

Industrial Production Engineering, V-Semester

IP- 5001 Design of Machine Elements

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

Unit I: 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: : Design of Belt, Rope and Chain Drives: Methods of power transmission, selection and design of flat belt and pulley; Selection of V-belts and sheave design; Design of chain drives, roller chain and its selection; Rope drives, design of rope drives, hoist ropes.

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. Wentzell Timothy H; Machine Design; Cengage learning
3. Mubeen; Machine Design; Khanna Publisher
4. Bhandari V B ,Design of Machine elements . TMH
- 5 Sharma & Agrawal; Machine Design; Kataria & sons
- 6 Maleev; Machine Design;

List of Experiment (Pl. expand it):

Designing and sketching of components contained in the syllabus

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Industrial Production Engineering, V-Semester

IP- 5002 Metrology and Mechanical Measurements

Unit 1 General concepts of measurement: definition-standards of measurement, errors in measurement, limit-gauging, various systems of limits, fits and tolerance, interchangeability, ISI and ISO system. basic principles and design of standards of measuring gauges, types of gauges and their design, accuracy and precision, calibration of instruments, principles of light interference, interferometer, measurement and calibration.

Unit 2 Linear and angular measurements: Slip gauges, micrometers, verniers, dial gauges, surface plates, comparators- mechanical, electrical, pneumatic and optical comparator, angular measuring instruments- sine bar, angle gauges, spirit level, autocollimators, clinometers; measurement of straightness, flatness and squareness.

Unit 3 Measurement of surface finish and measuring machines: surface finish- definitions, types of surface texture, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica, measurement of run out and concentricity, length bar measuring machine, optical projection, comparator, tool makers microscope.

Unit 4 Metrology of screw threads and gears: internal/external screw thread, terminology, measurement of various elements of threads, thread micrometer method, two wire and three wire methods; gear-terminology, measurement of various elements, constant chord method, base tangent method, plug method; gear tester, gear tooth measurement; rolling gear tester.

Unit 5 Computer aided and laser metrology: Co-ordinate measuring machine; applications; laser micrometer, laser interferometer, laser scanning gauge, non contact and in- process inspection, vision system.

References:

1. ASTE; Handbook of industrial metrology; Prentice hall of india ltd
2. Jain R.K.; Engineering metrology; Khanna publishers
3. Gupta. I.C. "A text book of engineering metrology", Dhanpat rai and sons;
4. Galye G.N et al; Metrology for engineers; elbs,
5. Rajput R.K; Engineering metrology and instrumentation; Kataria &sons publishers

List of Experiment (Pl. expand it):

1. Study and use of verniers, micrometer and dial gauges
2. Study and use of limit gauges
3. Study and use of slip gauges and sine bar
4. Study of Tool Makers Microscope
5. Measurement of straightness, flatness and squareness
6. Measurement of surface finish
7. Measurement of screw threads by one wire and two wire
8. Measurement of parameters of gear teeth
9. Study and use of profile projector
10. Study and use of comparators
11. Study and use of Coordinate measurement machines.

IP-5003 WORK STUDY

1. Introduction: Place of Industrial Engineering in Industries and Business. History of development of Industrial Engineering, works of Taylor and Gilberth, Modern industrial Engineering. Productivity: Productivity & Standard of living, productivity in individual enterprise, Reducing work content and ineffective time. Introduction to work study and its applications.
2. Method Study : Definition, Objectives and procedures, Selection of job, various recording techniques like outline process charts, Flow process charts, Man machine charts, Two handed process charts, String diagram, flow diagram, Multiple activity chart, Therbiligs, SIMO chart, Cyclographs and Chrono-cyclographs. Critical examinations, Development, Installation and Maintenance of improved methods. Principles of Motion economy and their application in work design. Micro-motion study, Memo-motion study & their uses in the study of methods.
3. Work Measurement:
 - A. Introduction: Definition, Objectives and procedure.
 - B. Time Study: Procedure, Methods of measuring time, selection of jobs, breaking a job into elements. Number of cycles to be timed, Rating and methods of rating, Allowances, Calculation of Standard time.
 - C. Work Sampling: Basic procedure, Design of work sampling study, conducting work sampling study and establishment of standard time.
 - D. Predetermined Motion time systems, Work factors system and other standard data systems.
4. Wage Incentives: Measured day work and wage incentives and Productivity, different types of wage incentive plans. Design of incentive plans managing incentive schemes, Supervisory incentives plans.
5. Introduction to Ergonomics : Ergonomics as a multi-disciplinary field, components. Importance of ergonomics in equipment and work design, Concept of man-machine system; Types and characteristics of Man-machine systems. Rest Pause design based on physiological consideration,

Books &References Recommended :

1. I. L. O., Introduction to Work Study.
2. Maynard, Industrial Engg. Hand Book.
3. Barnes R. M., Motion & Time Study.
4. Mundel “Motion and Time Study”
5. Salvendy “Hand Book of Industrial Engineering”
6. Jhamb L.C. “Work Study and Ergonomics”

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Industrial Production Engineering, V-Semester

IP-5004 Production Technology

Theory :

1. Principle of generation of surface, classification of machining processes and machine tools, cutting tool materials, their properties & types of single point cutting tools.
Type of lathe and operation such as turning, taper turning, thread cutting, grooving, parting off. Use of multiple tool for manufacturing of simple components, Concepts of feed, speed and depth of cut.
Machining time estimation: Evaluation of machining time for turning, facing, drilling, milling and shaping operations.
2. Shaping, Planing and slotting operation and machines, Quick return mechanism, Hydraulic system for shaper.
Drilling and drilling machines, Types of drills, taps and reamers, Geometry of drills, reamers and taps, Tapping and Spot facing operations.
Milling machines, Types and operations. Types of milling cutters, Up and Down milling, gang cradle milling. Broaching operation, types of broaching machines and broaches design of broaching tools.
3. Grinding process and grinding machines, Grinding wheel, Types nomenclature and their selection. Centreless grinding and job feeding arrangement, Dressing and truing of grinding wheels.
Super finishing processes : Honning, lapping, superfinishing, polishing and buffing.
4. Press working : Types of presses, Classification and specifications, press working operations as Blanking, piercing, shearing, bending, forming, embossing, coining drawing and deep drawing, operations. Elements of dies and punches, Clearance, Compound, combination, progressive and inverted dies and their operations, Blank layout, Metal spinning.
5. Gear and their types, elements of gears, different method of producing gears, gear cutting on milling m/c and by generating methods viz, hobbing, shaping, and rack cutting, gear finishing by shaving and grinding.

Books Recommended :

1. Campbell J. S., Principles of Manufacturing Materials & Processes.
2. Lindberg, Manufacturing Processes.
3. Chapman W. A. J., Workshop Technology part II and III.
4. Chitale A.K. and Gupta R.C. Product Design and Manufacturing
5. Rao P.N. Manufacturing Technology

References Recommended :

1. ASME, Fundamentals of Tool Design.

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Industrial Production Engineering, V-Semester

Elective –I IP-5005 (1) Foundry and Welding Engineering Practices

UNIT-I FOUNDRY PRACTICE

Moulding Tools-Moulding sands – Types-properties-ingredients. Types of moulding methods - floor, bench and machine moulding. Patterns: types allowances - pattern constructions. Core and core making- types of cores - Gating and Riser principles.

UNIT-II CASTING

Metal melting - Melting furnaces – cupola, Electric arc furnace, Induction furnace. Casting Procedure-advantages-limitations-Applications. Types of casting processes- sand, centrifugal, die & investment castings. Defects in castings - methods of control - fettling and cleaning of castings. Casting of cylinder block & head - cylinder liners - pistons and piston rings.

UNIT-III DESIGN OF WELDMENT

Design of Weldment: Weld geometry, Eccentric loading design in torsion and bending, designing welding fixtures. Distortion and Discontinuities in weldment, Testing, Inspection and

Specifications: Weldment distortion and its control, various discontinuities in Welds, Residual stresses in Weldments, Trouble shooting.

UNIT-IV ALLIED AND ADVANCE WELDING PROCESSES

Working Principle, advantages, limitations and applications of Friction welding and Friction Stir Welding, Thermit welding, Electron Beam Welding, Laser beam welding, Soldering and Brazing.

Robotics and Automation in Welding, Modes of Automation, Positioners, Welding fixtures, Arc motion devices, seam tracking devices. Under water welding.

UNIT-V WELDABILITY AND TESTING

Problems during welding of carbon steels, stainless steels, aluminium alloys, magnesium alloys and dissimilar metals – remedies. Welding defects, types of joints, welding symbols, post weld heat treatments, non-destructive testing of welded joints. Destructive and non-destructive methods of testing weldments, WPS, PQR and ASME section IX Welding.

TEXT BOOKS:

1. Richard W. Heine and Carl R. Loper, Principles of metal casting, Tata Mc Graw Hill, New Delhi, 1997.
2. Parmar.R.S., Welding Process and Technology, Khanna Publishers, EDITION 2, New

REFERENCES:

1. Jain. P.L., Principles of Foundry Technology, Tata Mc Graw Hill, Edition 3, New Delhi, 1997
2. Khanna. O.P., Welding technology, Dhanpat Rai& sons, NEW Delhi, 1998 .
3. Khanna. O.P., Principles of Foundry Technology, Dhanpat Rai& sons, NEW Delhi, 1998.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

Credit Based Grading System

Industrial Production Engineering, V-Semester

Elective –I IP-5005 (2) Metal Cutting and Machine Tools

1. Gear and their types, elements of gears, different method of producing gears, gear cutting on milling m/c and by generating methods viz. hobbing, shaping, and rack cutting, gear finishing by shaving and grinding.
2. Capstan and turret – construction, working, and its tool layout. Single spindle automat and multi spindle automats, various job/tool clamping methods, principle of CAM design. Introduction to process planning.
3. Basic features of machine tool construction. Kinematic structures of machine tools, elementary, complex and compound structure. Speed regulation, stepped regulation, cone pulley, change gear drive, gear box drive. Design of gear boxes for speeds and feeds.
4. Strength, Rigidity and Design Analysis : Strength, Rigidity and Design Analysis of Machine Tool Spindle etc. Elements compliance of machine tool. Force analysis, Bearing Slides and guide ways of machine tools, Hydrostatic bearings.
5. (a) Job Tolerance Analysis: Tolerance stacks (Design and Process tolerance stacks). Tolerance Charts: Purpose and layout, conversion of tolerances, developing the tolerance chart.
(b) Unconventional machining methods: Electro discharge machining, Wire EDM, Electro chemical machining, Laser beam welding, Ultrasonic Machining, Abrasive jet machining. Introduction to micro machining.

Books & References Recommended :

1. Campbell J. S., Principles of Manufacturing Materials & Processes.
2. Lindberg, Manufacturing Processes.
3. Chapman W. A. J., Workshop Technology part II and III.
4. Kempster M.H.A., Introduction to Jig and Tool Design, ELBS.
5. Joshi, Jigs and Fixture.
6. ASME, Fundamentals of Tool Design.
7. Kovan V. K., Process Engineering, Mir Publishers, Moscow.
8. Balakishan B., Fundaments of Manufacturing Engg., Mir Publishers, Moscow.
9. Eary and Johnson, Process Engineering, Prentice Hall.

Industrial Production Engineering, V-Semester

Elective –I IP-5005 (3) Estimating and Costing

1 Introduction to Estimating and Costing: Estimating-Definition, importance of estimating, aims, functions, organization of estimating department, qualities of estimator, constituents of estimation, profit costing- definition, aims of costing, standard cost, advantage of standard cost. Difference between estimating & costing, procedure for costing, costing methods, cost control- how to control costs, control on indirect material and tools, advantages of efficient costing.

2 Elements Of Costs: Elements of costs- material, labour costs, expenses, direct costs, Material costing- introduction, cost of material, control over material cost, waste control, valuation of material issued from stores, indirect costs, factory expense, administrative expenses, selling & Distribution expenses. Fixed & variable overheads, components of cost- selling price, allocation of cost percentage on prime cost, direct labour cost, Labour costing- introduction, objectives of labour costing, wages & incentives, direct material cost, man hour rate, machine hour rate, machine hour rate, combination of man hour & machine hour rate, unit rate method, examples of on costs. Value analysis, simplification, standardization, rationalization.

3. Mensuration : Areas of plane figures, areas of irregular figures, volumes & surface areas of solids, Guldinus rules- estimation of surface area & volume of solids of revolution.

4. Estimation of Various Manufacturing Processes:

A. Estimation in machine shop: speed, feed, depth of cut, lathe operations- turning, knurling, facing, Cutting drilling, boring, reaming, threading, tapping,. Milling operations- cutting, facing. Grinding operations- surface grinding, cylindrical grinding, shaping & planning, power consumption.

B. Estimation in Sheet metal shop: Operations in sheet metal shop, blank layouts, estimation of time, capacity for power process.

C. Estimation in Forging shop: Forging- hand forging, machine forging, forging operations, estimation procedure, and estimation of weight, losses & time.

D. Estimation in Welding shop: Types of welding joints, estimation of welding cost. Estimation of gas cutting cost, estimation of arc welding cost, factors affecting welding cost.

E. Estimation in pattern making & foundry shops: Estimation of pattern cost, Estimation of foundry shop. Foundry cost.

5. Cost Accounting, Cost Control And Cost Reduction: Important terms, cost accounting, standard costing, procedure for costing, costing methods, cost control, techniques of cost control. Cost reduction, cost saving areas, variance analysis.

Reference Books:

1. Estimation and Costing by Banga & Sharma, Khanna
2. Mechanical Estimating and Costing by B.P. Sinha, TMH
3. Mechanical Costing & Estimation by Sinha, Standard
4. Mechanical Estimating & Costing by Singla, Aggarwal, Kaston Pub.
5. Estimating & Costing by Mukharjee and Goswami
6. Elements of Estimating & Costing (Mechanical) by Saha

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

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Industrial Production Engineering, V-Semester

Elective –I IP-5005 (4) Manufacturing Analysis

Theory :

1. **Introduction of Manufacturing Analysis** :Pre and Post Production Analysis, Qualification of Analyst. Composition of effective Planning Group, Coordination of Engg. Functions, Communication Between Engg.Groups, Phases of Analysis.
2. **Product Engg. and Process Engg.**, Part Print Analysis, Determination of Principle Processes, Blank making process, Determination of Functional surfaces of W/pc, Machining Allowances (limits of size for initial and intermediate W/pc dimensions).
3. Selection of Manufacturing Processes, Influence of Process Engg. on product design.
Work piece Control.
Group Technology: Concept, Parts classification and coding system, Production Flow Analysis, Machine cell design, Computer Aided Process Planning.
4. Selection of materials (considering function and cost), Effect of process on material cost.
Selection of tooling, Selection of equipment (considering cost and design factors).
5. Dimensional Analysis : Flatness, Parallelism, Squareness, Concentricity etc. (ways to designate these).
Tolerance Analysis : Tolerance stacks (Design and Process tolerance stacks).
Tolerance Charts : Purpose and layout, conversion of tolerances, developing the tolerance chart.

Books & References Recommended :

1. Kovan V. K., Process Engineering, Mir Publishers, Moscow.
2. Balakishan B., Fundaments of Manufacturing Engineering, Mir Publishers, Moscow.
3. Eary and Johnson, Process Engineering, Prentice Hall.
4. Wilson F.W., Manufacturing Planning and Estimating Handbook, McGraw Hill Book Co.