

**AU- 5001 Machine Component Design**

**Note: PSG Design data book and/ or Mahadevan / Reddy's Mechanical design data book can be provided/ permitted in examination hall (duly verified by authority)**

**Unit 1 : Engineering Design;** Steps in designing, design process and role of designer, iteration. preliminary design, detail design. Conceptual Design; abstraction, modeling of an engineering problem; iconic, analog and symbolic Embodiment Design; steps, rules and principles, design for quality and cost. Design for safety, Concept & evaluation of factor of safety

**Unit II: Shafts:** Design of shaft under combined bending, twisting and axial loading; shock and fatigue factors, design for rigidity; Design of shaft subjected to dynamic load; Design of keys and shaft couplings.

**Unit III: Power Screws & Couplings :** design of power screws and power nuts, differential and compound screw, design of simple screw jack. ,design of Flanged coupling; Rigid coupling,

**Unit IV: Brakes & Clutches:** Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk , plate clutches, cone & centrifugal clutches. Design of brakes: Rope, band & block brake, Internal expanding brakes, Disk brakes.

**Unit V Design of Gears** Force analysis of gear tooth, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears. Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

**References:**

1. Shingley J.E; Machine Design; TMH
2. Bhandari VB; Design Of Machine Elements; TMH
3. Wentzell Timothy H; Machine Design; Cengage learning
4. Mubeen; Machine Design; Khanna Publisher
5. Sharma & Agrawal; Machine Design; Kataria & sons
6. Kanniah P; Machine design; Scitech Pub
- 7 Maleev; Machine Design;

**Unit-I:** Basic Concepts of Measurement: General measurement system; Experimental test plan: variables, parameters, noise and interference, replication and repetition; Calibration: Static calibration, dynamic calibration, static sensitivity, range, accuracy, precision and bias errors, sequential and random tests; Presenting data: Rectangular coordinate format, semi-log, full-log formats. General model for a dynamic measurement system and its special cases:

**Unit-II:** Statistics: Least square regression analysis and data outlier detection; Normal distribution and concept of standard deviation of the mean in finite data set, Uncertainty Analysis: Measurement errors; error sources: calibration, data acquisition, data reduction; Design stage uncertainty analysis; combining elemental errors; Bias & Precision errors; Error propagation, Higher order uncertainty analysis.

**Unit-III:** Temperature Measurement: Temperature standards, Temperature scales; Thermometry based on thermal expansion: Liquid in glass thermometers, Bimetallic Thermometers; Electrical resistance thermometry: Resistance Temperature Detectors, Thermistors; Thermoelectric Temperature Measurement: Temperature measurement with thermocouples, thermocouple standards. Pressure and Velocity Measurement: Relative pressure scales, pressure reference instruments, barometer, manometer, deadweight tester, pressure gauges and transducers, total and static pressure measurement in moving fluids  
Flow measurement: Pressure differential meters: Orifice meter, Venturi meter, rota-meter.

**Unit-IV:** Strain Measurement: Stress and strain, resistance strain gauges, gauge factor, strain gauge electrical circuits, multiple gauge bridge, bridge constant, apparent strain and temperature compensation, bending compensation. Motion, Force and Torque Measurement: Displacement measurement: Potentiometers, Linear variable differential transformers, rotary variable differential transformer; Velocity measurement: moving coil transducers; angular velocity measurement: electromagnetic techniques, stroboscopic measurement; Force measurement: load cells, piezoelectric load cells; Torque measurement: measurement of torque  
on rotating shafts, Power estimation from rotational speed and torque.

**Unit-V:** Introduction to control systems: Examples of control systems. Open loop and closed loop control, Mathematical modeling of dynamic systems: Transfer function, impulse response function, block diagram of closed loop system, block diagram reduction, Transient and steady state response analyses: First order systems, unit step and unit impulse response of first order systems, second order systems, unit step and unit impulse response of second order systems, transient response specifications, modeling of mechanical systems, modeling of fluid systems, modeling of thermal systems.

**References:**

1. Nakra and Chowdhry; Measurement and Control; TMH
  2. Figiola RS & Beasley DE; Theory and Design for Mechanical Measurements; 3e John Wiley
  3. Katsuhiko Ogata; Modern Control Engineering, 4e Pearson Education, New Delhi
  4. Doebelin EO, Manik DN; Measurement Systems- Application and design; TMH
  5. Gopal; Control Systems Principles and Design; Tata McGraw Hill, New Delhi.
  6. Swahney; Metrology and Instrumentation;
- Backwith & Buck , Mechanical Measurement . Mc Graw hills

**List of Experiment (Expandable) ( Measurement & control):**

- 1- Study of various temperature measuring devices; thermo couple, RTD, gas thermo meters.
- 2- Measuring velocity of fluid flow by Ventura meter/ orifice meter/ pitot-tube.
- 3- Measuring torque and power generated by a prime mover by using pony brake dynamometer.
- 4- Study of various pressure measuring devices like manometers, mercury in glass pressure gauge.
- 5- To develop a measuring device for fluid level measurement.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL**

***Credit Based Grading System***

**Automobile Engg, V-Semester**

**AU- 5003 Automotive Transmission System**

**UNIT 1** Transmission requirements: requirements of transmission system, general arrangement of power transmission, general arrangement of rear-engine vehicle with live axles, general arrangement of dead- axle and axles transmission; four-wheel-drive transmission.

**Unit 2** Clutches Requirements of clutches, principle of friction clutches, types of clutches and materials used- cone, single-plate, diaphragm-spring, multi-plate, centrifugal, over-running and electromagnetic clutch. dimensions for single plate ,multi plate, centrifugal and cone clutch.

**Unit 3** Gear box: Need of gear boxes, types- sliding mesh, constant mesh and epicyclic, gear boxes; synchronizers: principle, early and later Warner synchronizer, Vauxhall synchronizer- gear materials lubrication and design of gear box; Hydrodynamic drive: Advantages and limitations, principle of fluid coupling, constructional details, torque-capacity performance characteristics, drag torque, methods of minimizing drag torque; Torque converter: performance characteristics; single, multistage and poly phase torque converters, converter-coupling-performance characteristics, coupling-blade angle and fluid flow, converter fluid.

**Unit-4** Transmission systems-Drive line: Definition, forces & torques acting; types of drives- Hotchkiss, torque tube & radius rod drives; components- propeller shaft, slip joint, universal joints & constant velocity universal joints; front wheel drive; Final drive: definition; types- worm-wheel, straight-bevel gear, spiral-bevel gear & hypoid-gear drives; double-reduction & twin-speed final drives; Differential: Function, principle, construction and working; non-slip differential; differential lock; rear axle- loads acting & types; multi-axled vehicles.

**Unit 5** Automatic transmission: Chevrolet “turbo glide” transmission, power glide transmission, hydraulic control system of automatic transmission; Electric drive: advantages and limitations, principle of early and modified Ward-Leonard system, modern electric drive for buses; performance characteristics.

**References:**

- 1 Heldt P.M.; Torque converters; Chilton Book Co.
- 2 Giri NK; Automobile Engineering; Khanna Publisher
- 3 .Newton, Steeds & Garret; Motor Vehicles; B.H. Publication.
4. Judge, A.W., Modern Transmission Systems, Chapman & Hall Ltd.
5. Check Chart; Automatic Transmission; Harper & Row Publication.

**List of Experiments (Pl. expand it):**

1. Study of transmission of front and rear engine vehicles
2. Study of front and rear-wheel-drive vehicle
3. Study of four wheel-drive vehicles
4. Study of various gear boxes and presynchronization systems
5. Study of fluid couplings, hydrodynamic drives and torque converters
6. Automatic transmission system study
7. Electric drive vehicle study

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL*****Credit Based Grading System*****Automobile Engg, V-Semester****AU- 5004 Automotive Chassis system**

**Unit 1** Automotive chassis: Definition; chassis layout; types of chassis layout with reference to power plant location, steering position and drive on wheels; chassis components; chassis classification; Automotive frames: Construction; functions; loads acting; materials; types; frame cross sections; frame diagnosis and service; dimensions of wheel base; wheel track; chassis overhang and ground clearance.

**Unit 2** Front axle & steering system: Functions, construction & types of front axle; front wheel geometry; front wheel drive; steering mechanisms; steering linkages & layout; types of steering gear boxes; power & power assisted steering; electronic steering; four-wheel steering; terminology-reversible steering, under-steering, over-steering, turning radius.

**Unit 3** Suspension system: Need; factors influencing ride comfort; types; suspension springs-leaf spring, coil spring & torsion bar; spring materials; independent suspension; rubber suspension; pneumatic suspension; hydraulic suspension, shock absorbers-liquid & gas filled.

**Unit 4** Braking systems: Introduction, principles of braking; classification; brake actuating mechanisms; Drum brake- theory; principle; construction; working; Disc brake- theory, principle, construction, working; Parking brake- theory, principle; construction, types; Hydraulic system-theory, principles, master-cylinder basics, wheel-cylinder basics, tubing & hoses, valves & switches,

brake fluid; Power brake- theory, vacuum-booster basics, hydraulic-booster basics, electro-hydraulic booster basics;

Advanced brake theories; Exhaust brake; abs technology; factors affecting brake performance operating temperature, area of brake lining, clearance.

**Unit 5 Wheel:** Forces acting on wheels, construction of wheel assembly, types- spoke, disc & built-up wheels; wheel balancing; wheel alignment; Tyres: Static & rolling properties of tyres, construction details, types of tyres- pneumatic & hydraulic; types of tyre-wear & their causes; tyre rotation; Bearings: Functions; classification of bearings; bearing materials; automotive bearings.

**References:**

- 1) Giri NK; Automobile Technology; Khanna Publishers
- 2) Reimpell/Stoll/Betzler; The Automotive Chassis; SAE
- 3) Thomas W Birch- Delmar; Automotive Chassis Systems; Cengage Learning
- 4) Halderman/Mitchell; Automobile Technology; Prentice Hall
- 5) Don Knowles; Automotive Suspension & Steering Systems; Today's Technician
- 6) Jack Erjavec- Delmar; Automotive Technology; Cengage Learning

**List of Experiments (Pl. expand it):**

- 1 Study of types of chassis layouts.
2. Study and Construction of front axle
3. Study and Construction of steering linkages.
4. Study and Construction of rigid axle suspension system.
5. Study and Construction of independent suspension system.
6. Study and Construction of disc & drum brake assemblies..

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**Automobile Engg, V-Semester**

**Elective I -AU- 5005 (1) Entrepreneurship and Management Concepts**

**Unit-I: System Concepts:** Types, definition & characteristics; supra & subsystems, key component; boundary & interface complexity; feedback (pull) & feed forward (push) controls, open flexible-adaptive system, computer as closed system, law of requisite variety; system coupling, stresses and entropy; functional & cross functional system; Steven Alter's nine element work system model and its comparison with IPO (input-processing-output) model, structure and performance of work systems leading to customer delight.

**Unit-II: Management:** Importance, definition and functions; schools of theories, knowledge driven learning organization and e-business; environment, uncertainty and adaptability; corporate culture, difficulties and levels of planning, BCG matrix, SWOT analysis, steps in decision making, structured and unstructured decision; dimensions of organizations, size/specialization, behavior

formalization, authority centralization, departmentalization, span and line of control, technology and Minzberg organization typology, line, staff & matrix organization, coordination by task force, business process reengineering and process of change management, HR planning placement and training, MIS; attitudes and personality trait, overlap and differences between leader & manager, leadership grid, motivation, Maslow's need hierarchy and Herzberg two factor theory, expectation theory, learning process, team work and stress management.

**Unit-III: Marketing:** Importance, definition, core concepts of need want and demand, exchange & relationships, product value, cost and satisfaction (goods and services ) marketing environment; selling, marketing and societal marketing concepts; four P's, product, price, placement, promotion; consumer, business and industrial market, market targeting, advertising, publicity, CRM and market research. **Finance:** Nature and scope, forms of business ownerships, balance sheet, profit and loss account, fund flow and cash flow statements, breakeven point (BEP) and financial ratio analysis, pay-back period, NPV and capital budgeting.

**Unit-IV: Productivity and Operations:** Productivity, standard of living and happiness, types of productivity, operations (goods and services) Vs project management, production processes and layouts, steps in method improvement, time measurement, rating and various allowances; standard time and its utility, predetermined motion and time method, product and process specification, TQM, cost of quality, introduction to lean manufacturing (JIT), QFD, TPM & six sigma quality.

**Unit V: Entrepreneurship :** Definition and concepts, characteristics, comparison with manager, classification, theories of entrepreneur, socio, economic, cultural and psychological; entrepreneur traits and behavior, roles in economic growth, employment, social stability, export promotion and indigenization, creating a venture, opportunity analysis competitive and technical factors, sources of funds, entrepreneur development program.

#### **References:**

- 1- Daft R; The new era of management; Cengage.
- 2- Bhat Anil, Arya kumar; Management: Principles ,Processes and Practices; Oxford higher edu.
- 3- Davis & Olson; Management Information System; TMH.
- 4- Steven Alter; Information systems, Pearson, [www.stevenalter.com](http://www.stevenalter.com)
- 5- Kotler P; Marketing management;
- 6- Khan, Jain; Financial Management;
- 7- ILO; Work study; ILO.
- 8- Mohanty SK; Fundamental of Entrepreneurship; PHI.

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**Automobile Engg, V-Semester**

**Elective I -AU- 5005 (2) Engineering Economics & Management**



**UNIT I:** Demand Utility and indifference curves, Approach to Analysis of demand, elasticity of demand, Measure of demand elasticity, Factors of Production, Advertising elasticity, Marginalism

**UNIT II** Laws of Return and costs, price and output determination under perfect competition, monopoly, monopolistic, competition, oligopoly, Depreciation and methods for its determination.

**UNIT III** Functions of central and commercial banks Inflation, Deflation, Stagflation, Direct and Indirect Taxes, Monetary and cycles, New economic policy, Liberalization, Globalization, Privatization, Market friendly state. Fiscal policy of the government, Meaning and phases of business.

**UNIT IV** Definition, Nature and scope of management, Functions of management- Planning, organizing, Directing, Controlling, Communicating **UNIT V** Meaning of marketing management, Concept of marketing, Marketing Mix, Administrative and cost plus pricing, Channel of distribution, Advertising and sales promotion.

**UNIT V** Meaning, Nature and scope of financial management, Brief outline of profit and loss account, Balance sheet, Budget and their importance, Ratio Analysis, Principles of costing.

## **REFERENCES**

- 1) Modern Economics by H.L.Ahuja
- 2) Modern economics theory by K.K.Dewett
- 3) Monitory economics by M.L.Seth
- 4) Industrial Management by L.K.Chopde,A.M.Sheikh
- 5) Business organization and management by S.A.Sherlekar
- 6) Managerial economics by joel dean
- 7) Managerial economics by Pylee

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## **Automobile Engg, V-Semester**

### **Elective I -AU- 5005 (3) Mechatronics**

**UNIT – 1 INTRODUCTION:** Definition of Mechatronics, Multi-disciplinary scenario, origins. Evaluation of Mechatronics, An over view of mechatronics, Design of mechatronics system. Measurements system and function of main elements of measurement systems. Need for mechatronics in industries. Objectives, advantages and disadvantages of mechatronics. Microprocessor based controllers. Principle of working of engine management system, automatic washing machine.

**UNIT – 2 REVIEW OF TRANSDUCERS AND SENSORS:** Definition and classification of transducers. Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors. **MICROPROCESSOR:** Introduction, Microprocessor based digital control. Digital number system, binary and hexadecimal number system, Logic functions, Data word representation basic Elements of control systems.

**UNIT 3 : MICROPROCESSOR ARCHITECTURE:** 8085A processor architecture Terminology- such as, CPU, memory and address, ALU, assembler, data, registers, Fetch cycle, write cycle, state, bus interrupts. Micro controllers – difference between microprocessor and micro controllers. Requirements for control and their implementation in micro controllers. Classification of micro controllers.

**Unit 4 ELECTRICAL ACTUATORS:** Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches. Concept of bouncing Methods of Preventing bouncing of mechanical switches. Solenoids, Relays. Solid state switches – Diodes, Thyristors, Triacs, Transistors, Darlington pair. Electrical actuator. Principle, construction and working of AC, DC motors, stepper motors, permanent motors, servomotors, Servo systems and control

**HYDRAULIC ACTUATORS:** Valves – Classifications, Pressure Control Valves – Pressure relief valves, Pressure regulating/reducing valves, Pressure sequence valve. Flow control valves – Principle, needle valve, globe valve. Direction control valve –sliding spool valve, solenoid operated.

**Unit 5 : SINGLE CONDITIONING:** Concept, necessity, op-amps, protection, filtering, wheat stone bridge – Digital Signals – Multiplexer. Data acquisition – Introduction to digital signal processing – Concepts and different methods.

## REFERENCE BOOKS:

1. **Mechatronics** – Principles, Concepts and applications – Nitaigour and Premchand, Mahilik – Tata McGraw Hill -2003
2. **Mechatronics** – W. Bolton, Pearson Education Asia -2<sup>nd</sup> Edition, 2001.
3. **Introduction to mechatronics and measurement systems** –David G. Alciatore & Michel BiHstand – Tata McGraw Hill –2000
4. **Mechatronics** – H.D. Ramachandra – Sudha Publication -2003 **Mechatronics** by HMT Ltd. – Tata McGrawHill -2000.
5. **Mechatronics System design** by Devadas Shetty and Richard A. Kark – Thomas Learining -1997.
6. **Mechatronics an Introduction** by Robert H Bishop – CRC
- 7 **Mechatronics systems Fundamentals** by Rolf Isermann - Springer