

Unit V

Heat Pipe: Basics & its mathematical model, micro Heat Exchangers , Use of Software in heat exchanger design.

References Books:

1. Kern D Q, Kraus A D; Extended Surface Heat Transfer; TMH.
2. Kays, Compact Heat Exchangers and London, TMH.
3. Kokac, Heat Exchangers- Thermal Hydraulic fundamentals and design;TMH.
4. Tubular Exchanger Manufacturer Association (TEMA), and other codes

List of Experiments:-

1. To Study of heat exchangers.
2. To Study of LMTD & NTU Methods.
3. To Study of Tubular heat exchangers TEMA standard heat- exchanger nomenclature
4. To Study of Review of mechanical Design.
5. To Study of of Software in heat exchanger design.

MEC 704 (A) INDUSTRIAL ENGINEERING

Unit-I

Introduction to Industrial Engineering - Evolution of modern Concepts in Industrial Engineering - Functions of Industrial Engineering - Field of application of Industrial Engineering Product Development and research- Design function - Objectives of design, - Manufacturing vs purchase- Economic aspects- C-V-P analysis – simple problems.

Unit-II

Plant layout and Material handling- principles of material handling, Types of material handling equipments, Selection and application. Preventive and break- down maintenance - Replacement policy-- Methods of replacement analysis-Method of providing for depreciation- Determination of economic life - Simple problems.

Unit-III

Methods engineering: Analysis of work methods using different types of process chart and flow diagrams- Critical examination Micro motion study and therbligs- Principles of motion economy – Work measurement-Performance rating.-Determination of allowances and standard time. - Job evaluation and merit rating

Unit-IV

Industrial relations- Psychological attitudes to work and working conditions - fatigue- Methods of eliminating fatigue- Effect of Communication in Industry-Industrial safety-personal protective devices-, causes and effects of industrial disputes- Collective bargaining- Trade union - Workers participation in management.

Unit-V

Production planning and control- Importance of planning - job, batch and mass production- Introduction and need for a new productproduct life cycle. - Functions of production control - Routing , Scheduling, dispatching and follow up- Gantt charts. Inventory Control, Inventory models

Unit-VI

Quality control and Inspection- Destructive and non-destructive testing methods- process capability- Statistical quality control – causes of variation in quality- control charts for X and R. Reliabilitycauses of failures- Bath tub curve.-System .TQM, ISO, Six Sigma and Quality circles (Brief description only).

References Books:

1. B. Kumar, Industrial Engineering Khanna Publishers,2013
2. M Mahajan, Industrial Engineering & Production Management, Dhanpat Rai, 2005
3. Martand Telsang, Industrial Engineering & Production Management, S. Chand, 2006

MEC 704 (B) NANO MANUFACTURING

Unit-I

Introduction to Nano-manufacturing and Nanotechnology, Advantages, disadvantages and applications of Nanotechnology and Nano-manufacturing, Top-down and Bottom-up techniques,

Unit-II

Self-Assembly, self-assembled monolayer. Characterization Techniques: Scanning Electron Microscope, Transmission Electron Microscope, Atomic force microscopy (AFM), Scanning Probe Microscope (SPM),

Unit-III

Scanning Tunneling Microscope (STM), X-ray Diffraction (XRD). Nano-lithography: Photolithography: UV Photolithography, X-ray Lithography, Electron Beam Lithography, Particle Beam Lithography's, Probe lithography's.

Unit-IV

Micro and Nano machining, Focused Ion beam machining. Chemical methods in Nano manufacturing, Si processing methods: Cleaning /etching, Epitaxy, Molecular-beam epitaxial, chemical beam epitaxial

Unit-V

Metal-organic CVD (MOCVD), Plasma enhanced CVD (PECVD), Sol-gel Technique. Properties and application of Nano Materials: Fullerene Structure, Carbon nano tubes, Nano Particles, Processing of Nano composites, Micro & Nano Electromechanical Systems (MEMS, & NEMS).

References Books:

1. Introduction to nanotechnology by Charles P. Poole Jr. & Frank J. Owens Publisher: John Wiley & Sons (Asia) Pvt. Ltd.
2. Nanotechnology: Introduction to Nanostructuring Technoques by Michael Kohler, Publisher: John Wiley & Sons (Asia) Pvt. Ltd.
3. Magnetic Microscopy of Nanostructures by H. Hopster & H. P. Oepen, Publisher:Springer
4. Micro-engineering, MEMS and Interfacing: A practical Guide by Danny Banks, Publisher: Taylor & Francis
5. Nanomaterials Chemistry Recent Developments and New Directions by C. N. R. Rao, Publisher: John Wiley & Sons (Asia) Pvt. Ltd.

MEC – 704 (C) RELIABILITY ENGINEERING

Unit -I

Reliability: Definition Probability Concept; Addition of Probabilities; Complimentary Events; Calculation of Reliability, Reliability analysis.

Unit –II

Failure Data Analysis: Introduction, Mean Failure Rate, Mean Time to Failure (MTTF), Mean Time between Failures (MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form.

Unit - III

Conditional Probability : Introduction, Hazard Rate as conditional probability, Principles of CBM, Pillars of condition monitoring, CBM implementation and benefits, visual monitoring, vibration monitoring, wear debris monitoring, corrosion monitoring, performance monitoring.

Unit - IV

General Maintenance & Management function : Breakdown, emergency, corrective, predictive, Objectives and evolution of TPM, Effects and Criticality analysis (FMECA), applications and benefits, risk evaluation, risk priority.

Unit – V

Maintainability and Availability: Introduction, Maintenance Planning & scheduling, Maintenance organization, Tools for better maintenance –preventive, shutdown and Scheduled maintenance.

References Books:

1. Reliability Engineering, L.Balagurusamy, Tata Mc-Graw Hill, New Delhi, 1984.
2. Reliability Based Design, S.Rao, Mc-Graw Hill, 1992.
3. Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, Wiley Publications.
4. Reliability Engineering, D.J. Smith, 1972, E.W. Publications.
5. Mishra R.C. Reliability and Maintenance Engineering New age International Publisher.
6. Reliability Engineering, L.S. Srinath, Affiliated East-West Press, New Delhi.
7. Reliability Engineering, A.K.Govil, Tata Mc-Graw Hill, New Delhi.

MEC-705 (A) SIMULATION & PROCESS MODELING.

Unit I:

Introduction to modeling and simulation: Modeling and simulation methodology, system modeling, concept of simulation; gaming; static, continuous and discrete event simulation.

Unit II:

Basic concept of probability, generation and characteristics of random variables, continuous and discrete variables and their distributions; mapping uniform random variables to other variable distributions; linear, nonlinear and stochastic models

Unit III;

Introduction to Queuing Theory: Characteristics of queuing system, Poisson's formula, birth death system, equilibrium of queuing system, analysis of M/M/1 queues. Introduction to multiple server Queue models M/M/c Application of queuing theory in manufacturing and computer system

Unit IV;

System Dynamics modeling: Identification of problem situation, preparation of causal loop diagrams and flow diagrams, equation writing, level and rate relationship, Simulation of system dynamics models.

Unit V:

Verification and validation: Design of simulation experiments, validation of experimental models, testing and analysis. Simulation languages comparison and selection, study of simulation software - Arena, Pro-model, SIMULA, DYNAMO, STELLA, POWERSIM.

References Books:

1. Law AM and Kelton WD; Simulation Modeling and Analysis; TMH
2. Gordon G., System simulation, PHI Learning
3. Banks J; Hand book of Simulation; John Wiley.
4. Taha H, Operations Research; PHI.
5. Hillier FS, Liberman GJ; Introduction to OR; TMH.
6. Deo N; System Simulation with Digital Computer; PHI Learning
7. Harrell C, Ghosh B, Bowden R; Simulation Using Promodel; MG Hill
8. Seila, Ceric and Tadikmalla; Applied Simulation Modeling, Cengage
9. Payer T., Introduction to system simulation, McGraw Hill.

MEC- 705 (B) TRIBOLOGY

Unit – I

TRIBOLOGICAL ASPECTS OF ROLLING MOTION Introduction to tribological systems and their characteristic features; analysis and assessment of surface; topography; deterministic and stochastic tribo-models for asperity contacts; techniques of surface examination; technological properties of surfaces. Quantitative laws of sliding friction, causes of friction, adhesion theory, laws of rolling friction, measurement of friction

Unit – II

WEAR Introduction, mechanism of wear, types of wear, quantitative laws of wear, measurement of wear, wears resistance materials

Unit - III

LUBRICANTS Introduction, dry friction, boundary lubrication, hydrodynamic, hydrostatic and elastohydrodynamic lubrication, functions of lubricants, types and properties, lubricant additives. Principles, application to rolling contact bearings, cams, Gears

Unit - IV

BEARING DESIGN CONSIDERATION & CHARACTERISTICS Geometry and pressure equation of journal bearing, hydrostatic bearings, thrust bearings, porous bearings and hydrodynamic gas bearings. Journal bearings with specialized applications. General requirements and different types of bearing materials.

Unit - V

SURFACE INTERACTIONS Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact.

REFERENCES Books:

1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2. Hand Book of Tribology – WHILEY
3. Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.
4. Tribology in Industries by Sushil. K. Srivastava, S Chand & Publicatio

MEC – 705 (C) ENERGY CONVERSION SYSTEMS

Unit-I

Introduction: need for energy conservation. Energy conservation in production of heat, Introduction to different energy conversion systems, site selection criteria of thermal power plant layout of modern thermal power plant

Unit -II

Details of different components of thermal power plant selection criteria of different components of thermal power plant ex. Fuel consumption economy , firing arrangement and selection of burners,. Fluidized bed combustion.

Unit-III

Energy conservation in use of heat. Economical design of furnace, water treatment, drying, conditioning and industrial space heating, boiler accessories etc. Selection of cycles: Combined cycle, power generation for better energy efficiency management.

Unit-IV

Combined cycle power plant. Energy conservation furnish better management techniques, improved production design, improved production powers, substituted materials, waste recovery and recycling. New and renewable energy technologies.

Unit- V

Appropriate energy technology for rural development. Energy conservation in production, agriculture sector. Instrumentation and control in energy conservation: Economics of conventional and new and renewable energy technologies. Environmental aspects and case studies :

References Books:

- 1.Power plant Engineering Domkundwar
2. Power plant Engineering G.D. Rai
3. Power plant Engineering R.L. Agrawal
4. Energy Technology S. Rao & B.B. Parulka

MEC-706 (A) – PROJECT MANAGEMENT

Unit I

Concepts of project management:: Meaning, definition and characteristics of a project, technical and socio-cultural dimensions; project life cycle phases, project planning and graphic presentation; work breakdown structure, manageable tasks; size of network; blow down NW; identity and logic dummy activity; Fulkerson rule for numbering NW; time-scaled NW

Unit-II

NW analysis: PERT network; mean time and variances; probability to complete PERT project in specified time; CPM network; Event Occurrence Time (EOT); activity start/ finish times; forward and reverse path calculations, concept and calculation of floats; resource allocation and critical-chain; overview of MS-project-2000.

Unit-III

Project duration and control: Importance and options to accelerate project completion; timecost tradeoff; fixed variable and total costs; use of floats and cost optimization; project performance measures; project monitoring info and reports; project control process; Gant chart and control chart; cost-schedule S-graph; planned cost of work schedule (PV),

Unit-IV

Project organization, culture and leadership: projects within functional organization; dedicated project/ task-force teams; staff, matrix and network organization; choosing appropriate project organization; Organization culture; ten characteristics; cultural dimensions supportive to projects; social network and management by wandering around (MBWA); different traits of a manager and leader; managing project teams; five stage team development model;

Unit-IV

Strategic planning and project appraisal: Capital allocation key criteria; Porters competitive strategy model; BCG matrix; Strategic Position Action Evaluation (SPACE); time value of money; cash flows; payback period; IRR; cost of capital; NPV; social cost benefit analysis; UNIDO approach; project risks and financing.

References Books:

1. Prasana Chandra: Projects: planning Implementation control; TMH.
2. Gray Clifford F And Larson EW; Project The managerial Process; TMH
3. Panneerselven and Serthil kumar; Project management, PHI
4. Burke ; Project Management-Planning and control technics; Wiley India
5. Kamaraju R; Essentials of Project Management; PHI Learning
6. Jack R. Meredith, Project Management: a managerial approach, Wiley.
7. Choudhary ;Project Management; TMH

MEC-706 (B) – FLEXIBLE MANUFACTURING SYSTEMS

Unit-I

Review of Computer Aided Design and Drafting (CADD): The design processes, advantages and applications of CAD, computer hardware system, computer programming languages, model storage and data structure, CADD software packages – AutoCAD, orthographic projections. CAD/CAM Interface and Product Design: Rationale for CAD/CAM,

Unit-II

Computer Aided Manufacturing, Elements of CAM Systems, NC in CAM, Product Design and Development. Integrated Manufacturing Systems: (FMS) (CIMS): Components of FMS, components of CIMS, applications. Hardware and software pertaining to FMS installations.

Unit-III

Machine Tool Control: Elements of the NC Systems, Types of Control Systems, NC Part Programming, Computer Aided Part Programming, Machining Centers. Manufacturing Systems and Automation:

Unit-IV

Trends in Manufacturing Systems, system Defined, Classification of Manufacturing Systems, Leveling and balancing the manufacturing Systems, Robotics and Automated Guided Vehicles: Definition Robotics, Terminology, Types of Robots, basic robot motion and their control, robot programming,

Unit-V

Automated Guided Vehicles. Typical applications in manufacturing like in welding, assembly, material handling, spray painting etc., Group Technology (G T): Part families, parts classification, machine group/cell, CAD/CAM and GT, applications. Flexible Manufacturing Systems and Computer

References Books:-

1. Computer Aided Manufacturing Rao P N Tewari N K and Kundra
2. Introduction to Robotics – A System Approach Rehg J A
3. CAD/CAM Handbook Terholz E
4. Robotics: An Introduction Malcolm D R Jr

MEC-706 (C)TECHNOLOGY ENTREPRENEURSHIP

Unit-I

The Entrepreneurial Perspective Introduction to entrepreneurship, need and importance of entrepreneurship, charms of becoming entrepreneur, evolution of entrepreneurship, characteristics of an entrepreneur, barriers of entrepreneurship, achievement motivation to become entrepreneur, creativity & innovation, decision making and other behavioral aspects of entrepreneurship,

Unit-II

Opportunity Recognition and Planning to establish SSI Opportunity identification process, opportunity evaluation process, market research, market survey, Identification of relevant resources, Steps in establishing an enterprise / industry, procedure and formalities to establish a SSI or business enterprise, Incentives and benefits available to SSI units and new entrepreneurs,

Unit-III

Information about various support agencies. Formulation of Business Plan Preparation of market survey report, techno economic feasibility assessment, preparation of preliminary and detailed business plan.

Unit-IV

Marketing Management Marketing and sales management, demand forecasting, advertising, product mix, characteristics of a good sales person, Govt support in marketing, Financial Management of small scale industries Sources of finance, Debt financing, Venture capital sources,

Unit-V

Lease finance, Banking policies & incentives available to entrepreneurs, Loanstypes and benefits, Book keeping and accountancy, working capital management, various financial ratios, Costing, Break-Even-Analysis

References:-

1. Managing innovation and entrepreneurship in technology-based firms Martin, Michael J.C
2. Technological entrepreneurship: enterprise formation, financing and growth Cardullo, Mario W.
3. Growing new ventures, creating new jobs Rice, Mark P
4. Entrepreneurship development programme in India and its relevance to developing countries Patel, V.G.

MEC-707 Industrial Training –II

Duration:- 2 weeks after the VI semester in the summer break, Assessment in VII semester.
Students must observe following to enrich their learning during industrial training:

- Industrial environment and work culture.
- Organizational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.