RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VII-Semester

ME- 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,

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VII-Semester

ME- 7002 Automobile Engineering

Unit-I: Chassis & Body Engg: Types, Technical details of commercial vehicles, types of chassis, lay out, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's 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, centre 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 breaking, 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:

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
7. Emission standards from BIS and Euro –I and Euro-III

List of experiments (please expand it):

Study of chassis, suspension, steering mechanisms, transmission, gear-box, differential systems, and electrical systems of various light and heavy automotive vehicles;

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VII-Semester

ME- 7003 OR & Supply Chain

Unit 1 Linear system and distribution models: Mathematical formulation of linear systems by LP, solution of LP for two variables only, special cases of transportation and assignment and its solution, Vogel's forward looking penalty method, cell evaluation degeneracy, use of SW Lindo, Tora, Excell.

Unit 2 Supply chain (SCM): Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

Unit 3 Inventory models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time (=WIP/ Throughput), JIT/ lean mfg; basic EOQ/ EPQ models for constant review Q-system(S,s); periodic review, base stock P-system; service level, lead time variance and safety stock;; ABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

Unit 4(a) **Waiting Line Models** Introduction, Input process, service mechanism, Queue discipline, single server (M/M/1) average length and times by Little's formula, optimum service rate; basic multiple server models (M/M/s)
(b) **Competitive strategy**: concept and terminology, assumptions, pure and mixed strategies, zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

Unit 5: (a) **Decision analysis**: decision under certainty, risk probability and uncertainty; Hurwicz criteria; AHP- assigning weight and consistency test of AHP
(b**) Meta-heuristics** Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search, Simulated Annealing and Genetic algorithms and solution of traveling salesman and non linear optimization problems.

References:

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2. Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5. Taha H; Operations research; PHI
6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7. Sharma JK; Operations Research; Macmillan
8. Ravindran , Philips and Solberg; Operations research; Wiley India
9. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
10. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain Logisti Mgt; TMH
11. Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH

12. Bronson R ;Theory and problems of OR; Schaum Series; TMH

List of experiments (please expand it):

1. Use computer and software to solve problems contained in the syllabus
2. Case studies in SCM

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Credit Based Grading System

Mechanical Engg, VII-Semester

Elective –III ME- 7004 (1) Machine Tool Design

1. Classification, General Requirements and Design Recommendations of Machine Tools. Cutting forces in various machining processes and power requirements of various Machine Tools such as Lathe Machine, Drilling Machine, Shaping Machine, Milling Machine, Grinding Machine and Broaching Machine.
2. Kinematics of Machine Tool Drives, Classification, selection of maximum and minimum cutting speeds and feeds, series of spindle speed, standard series and value of common ratio, determining common ratio and transmission ratio for drives powered by multispeed electric motor, Semigraphical method for transmission ratio, structures deviating from normal uniform structures, gear box layout and teeth calculations, step less regulations-Electrical and Mechanical.
3. Design aspects of Machine Tool Elements, Framework, Guides, Spindle Bearing and Power Screws
4. Lubrication and Rigidity in Machine Tools, Introduction, Steps in selecting proper lubrication oil, Frictional conditions of working, Specifications of lubrication oil, Rigidity of Machine Tool Units, Rigidity of recirculating ball Screw Assembly, overall static rigidity of machine tools, dynamic rigidity of machine tools
5. Stick slip vibration in machine tools, Vibration isolated tool holders, Forced vibrations in machine tools, Shock Absorber self excited vibrations or chatter.

References:

1. Ghosh and Bhattacharya, Machine Tool Design
2. Acherken, Design of Machine Tools, Mir Publications.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VII-Semester

Elective –III ME- 7004 (2) Reliability Engineering

1. Reliability : Definition, Importance, History, Failure pattern of complex product, Factor of safety and reliability, Reliability analysis procedure, Reliability management Some examples of system failures.

2. Basic probability theory, Set theory, Laws of probability, Probability theorem Random variables and probability distributions, Central limit theorem,

3. Functions of random variables, Single , two and several random variables, Probability distribution functions, density functions for different types of discrete and continuous variables, mean, mode and median, Numerical solutions, Extremal distributions,

4. Modeling of geometry, strength and loads, Fatigue strength, Time dependent reliability of components, Failure rate versus time, reliability and hazard functions and different distributions, Estimation of failure rate, Expected residual life, Series, parallel and mixed systems, complex systems, Reliability enhancement,

5. Reliability based design, Optimization problems, Failure modes and effect analysis, Event tree and fault tree analysis, Reliability testing, Reliability data and analysis, measurement of reliability, Monte Carlo Simulation, Computation of reliability

References:

1. Singiresu S. Rao, Reliability Engineering, Pearson
2. Grant E. L. & Leave Worth, Statistical Q. C., T.M.H.
3. Balagurusamy, Reliability Engg., T.M.H.
4. Mahajan , Statistical Q.C.
5. Juran and Grayan, Quality Planning Analysis, T.M.H.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VII-Semester

Elective –III ME- 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, Kinesthitics, 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 :

6. McCormick, Human Factors in Engineering and design.
7. Singalton, Introduction to Ergonomics.
3 Grandjean, fitting task to the men, TMH
4 ILO, Work study
5 R.M. Currie, Work Study, BIM Publication

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

Mechanical Engg, VII-Semester

Elective –IV ME- 7005 (1) 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 Serving 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 effecter 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.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

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Mechanical Engg, VII-Semester

Elective –IV ME- 7005 (2) Power Technology

1. Nuclear reactions and artificial radioactivity, introduction, energy and world, nuclear heat energy, nuclear fission and fusion and nuclear reactors, carbon dating, particle accelerators, International Thermonuclear Experimental Reactor, ITER, Large hadron collider, LHC, Radiation and materials, Biological effects of radiation, Nuclear propulsion, Radiation protection, Waste disposal
2. Solar energy, Introduction, an overview of thermal applications, Sun and geographic availability, Solar radiation, Thermal energy storage and utilisation, Solar pond, Solar heaters, Solar collectors, Solar systems design, Passive heating systems, Economic analysis.
3. Wind technology- Introduction, Nature of wind, Place and direction, Energy in wind,wind data, Multi blade propeller type wind mill units and power calculations, Standardization, Conversion effectiveness to electrical and Mechanical Energy, Connectivity with grid, Wind machines classifications and applications, Turbines-Design and performance.
4. Biomass technology, Introduction, Direct and indirect methods of bio mass resource utilisation, Energy plantation, Biomass classification, Biomass general chemical thermodynamics, Combustion.
5. Hydrogen energy-Introduction, Collection and safety, Comparison with other power sources and effectiveness, Reforming and collection of hydrogen from water and hydrocarbons, Hydrogen fuel cells, Fuel cell efficiencies.

References:

1. Arthur Beiser, Concepts of modern Physics, TMH
2. R.L. Murray, Nuclear Energy, Pergamon Press.
3. S. P. Sukhatme, Solar Energy, TMH
4. J. F. Kreider- The solar heating design process, Mc Graw-Hill.
5. Philipp Kiameh-Power generation Handbook.
6. Wiley, Engineering Chemistry, Wiley.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Credit Based Grading System

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.