RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Automobile Engineering, VII-Semester (w.e.f. July 2023)

AU- 701 Mechanical Vibration

Unit-I Introduction : Periodical motion, harmonic motion, the vector method of representing vibrations, displacement, velocity and acceleration in harmonic motion, work done in harmonic motion, superposition of simple harmonic motion, beat phenomenon, non harmonic periodic motions. Harmonic analysis System having single degree of freedom, free vibration of systems without damping, Equilibrium and Energy Method for determining natural frequency. Reyleigh's Method, Equivalent Systems (systems with compound springs, shafts of different diameter Equivalent length, effects of mass of spring and shaft). Free vibration of systems with Viscous, Coulomb and Structural damping. Equations of motion – Discussion of its solutions. Electrical Analogies : Electric circuit principles, equivalent circuits.

Unit-II Forced vibrations of systems with and without damping (viscous and coulomb), Method of complex algebra, equivalent viscous damping, impressed force due to unbalance, inadmissibility, support motion, Vibration isolation, commercial isolators.

Unit-III System with two-degree of freedom : Normal mode vibrations, Torsional systems, Coupled vibrations, General solution in terms of normal mode, vehicle suspension, Undamped dynamic vibration absorber, Centrifugal absorber, friction damper. Whirling of shafts : Whirling of light flexible shaft with an unbalance disk at the centre of its length with and without damping, discussion of the speeds above and below the critical speed, uniform shaft with and without unbalanced masses attached along its length (by Rayleigh Method) for simply supported and fixed ends.

Unit-IV Multiple degree of freedom system, introduction, modelling of continuous system as multiple degree of freedom system, newton's law to derive equation of motion, influence coefficients, equation of motion of undamped system in matrix form, Eigen value problems and solutions., Free vibration of undamped system, Forced vibration of undamped system and viscous damped system

Unit-V Vibration Measurement : Principle of frequency, amplitude, velocity and acceleration measuring instruments, frequency response plots, phase shift plots, analysis of vibration records.

List of Practicals

1. Determination of Natural Frequency of Spring Mass Lever System
2. Determination of Natural Frequency of Spring Mass Pulley System
3. Determination of Natural Frequency of Torsional Pendulum and value of damping factor when system is damped.
4. Identification of Principal Modes of Vibration of a two DOF system and demonstration of beats phenomenon.
5. Demonstration of Principle of Dynamic Vibration Absorber.
6. Demonstration of Whirling phenomenon of shaft and determination of critical speed of shaft-disk system.

7. Determination of Natural Frequency of a Cantilever beam setup.
8. Determination of Natural Frequency of a Simply Supported beam setup.

References:

1. S.S. Rao , Mechanical Vibrations,

2. Meirovitch Leonard, Elements of Vibration Analysis, TMH

3. Thompson, W.T. , Theory of Vibration with Applications,

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

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Automobile Engineering, VII-Semester

Departmental Elective AU702 (A) - Combustion & Heat Transfer

Unit-I Combustion: Combustion phenomena of S.I. and C.I. engines, Stages of combustion- Photographic studies of combustion process- p-q diagrams in S.I. and CI engines. Abnormal combustion-Effect of engine variables on knock-Factors controlling combustion chamber design.
Combustion chambers: Diesel engine combustion chambers open, Divided, Swirl, Turbulent and Ricardo's M Combustion chambers.

Unit-II Heat Transfer in IC engines: Heat transfer, Temperature distribution and thermal stress in Piston, Cylinder Liner, cylinder head, Fins and valves. Variation of gas temperatures, Heat transfer coefficient and combustion system-Effect of engine load on piston temperature heat rejected to coolant quantity of water required.

Unit-III Measurements Flow meters-Volumetric type, gravimetric type-fuel consumption measurement in vehicles-Air consumption: Air box method, viscous air flow meter; flame temperature measurement and pressure measurement.

Unit-IV Introduction to heat transfer: Temperature, Heat and thermal equilibrium, Modes of basic laws of heat transfer i.e. conduction, Convection and Radiations; Fourier equation and Thermal Conductivity, Derivation of the general form of heat conduction equation in Cartesian, Cylindrical Spherical Coordinates.

Unit-V Conduction Heat Transfer: Steady State Conduction, Heat conduction through plane wall, Composite wall, cylindrical wall, Multi layer cylindrical wall, and through spheres; effect of variable conductivity, Critical thickness of Insulation; conduction with heat generation, plane wall with uniform heat generation, Dielectric heating, Cylinder with uniform heat generation, Heat transfer through Piston crown. Heat transfer from extended surface, steady flow of heat along a rod, Governing differential equation and its solution, Heat dissipation from and infinitely long fin, Fin performance.

Unit-VI Convection Heat Transfer: Free and forced convection, Laminar and Turbulent flow, Newton-Rekhman Law: Convection rate equation, Nusselt Number; radiation heat exchanger; salient features and characteristics of radiation, Absorptive, reflectivity and transmittance; spectral and spatial energy distribution, wavelength distribution of black body radiation, Plank's law; total emissive power: Stefan Boltzman law, Wien's displacement law, Kirchoffs Law, gray body and selective emitters, intensity of

References:

1. Arora and Domkundwar, Heat and Mass Transfer
2. D.S. Kumar, Heat and Mass Transfer.
3. Frank Kreith, Heat Transfer
4. P.M. Heldt, Internal combustion engines.
5. V. Ganeshan Internal combustion engines.
6. Eckert and Drake, Introduction to heat transfer.
7. Jakob and Hawkins, Elements of Heat Transfer
8. Holman, Heat Transfer

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Automobile Engineering, VII-Semester

Departmental Elective AU702 (B) Heat & mass transfer

Unit-I Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; Conduction: Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity. Heat source system

Unit II Extended surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; Unsteady heat conduction: Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

Unit-III Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

Unit IV Heat exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method; Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

Unit V Thermal radiation: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields. Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

References:

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Nag PK; heat and Mass Transfer; TMH
4. Dutta BK; Heat Transfer Principles And App; PHI Learning
5. Mills AF and Ganesan V; Heat transfer; Pearson
6. Cengel Yunus A; Heat and Mass transfer;TMH

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Automobile Engineering, VII-Semester

Departmental Elective AU702 (C) Computer Aided Engineering

Unit-I Introduction : Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum structures, Modeling of infinite d.o.f. system into finite d.o.f. system, Basic steps in finite element problem formulation, General applicability of the method.

Unit-II Element Types and Characteristics : Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions; ID bar and beam elements, 2D rectangular and triangular elements; axis-symmetric elements.

Unit-III Assembly of Elements and Matrices : Concept of element assembly, Global and local coordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Choleksy decomposition methods, Numerical integration, One and 2D applications.

Unit-IV Higher Order and iso-parametric Elements: One dimensional quadratic and cubic elements, Use of natural co-ordinate system, Area co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

Unit-V Static Analysis: Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations

Unit-VI Dynamic Analysis: Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for ID elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.

References:

1. Gokhle Nitin; et al; Practical Finite Element Analysis; Finite to Infinite, 686 Budhwar Peth, Pune.
2. Logan DL ; A First Course in Finite element Method; Cegage
3. Krishnamoorthy; Finite Element Analysis, theory and programming; TMH
4. Buchanan; Finite Element Analysis; Schaum series; TMH
5. Seshu P; Textbook of Finite Element Analysis; PHI.
6. Chennakesava RA; Finite Element Methods-Basic Concepts and App; PHI Learning
7. Reddy JN; An introduction to finite element method; TMH
8. Desai Chandrakant S et al; Introduction to finite element Method; CBS Pub
9. Hutton D; Fundamentals of Finite Element Analysis; TMH
10. Zienkiewicz; The finite element Method; TMH
11. Martin and Grahm; Introduction to finite element Analysis (Theory and App.)
12. Rao, S.S., The Finite Element Method in Engineering; Peragamon Press, Oxford.
13. Robert DC., David DM et al, Concepts and Application of Finite Element Analysis; John

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Automobile Engineering, VII-Semester

Departmental Elective AU702 (D) Machine Tool Design

Unit I Basic Features and Kinematics of Machine Tools: Features of basic machine tools; construction and operation, types of machine tools, machine tools motions, transmissionrotation in to rotation, rotation in to translation, kinematical-structures of machine tools: elementary, complex and compound structure, kinematical-features of gear shapers and gear hobbing machine.

Unit II Regulation of Speed: Design of gear boxes- need for variation of speed, selection of speed range, laws of stepped regulation, standardization of speeds, speed diagram, analysis of productivity loss, kinematical advantage of GP, structural diagrams, ray diagram and speed chart. Gear Drives: Belt and cone pulley, slip gear type, north gear drive, draw key gear drive, clutch type, mechanical step less drives, electrical drives; hydraulic drive.

Unit III Design of Metal working Tools: Design of press working tools, shearing, piercing, blanking, dies, compound die design principles for forging dies, bending, forming drawing dies, tooling for forging design principles for forging dies, drop forging, upset forging, design principles and practice for rolling, roll press design.

Unit IV Design of Jigs and Fixtures: Principles of location, locating method and devices, principles of clamping, clamping devices, drilling jigs, types, drill bushes, fixture and economics, types of fixture, milling, grinding, broaching, assembly fixtures indexing jig and fixtures, indexing devices.

Unit V Design of Gauges and Inspection Features: Design of gauges for tolerance for dimensions and form inspection; dies and mould design for Plastics & rubber parts: compression molding, transfer molding, blow molding.

References:

1. Mehta N.K.; Machine Tool Design and Numerical Control; TMH
2. Sen G.C, Bhattacharya A; Principles of Machine Tools; New Central Book Agency.
3. Donaldson; Tool Design T.M.H.
4. Jain KC and Chitale AK; Text Book Of Production Engineering; PHI Learning
5. Juneja, Sekhon and Seth; Fundamentals of Metal Cutting and Machine Tools; New Age.
6. Krar SF, Gill AR, Smid P; Technology of Machine Tools;TMH
7. Sharma P.C; Production Engineering; Chand S
8. Wilson; Fundamentals of Tool Design; ASTME
9. Paqwin J.R; Die Design Handbook; The Industrial Press-NY
10. ASTME; Die Design Hand Book; McGraw Hill 11. Archinov; Metal Cutting & Cutting Tool Design; MIR Publish

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Automobile Engineering, VII-Semester

Open Elective AU703 (A) - Alternative Fuels & Pollution Control

Unit-I Introduction about the alternate fuels and renewable sources of energy in automobile field -availabilities, Storage, Handling and Safety aspects- Costs and other factors.

Unit-II Alternate Fuels: Alcohols-CNG-LPG vegetable oils- Hydrogen and Biogas properties performance and Emission characteristics. Solid fuels coal and wood Ash fusibility test; Modification requited use of Alternate fuels in SI and CI engines- Combustion equation; conversion of gravimetric to volumetric analysis flue gas analysis.

Unit-III Renewable sources of energies Introduction about the solar energy collectors-Concentrating, Flat plate collectors- application wind energy-Bio energy, Geo thermal energy-Chemical energy: Fuel cells, Batteries; Hydrogen energies- Energy conservations in sterling and heat pumps.

Unit-IV Pollutants: Sources from SI and CI Engines, Two Stroke (SI and CI) engine pollution formation; Indian Emission Standards for SI and CI engines; European Emission Standards Comparison with alternate fuel emissions.

Unit-V Pollution control Techniques and Test procedures: Optimization of operating factor-EGRFumigation- Air injection-PCV system (opens Closed) Catalytic Converters-Catalyst use of unleaded petrol.
Gas Analyzers-Different Smoke meters-Different test methods; Electric Vehicles
Simple layout-Traction batteries-Re charging methods-rating pollution factors, Fuel Cells.

References:
1. Ganesan V., Internal Combustion Engines.
2. Held P.M., High speed Combustion Engines
3. Rai,GD Non Conventional sources of Energy
4. Obert E.F., Internal Combustion Engines.
5. SAE Transaction-Vehicle emission.
6. John. H. Jhonson, Diesel Particulate Emissions Landmark Research

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New Scheme Based On AICTE Flexible Curricula

Automobile Engineering, VII-Semester

Open Elective AU703 (B) - CIM Automation

Unit-I Fundamentals of computer technology, types of computers, bit, byte and word, computer systems, external interfacing. Recent advances in hardware and software developments, Interfacing, Industrial computers workstations and fifth generation computers. CIM hardware, software and workstations, Security and computer viruses. Computers Integrated Manufacturing Definition, CIM wheel concept, Evolution of CIM, CIM and systems view of manufacturing, and CIM IT & concurrent engineering, Economic Impact of CIM and Scale Dynamics

Unit-II Databases Introduction to manufacturing data, types and sources, Database technology, Basic concepts, Logical and physical issues, Databases requirements, Types of data models, File structures and relational databases operation of DBMS.

Unit-III Geometric Modelling in CAD : Wireframe models, parametric representation of Analytical and Synthetic Curves. Surface Models: Parametric Representation of Analytical and Synthetic Surfaces. Solid Modelling : Boundary Representation, Constructive Solid Geometry, Parametric and Variational modeling, Feature Based Modeling, CAD/CAM data exchange Rapid Prototyping Technologies : Sterelithography, Selective Photocuring, Selective sintering, Fused Deposition Modeling, Laminated Object Manufacturing, 3D Printing, Applications of RP techniques, Emerging Techniques in RP, RP Methodology, Rapid Tooling.

Unit-IV Group Technology: Concept, Part family formation, Part Classification and Coding Systems types, OPITZ system, Production Flow Analysis, Composite Part Manufacturing and Machine Cell formation. Computer Aided Manufacturing : Online and Offline CAM, Fields of CAM, Computer Aided Process Planning and its Types, Design For Manufacturing and Assembly

Unit-V Flexible Manufacturing Systems : Concept, Components and Types. Automated Storage and Retrieval Systems, AGVs and their types, Adoption Strategies of FMS, Flexibility Analysis. FMS Scheduling. Automation in manufacturing and automation support in design of components

References:

7. Groover, *Production System & CIM*, P.H.I.
8. Zeid, *CAD/CAM Theory & Practice, McGrawHill*
9. Principles of computer integrated manufacturing: S. Kant Vajpayee – PHI

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New Scheme Based On AICTE Flexible Curricula

Automobile Engineering, VII-Semester

Open Elective AU703 (C) - Ergonomics

Unit-I Productivity and work study, Techniques for productivity improvement, The influence of working conditions on work study.

Unit-II Work measurement, Purpose and procedure, Work sampling study, sample size, Random observations, Errors, Standard data, Man power planning, Production planning based on work study, Design of individual work, design of group work, Design of product oriented organisation. Process charts of man and material, Multiple activity chart, String chart.

Unit-III Human factors in engineering,Introduction: Definition, History of Development, Characteristics of Man Machine Systems, Relative capabilities of Human beings and Machines,Information Input and Processing : Human Motor Activities : a. Bio mechanisms of motion, Measurement of Physiological Functions, Energy Expenditure in Physical Activities.
b. Human Control of Systems: Human input and output channels. Compatibility, Tracking Operations, Design of Control.
c. Anthropometry: Anthropometrics Data and their uses, Work Space Dimensions. Design of seats and seating Arrangement, Location of components, Design of work place.
d. Introduction to information theory, Factors affecting information reception and processing. Coding and Selection of sensory inputs.
e. Human Sensory Process: Vision, Hearing, Cutaneous, Kinesthitics, and orientation senses.

Unit-IV Display:
a. Visual Display: Quantitative and qualitative types of visual display, Visual indicators and warning signals, pictorial and Graphic displays, Alphanumeric Characteristics, Symbolic Codes.
b. Auditory and Textual Display: General Principles, Characteristics and Selection of Auditory and Textual display.

Unit-V Environment and Safety: Introduction to Environmental stresses and their impacts on human work. Industrial Safety: Analysis of cost of accidents, Hazards in various fields like Fire, Electrical shocks. Chemicals, Material Handling, Radiation Machine and Machine Tools and Methods of eliminating them, Personnel Protective equipments, Government legislation about occupational safety, organization for safety, plant safety.

Books Recommended :

1. McCormick, Human Factors in Engineering and design.
2. Singalton, Introduction to Ergonomics.
3. Grandjean, fitting task to the men, TMH

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

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Automobile Engineering, VII-Semester

Open Elective AU703 (D) In-Vehicle Networking

UNIT I BASICS OF IN-VEHICLE NETWORKING

Overview of Data communication and networking –need for In-Vehicle networking – layers of OSI reference model –multiplexing and de-multiplexing concepts –vehicle buses.

UNIT II NETWORKS AND PROTOCOLS

Overview of general-purpose networks and protocols -Ethernet, TCP, UDP, IP, ARP, RARP - LIN standard overview –workflow concept-applications –LIN protocol specification –signals - Frame transfer –Frame types –Schedule tables –Task behaviour model –Network management – status management - overview of CAN –fundamentals –Message transfer – frame types-Error handling –fault confinement-Bit time requirements.

UNIT III HIGHER LAYER PROTOCOL

Introduction to CAN open –TTCAN –Device net -SAE J1939 - overview of data channels – control channel-synchronous channel – asynchronous channel –Logical device model – functions-methods-properties-protocol basics- Network section-data transport –Blocks – frames –Preamble-boundary descriptor

UNIT IV FLEXRAY PROTOCOL

Introduction –network topology –ECUs and bus interfaces –controller host interface and protocol operation controls –media access control and frame and symbol processing – coding/decoding unit –FlexRay scheduling

UNIT V LATEST TRENDS

Car networking protocols – Networking future trends –Roadmaps –Competitive advantage

Reference Books:

1. J.Gabrielleen,"Automotive In-Vehicle Networks", John Wiley & Sons, Limited, 2008
2. Robert Bosch," Bosch Automotive Networking", Bentley publishers, 2007
3. Society of Automotive Engineers, "In-Vehicle Networks", 2002.
4. Ronald K Jurgen, "Automotive Electronics Handbook", McGraw-Hill Inc. 1999.
5. Indra Widjaja, Alberto Leon-Garcia, "Communication Networks: Fundamental Concepts and Key Architectures", McGraw-Hill College; 1st edition, 2000.
6. Konrad Etschberger, "Controller Area Network, IXXAT Automation", August 22, 2001.
7. Olaf Pfeiffer, Andrew Ayre, Christian Keydel, "Embedded Networking with CAN and CANopen", Annabooks/Rtc Books, 2003.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

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Automobile Engineering, VII-Semester

AU705- FEM/CFD Lab

List of Experiments (Please Expand it)

1. To study fundamentals of Computational Fluid Dynamics (CFD)
2. To perform CFD analysis of lid driven cavity in Open-Foam
3. To perform CFD analysis of square tube in Open-Foam
4. To perform CFD analysis of a 2D-plate in Open-Foam
5. To perform CFD analysis of bifurcated blood vessel in FEM
6. To study fundamentals of Finite element method and FEA
7. To perform FEM analysis of deep drawing process in FEM
8. To study fundamentals of Sci-Lab
9. To perform matrix operations in Sci-lab
10. To plot 2D & 3D graphs in Sci-lab

References:

1. Versteeg H; An introduction to Computational Fluid Dynamics (The Finite Volume Method);Pearson
2. Jiyuan Tu; Computational Fluid Dynamics: A Practical Approach; Butterworth-Heinemann.
3. Gokhale NS; Practical Finite Element Analysis; Finite to Infinite
4. Seshu P; Finite element analysis; PHI.
5. Reddy JN; Introduction to the Finite Element Method;McGraw Hill Inc.
6. Das VV; Programming in Scilab 4.1; New Age International Publishers.
7. Verma A K; Scilab : A Beginner's Approach; Cengage publishers.