

# **RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL**

## **Credit Based Grading System**

### **Automobile Engg, VII-Semester**

#### **AU- 7001 Mechanical Vibration**

1. 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.

2. 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.
3. 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.

4. 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.
5. 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.
9. Study of Accelerometer.
10. Study of FFT Analyser.

## **References:**

1. S.S. Rao , Mechanical Vibrations,
2. Meirovitch Leonard, Elements of Vibration Analysis, TMH
3. Thompson, W.T. , Theory of Vibration with Applications,

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**Automobile Engg, VII-Semester**

**AU- 7002 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
9. S.P. Sukhatme, Heat Transfer
10. Kothandaraman, Heat Transfer Data Handbook.

**List of experiments (please expand it);**

- 1 Conduction through a rod to determine  $t$
- 2 Thermal conductivity of material
- 3 Forced and free convection over circular cylinder
- 4 Free convection from extended surfaces
- 5 Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
- 6 Calibration of thermocouple
- 7 Experimental determination of Stefan-Boltzmann constant

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**Automobile Engg, VII-Semester**

**AU- 7003 Computer Aided Engineering**

1. CAD Hardware: Types of systems, Systems evaluating criteria, Input devices, output devices. Hardware integration, Networking.

CAD Software: Graphics standards, Modes of graphics operation, modelling and viewing, CAD data exchange.

2. Geometric Modelling: Basic Element Shapes, Aspect Ratio, Shape Functions, Generalised coordinates and nodal shape functions. Types of Mathematical representation of curves, parametric representation of analytic and synthetic curves.

Introduction of transformation of geometric models, visual realism.

3. Surface Modelling: Parametric representation of analytic and synthetic curves, surface manipulation, Design and engineering applications, Engineering components and sub-assembly, Assembly.
4. Solid Modelling: Boundary representation, constructive solid geometry, Sweep representation, Analytical solid modelling, Design and Engineering applications, prototyping and Simulation.
5. Numerical Methods: Solution of algebraic linear equation, Eigen Value problem, Differential equations, convergence errors. Introduction to FEM and its application to simple 1-D problem

**References :**

1. V Ramammurthy, *Computer-Aided Mechanical Design and Analysis*, McGraw-Hill, 1998
2. Besant and Lui, CAD, East-west Press Pvt Ltd, 1986
3. Ibrahim Zeid, CAD/CAM: Theory & Practical, Tata Mc-Graw Hill, 2012
4. Donald Hearn & M. Pauline Baeur, Computer Graphics, Prentice Hall, 1997
5. Dean and Taylor, Computer-Aided Design, Addison Wesley, 1992
6. Herrington, S., Computer Graphics, McGraw Hill, 1987

**List of experiments**

1. Implementation of Bresenham's algorithm
  - i) Line
  - ii) Circle
  - iii) Ellipse
- 2) Two Dimensional Transformations.
  - i) Translation
  - ii) Rotation
  - iii) Scaling
  - iv) Reflection
  - v) Shear

- 3) Drawing and 3D Modelling
  - i) Cotter Joint with Sleeve. Knuckle joint
  - ii) Screw Jack
  - iii) Universal Coupling.
  - iv) Bearing blocks, plummer block
  - v) Flexible couplings,
  - vi) Levers
  - vii) Simple spindle units
  - viii) Spur gear, bevel gear, worm wheel, worm
  - ix) Simple gear box
  - x) Slide Units, double –V, Dove tail, Rectangle, combined
- 4) FEM Analysis.
  - i) Static Analysis of Beam .
  - ii) Static Analysis of Truss.

Different soft wares may be used as available.

**Elective –III AU- 7004 (1) 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 required 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- EGR Fumigation- Air injection-PCV system (open 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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**Automobile Engg, VII-Semester**

**Elective –III AU- 7004 (2) Robotics**

1. **FUNDAMENTALS OF ROBOT** : Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications
2. **ROBOT DRIVE SYSTEMS AND END EFFECTORS** : Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.
3. **SENSORS AND MACHINE VISION** : Requirements of a sensor, Principles and Applications of the following types of sensors– Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analogue Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis –Data Reduction: Edge detection, Feature Extraction and Object Recognition -Algorithms. Applications – Inspection, Identification, Visual Servoing and Navigation.
4. **ROBOT KINEMATICS AND ROBOT PROGRAMMING** : Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs
5. **IMPLEMENTATION AND ROBOT ECONOMICS** : RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

Reference:

1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001.
2. Saha S. , Introduction to Robotics , TMH
3. Ghoshal Ashitava, Robotics, Fundamental Concepts and Analysis, Oxford.
4. Yu Kozyhev, Industrial Robots Handbook, MIR Publications.



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#### **Elective –III AU- 7004 (3) Ergonomics**

1. Productivity and work study, Techniques for productivity improvement, The influence of working conditions on work study.
2. 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.
3. 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, Kinesthetics, and orientation senses.
4. 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.
5. 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
4. ILO, Work study
5. R.M. Currie, Work Study, BIM Publication

**Elective –IV AU- 7005 (1) Renewable Energy**

**UNIT-I Solar Radiation:** Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions. **Solar thermal conversion:** Basics, Flat plate collectors-liquid and air type. Theory of flat plate collectors, selective coating, advanced collectors, Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills, solar cooling and refrigeration.

**Solar photovoltaic:** Principle of photovoltaic conversion of solar energy; Technology for fabrication of photovoltaic devices; Applications of solar cells in PV generation systems. Organic PV cells.

**UNIT-II Wind energy** characteristics and measurement: Metrology of wind speed distribution, wind speed statistics, Weibull, Rayleigh and Normal distribution, Measurement of wind data, Energy estimation of wind regimes; **Wind Energy Conversion:** Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics. Power curve of wind turbine, capacity factor, matching wind turbine with wind regimes. Application of wind energy.

**UNIT-III Production of biomass,** photosynthesis-C3 & C4 plants on biomass production. Biomass resources assessment. Co<sub>2</sub> fixation potential of biomass. Classification of biomass. Physicochemical characteristics of biomass as fuel **Biomass conversion** routes: biochemical, chemical and thermochemical Biochemical conversion of biomass to energy: anaerobic digestion, biogas production mechanism, technology, types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas plant manure-utilization and manure values. Biomass Gasification: Different types, power generation from gasification, cost benefit analysis of power generation by gasification.

**UNIT-IV Small Hydropower Systems:** Overview of micro, mini and small hydro system; hydrology; Elements of turbine; Assessment of hydro power; selection and design criteria of turbines; site selection and civil works; speed and voltage regulation; Investment issue load management and tariff collection; Distribution and marketing issues. **Ocean Energy:** Ocean energy resources, ocean energy routs; Principle of ocean thermal energy conversion system, ocean thermal power plants. Principles of ocean wave energy and Tidal energy conversion.

**UNIT-IV Geothermal energy:** Origin of geothermal resources, type of geothermal energy deposits, site selection geothermal power plants; **Hydrogen Energy:** Hydrogen as a source of energy, Hydrogen production and storage. **Fuel Cells:** Types of fuel cell, fuel cell system and sub-system, Principle of working, basic thermodynamics

**References:**

1. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn
2. Khan, B H, Non Conventional Energy, TMH.
3. Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.
4. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, Narosa Publ
5. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
6. Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI L
7. Abbasi Tanseem and Abbasi SA; Renewable Energy Sources; PHI Learning

8. Ravindranath NH and Hall DO, Biomass, Energy and Environment, Oxford University Press.
9. Duffie and Beckman, Solar Engineering of Thermal Process, Wiley
10. Nikolai, Khartchenko; Green Power; Tech Book International
11. Tester, Sustainable Energy-Choosing Among Options, PHI Learning.
12. Godfrey Boyle, Renewable Energy: Power for a sustainable future, Oxford OUP.

1. 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
2. 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.
3. 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 : Stereolithography, Selective Photocuring, Selective sintering, Fused Deposition Modeling, Laminated Object Manufacturing, 3D Printing, Applications of RP techniques, Emerging Techniques in RP, RP Methodology, Rapid Tooling.
4. 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
5. 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
10. CAD CAM, Principles, Practice and Manufacturing Management, Chris McMahon, Jimme Browne- Pearson Education Asia
11. Automated Fabrication, Marshall Burns, PTR-Prentice Hall

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**Mechanical Engg, VII-Semester**

**Elective –IV ME- 7005 (3) Enterprise Resource Planning, ERP**

1. Evolutionary stages of Enterprise Resource Planning(ERP), Need for ERP, Variety accommodation, Strategic and operational issues in ERP, Integrated and Business model of ERP, Online analytical processing( OLAP)
2. Introduction to Business Process Re-Engineering (BPR), ERP Implementation: Role of consultants, vendors and users, Guidelines and Procedure for ERP implementation, strategic advantage through ERP, ERP Domain.
3. Business module in ERP, Finance, Manufacturing, Human resources, Plant maintenance, Materials management, Quality management, Sales and Distribution.
- 4 Turbo Charge the ERP System, Enterprise Integration Applications (EIA), ERP and E – Commerce, ERP and internet , Future of ERP.
- 5 Resource Management, ERP – A Manufacturing perspective, ERP Case studies with applications and uses of software, E- business components and interrelationship, Integrated data model, Information Technology and computer net work support to MIS.

**References**

1. Chhabra, Ahuja & Jain, Planning Men at Work.
2. Enterprise Resource Planning, Concept and Practice Garg V.K. Venkitkrishnan N.K., PHI
3. Business Process Re-Engineering, Jayaraman, , TMH.
4. ERP by Alexis Leon
5. Murdick & Ross, Management Information System, PHI.