Shivaji University, Kolhapur

SYLLIBUS/ STRUCTURE (REVISED from June- 2009)

T.E. Production (Semester – V)

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs.	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Metallurgy - I	3	2	-	5	3	100	25	-	-	125
2	Theory of Machines – II	3	2	-	5	3	100	25	-	-	125
3	Design of Machine Elements	3	1	-	4	3	100	25	-	-	125
4	Metal Cutting Technology	3	1	-	4	3	100	25	-	-	125
5	Metal Forming & Plastics Technology	3	2	-	5	3	100	25	-	-	125
6	Metrology	3	2	-	5	3	100	25	-	25	150
7	Basic CNC Laboratory	-	2	-	2	-	-	25	-	-	25
8	Work Shop Practice-V	-	2	-	2	-	-	-*	-	-	-
	TOTAL	18	14	-	32	-	600	175	-	25	800

L: Lecture, Pr: Practical, Tut: Tutorial, PT: Paper (Theory), TW: Term Work, Pract: Practical
*Note : Workshop Practice –V Term work shall be assessed under Workshop Practice –VI.

T. E. (Prod. Engg.) - Semester VI

Sr. No.	SUBJECT	Teaching Hours/Week				Paper Duration Hrs.	Examination Scheme				
		L	Pr	Tut	Total		PT	TW	Oral	Pract	Total
1	Metallurgy – II	3	2	-	5	3	100	25	-	-	125
2	Industrial Management	3	-	-	3	3	100	-	-	-	100
3	Industrial Hydraulics & Pneumatics	3	2	-	5	3	100	25	-	25	150
4	Design of Jigs, Fixtures & Dies	3	2	-	5	4	100	25	25	-	150
5	Quality Management	3	2	-	5	3	100	25	-	-	125
6	Machine Tools & Product Design	3	2	-	5	3	100	25	-	-	125
7	Work Shop Practice-VI	-	2	-	2	-	-	25	-	25	50
8	Seminar*	-	1	-	1	-	-	25	-	-	25
	TOTAL	18	13	-	31	-	600	175	25	50	850

- Note: For Seminar, a group of nine students shall be considered.
- After the Sem. VI examinations the student shall undergo a vacational in plant training of four weeks duration which will be assessed during B. E. Semester VII of next year.

T. E. (Production Engineering) – Semester V

1. METALLURGY - I

Teaching scheme:
Lectures: 3 Hrs per Week
Practical: 2 Hrs per week per batch

Examination scheme:
Theory Paper: (3 Hrs) - 100 Marks
Term Work: 25 Marks

Course Objective

Study of structures, compositions, properties, applications, testing, specifications and selection of various Ferrous and Non Ferrous materials

SECTION –I

1. Introduction Of Materials**:** Classification metals, alloys, ceramics, polymers and composites (GRP, glass cermets and cermets), types, properties and applications (2)

2. Crystallography - Unit Cell, Bravais lattices, study of crystal structures of S.C., B.C.C., F.C.C. and C.P.H. - Average number of atoms per unit cell, A.P.F. coordination number, Miller indices for planes and directions (2)

3. Metals and Alloy Systems
(a) Nucleation and growth, dendrite structure
(b) Concept of phases, constituents (components) and degree of freedom
(c) Phase rule and lever rules, modification and applications
(d) Construction of phase diagram using cooling curves
(e) Equilibrium diagrams for isomorphous systems, eutectic system, impure eutectic systems (partial solubility), peritectic and intermetallic compounds. explanations of cooling of an alloy from liquid state to room temperature. room temperature structures, coring
(f) Solid solutions : types, substitutional and interstitial, ordered/ disordered type solid solutions, Hume- Rothery rules for formations of substitutional solid solutions
(g) Intermediate phases: electron compound, laves phases (interstitial compounds) (7)

4. Study of Ferrous Equilibrium Diagrams, Compositions, Properties, Applications and Specifications of Important Alloys
a) Fe-Fe_3C equilibrium diagram - plain carbon steels, effect of carbon on structure and properties, free cutting steels
b) Alloy steels - effect of alloying elements on Fe-Fe_3C equilibrium Diagram and properties of steels -tool steels, stainless steels, heat resisting steels, HSLA steels, OHNS steel, structural steels, low temperature alloys, Invar, Hadfield steel, spring steel
c) Cast Irons - Fe-C Equilibrium Diagram, Factors Affecting Structure of C.I.(graphitization), Carbon equivalent of cast iron, grey C.I., white C.I., mottled C.I., malleable iron (heat treatment cycle only), S.G.iron, meehanite, alloy C.I., Ni-Hard, modified Ni- Hard and Ni-Resists,.
d) Wrought Iron (8)

SECTION –II

5. Study of non-ferrous equilibrium diagrams, compositions, properties, applications and specifications of important alloys
a) Copper-based alloys - Cu-Ni- Cupronickels, Cu-Zn- Brasses, Cu-Sn-Wrought and Cast Tin Bronzes, Cu-Be
b) Aluminum-based alloys - Al-Cu: Duralumin, Al-Si: modification treatment
c) Titanium-based alloys - Ti-Al, Ti-Mn
d) Non-ferrous equilibrium diagrams - Pb-Sn : solders, Sn-Sb : Babbit (4)

6. Principles of destructive testing- Introduction, purpose and importance of,
(a) Tension test - stress-strain diagrams for ductile and brittle metals, test procedure and analysis of results
(b) Hardness test - concept, various tests such as Brinell, Rockwell, Vickers, Shore's Scleroscope
(c) Impact test - Charpy and Izod tests
(d) Fatigue test - S-N curve for ferrous and non-ferrous alloys, factors affecting endurance strength
(e) Creep test - effect of temperature, creep curve (4)

7. Pyrometry - Study of principles, construction, working, temperature ranges, accuracy and applications of following pyrometers
(a) Contact type - thermocouples and resistance pyrometers
(b) Distant type - optical pyrometer (disappearing filament type) and total radiation pyrometer (2)

8. Theory of plastic deformation
(a) Imperfections and defects in crystals - point defects, line defects (edge and screw dislocations), plastics deformation in crystalline materials, slip and twinning
(b) Hot and cold working of metals and alloys - effect of cold working and annealing on structure and properties
(c) Fractures - Griffith's theory of brittle fracture, ductile fracture
(d) Fatigue and creep-mechanisms and theories (5)

9. Selection and Specifications of engineering materials for various applications
(a) Materials based on IS, BS/EN, ASTM, AISI/SAE standards
(b) Various criteria for selection
(i) Material properties –mechanical, physical and chemical (ii) manufacturing properties - formability, weldability, castability, heat-treatability and machinability (iii) cost and (iv)availability (5)

TERM WORK

1. Study of Metallurgical microscope and need for microscopy
2. Metallography – preparation of specimen and study of mounting
3. Study of microstructure of steel
4. Study of microstructure of cast iron
5. Study of microstructure of Non-ferrous alloys
6.Macroscopy and spark test of ferrous and non-ferrous alloy specimens
7. Assignment on Selection of Steels
Specifications Properties and applications of Steels:
a. Structural steels-
En3 as per B.S 970 / St 42 as per IS 1079,
En4 as per B.S 970/ St42-S as per IS 1079 and equivalent specifications,
b. Medium carbon/ Heat treatable steels:
En 8/ C45 as per IS 1570/ C 1042 as per AISI, En 9, En 18B as per B.S 970/ 40Cr1 as per IS 1570/ 5135 as per AISI, En36, En 42 etc and Equivalent specifications
c. Case Hardening steels-
En32 as per B.S 970/ C14 as per IS / C 1016 as per AISI/SAE
En 207 as per B.S 970/15Cr65 as per IS1570 &
17 Mn1Cr as per IS 1570/5117as per AISI
d. Unalloyed tool steels
Ex- T 90 as per IS 1570/ W1 as per AISI
e. Cold working alloyed tool steels (Die Steel or High C high Cr steel)
T 215 Cr 12 as per IS 1570/ D3 as per AISI

8. Assignment on Selection of Cast Irons
Specifications Properties and applications of Cast Irons
a. Specifications of Grey Cast Iron- IS 210 and equivalent.
b. Specifications of Malleable Cast Iron Black Heart Malleable (B35-12 & B32-10) and White Heart Malleable (W 35-4 & W 40-4)
c. Specifications of SG Iron as per IS 1865

9. Assignment on Selection of Non Ferrous Alloys
Specifications Properties and applications of Non Ferrous alloys
a. Aluminum based alloys (Important Al-Si, Al-Cu as per BS/LM series/
b. Copper based alloys (Important Cu-Sn, Cu-Zn and Cu-Be alloys)
c. Tin and Lead based alloys (Sn-Sb Babbits/ Pb-Sn Solders)

REFERENCE BOOKS

1. Introduction To Physical Metallurgy, -Avner, TMH
2. Engineering Metallurgy Vol. I And II ,- R.A.Higgins (ELBS)
3. Engineering Metallurgy - E. C. Rollason, (ELBS)
4. Introduction To Engineering Materials,- B.K.Agrawal (TMH)
5. Mechanical Metallurgy(SI Units), -Dieter, (TMH)
6. Engg Materials, Properties and Selection, Kenneth G. Budunski (PHI)
7. Engineering Metallurgy by Lakhtin, C.B.S. Publishers & Distributors
8. Physical Metallurgy, Vijendra Singh , Standard,Publishers Distributors, New Delhi
9. Materials Science And Metallurgy, -Dr. Kodgire (Everest , Pune)

T. E. (Production Engineering) – Semester V

2. Theory of Machines – II

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objective

To introduce the students to the kinematics and kinetics in the machines and mechanisms.

SECTION – I

1. **GEAR:** Introduction, law of gearing, involute and cycloidal profiles, gear terminology, length of path of contact, arc of contact, contact ratio, interference of involute gear teeth, helical and double helical gears, (5)

2. **GEAR TRAINS:** Types of gear trains, analysis of gear trains. (4)

3. **BALANCING:** Static and dynamic balancing, balancing of rotary masses, masses in the same plane, masses in different planes, balancing of reciprocating masses, primary and secondary balancing, balancing of locomotives, balancing of multi-cylinder inline engines, balancing of V-engines (6)

4. **FLYWHEEL:** Crank effort, turning moment on crankshaft, turning moment diagram, fluctuations of energy and speed. (4)

SECTION – II

5. **GYROSCOPE:** Introduction, Gyroscopic couple, Effect of gyroscopic couple on motion of aero plane, naval ship, two and four wheelers, Gyroscopic stabilization (5)

6. **GOVERNORS:** Functions of governor, types of governors, characteristics of governor, effort and power of governor. (5)

7. **VIBRATIONS:**

a) Longitudinal and transverse vibrations: Introduction, types, natural frequency for various loading systems, Dunkerly's empirical formula, critical speed of shaft, (4)

b) Torsional vibrations: Introduction, natural frequency for single, two and three rotor system, bifilar, trifler suspension system, torsionally equivalent shafts, free torsional vibrations of a geared system (5)

TERM WORK

1. At least one industrial visit to study industrial practices related to the subject and submission of the visit report.
2. One presentation by each student for 10 minutes related to the subject and submission of the same. **(Optional)**

And any eight experiments from below,

1. Generation of involute gear tooth profile.
2. Study of differential gear box.
3. Experiment on verification of static and dynamic balancing principle.
4. Experimental verification of gyroscopic principle.
5. Determination of the governor characteristics of Porter and Hartnell governor.
6. Experiment on free longitudinal vibrations
7. Experiment on trifler suspension system.
8. Experiment on critical speed of the shaft.
9. Experiment on forced vibration
10. Measurement of vibrations by using vibration-measuring instrument.

(At least one experiment should involve use of computer.)

REFERENCE BOOKS

1. Theory of Machines, - Thomas Bevan, CBS Publishers & Distributors
2. Theory of Machines and Mechanisms, -Joseph Shigley, McGraw Hill Intl. Edition.
3. Theory of Machines and Mechanisms, -P. L. Ballaney, Khanna Publications
4. Theory of Machines, -W. G. Green, Blackie & Sons
5. Theory of Machines, -S. S. Ratan , Tata McGraw Hill Co. Ltd.
6. Theory of Machines, -R. S. Khurmi and J. S. Gupta, Eurasia Pub. House (Pvt.) Ltd.
7. Mechanism and Machine Theory, -J. S. Rao & R. V. Dukipatti, Wiley Eastern Ltd.

T. E. (Production Engineering) – Semester V

3. Design of Machine Elements

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 1 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objective

To study the different types load considerations and design aspects of various machine members.

SECTION – I

1. Introduction: Concept of machine design, general design considerations, design procedure; factor of safety for different types of loading its significance and selection; theories of failures, Selection of engineering materials for a component considering functionality, raw material generating process, strength, cost, quantity and aesthetics, use of IS codes (5)
2. Design for static loading: Knuckle joint, turnbuckle, cotter joint, levers. (3)
3. Design for fluctuating loads: Fatigue phenomena, concept of stress vs. number of cycles diagram and endurance limit, stress concentration and remedies, use of Goodman and Soderberg diagram in design of machine elements like shafts, springs and couplings. (5)
4. Design of shafts, keys, splines and couplings: Design of solid and hollow shafts for strength and rigidity against pure torsion, pure bending, combined bending, torsion and axial loads; design of keys and splines; design of rigid and flexible couplings. (6)

SECTION - II

5. a) Design of pressure vessels: Classification and design of thick a thin pressure vessels and cylinders.
b) Design of joints: Design of bolted, riveted, and welded joints subjected under transverse and eccentric loading, materials for bolts, initial tightening loads on bolts, effect of washer and gasket, uniform strength bolts.

(5)

6. Design of springs: Types, applications, spring materials, stress deflection equation of helical spring, Whal's stress factor, style of ends, design of springs for valves, clutches, buffers etc., design considerations for leaf spring.

(4)

7. Design of power screw: Types, materials used, thread forms and their applications; types of stresses induced, overhauling and self-locking properties, re-circulating ball screw, design of nuts, methods of pitch error compensation for machine tools

(4)

8. Design of gears: a) Spur gears- materials, gear tooth loads, number of teeth, face width, strength of gear teeth, static beam strength (Lewis equation), dynamic tooth load (Spot equation), Wear strength (Buckingham's equation), estimation of module based on beam strength and wear strength, gear design for maximum power
b) Helical gears- No. of teeth, force analysis, beam and wear strength, effective load and design procedure
c) Construction details of gears i.e. hub, web, arms, rim, gear Lubrication, gear tooth failures and remedies.

(7)

TERM WORK

(Any Six of the following exercises.)
(Standard components shall be selected from relevant I.S. codes and Design Data Handbooks for the exercises given below.)

1) Study of Engineering Materials, their applications and selection as per different standards used in practice.
2) Design, stress analysis and working drawing of components and assembly of Cotter Joint, Knuckle Joint and Turnbuckle.
3) Design of Coupling and Detailed Working drawings with assembly.
4) Design of bolted, riveted and welded joints for transverse and eccentric loading.
5) Design of Gear Drive involving Gears, Shafts, and Keys with working drawings.
6) One assignment using CAD package on any one of the exercises 2, 3, or 5 above.
7) Two computer programs on any of the above exercise

REFERENCE BOOKS

1. Design of Machine Elements, V. B. Bhandari, (Tata McGraw-Hill Publishing Company Ltd.)
2. Elements of Machine Design, N. C. Pandya and C. S. Shaha, (Charotar Publishing House)
3. Mechanical Engineering design, J. E. Shigley, Mitchell, (McGraw-Hill Publishing Co. Ltd)
4. Machine Tool Design, N. K. Mehta, (Tata McGraw-Hill Publishing Company Ltd.)
5. Design of Machine Elements, Dbrovalsky (MIR Publisher)
6. A Text Book of Machine Design, R. S. Khurmi, (S. Chand)
7. Design of Machine Elements by M. F. Spoots, T.E.Shoup (PHI)
8. Machine Design, R. K. Jain, (Khanna Publishers.)
9. Engg. Design, a Materials & Processing Approach, G. Dieter, (Tata McGraw-Hill Publishing Company Ltd.)
10. Computer Aided Analysis and Design of Machine Elements by Dukki Patti, Rao, Bhat , (New Age, Delhi)

11. CMTI Machine Tool Design Handbook (TMH)
12. Design of Machine Elements, An Integrated Approach by Robert and Norton, (Pearson)
13. Machine Design by Black and Adams (McGraw-Hill Publishing Company Ltd)

T. E. (Production Engineering) – Semester V

4. METAL CUTTING TECHNOLOGY

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 1 Hr. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objective

Study of metal cutting technology including the process, measurements, design and selection of various cutting tools and their industrial specifications.

SECTION I

1. Theory of Metal Cutting:

a) General principles: Wedge action of cutting, concept of speed, feed and depth of cut, orthogonal and oblique cutting.
(2)

b) Mechanics of metal cutting: Chip Formation and types of chips, shear plane angle, cutting ratio and force relationship - velocity relationships, Merchant theory, it's assumptions and limitations
(4)

c) Tool dynamometry – Requirements, types and applications
(2)

d) Machinability of metals – Cutting force, surface roughness and tool life as measures of machinability.

(i) Cutting force - Effect of speed, feed, depth of cut, tool materials, angles and work material on - tangential cutting force, gross and net power requirements, concept of specific cutting force, specific power consumption.

(ii) Tool Life - Flank and crater wear, preliminary and ultimate failure, mechanism of wear - effect of variables such as speed, feed, depth of cut and material on tool life, Taylor's equation.

(iii) Surface roughness: Factors affecting surface roughness like speed, feed and depth of cut, tool angles, tool/work piece materials etc. built up edge, chatter and its elimination.

(iv) Metal cutting with and without coolants, comparison, types and selection of coolants. (9)

e) Sharpening of drills and milling cutters using tool and cutter grinder
(1)

SECTION II

2. Tool Materials: Study of modern tool materials such as uncoated / coated carbides, ceramics, cermets, cubic boron nitride, diamond etc. Selection of tool grades and styles including specifications from commercial catalogues for different processes like turning, milling, drilling, grinding for different operations.
(4)

3. Design of Cutting tools: a) Single point tools - Definition of angles as per ASA system and ORS system, tool signature, design procedure of single point turning tool and boring bar, constructional features of carbide tools - brazed and indexable insert, coated tips, components of tool assembly, ISO nomenclature of cutting tools
(4)

b) Form tools: Flat, tangential and circular form tools, Constructional features-Design of flat and circular form tool.
(2)
c) Drills and Reamers: Geometry, nomenclature, types, selection and applications
(1)
d) Milling cutters: Geometry, nomenclature, types, selection procedure
(2)
e) Broach: Types, Applications, Nomenclature - Design of broach.
(3)
f) Gear cutting tools- Nomenclature, types and selection of gear hobs and shaper cutters
(2)

4. Modern cutting tools for CNC machines, high speed machining, modular tooling, tool presetting
(2)

Note: Selection of cutting tools shall be done by using catalogs of commercial tool manufacturers.

TERM WORK

1. Measurement of Cutting force with the help of Tool Dynamometer (**Any Two**)
   a) Lathe tool dynamometer
   b) Drill tool dynamometer
   c) Milling tool dynamometer
2. Machining of minimum two jobs of different materials such as C.I., Steel, Aluminium etc. and measurement of surface roughness to study the effect of parameters such as feed, tool nose radius, depth of cut on the surface roughness.
3. Design of form tool and broach for given components
4. Industrial visit to study applications of tools for different metal cutting processes.

REFERENCE BOOKS

1. Cutting tools - P.H. Joshi - Tata McGraw Hill Publishing Co. Ltd..
2. Production Technology - HMT Handbook (TMH)
3. Metal Cutting Theory and Cutting Tool Design - Arshinov V. and Alekseev G., Mir Publication.
4. Metal cutting Theory and Practice- A. Bhattacharya, New Central Book Agency.
5. Metals Handbook, Vol. 16 Machining, A.S.M., Metals Park, Ohio.
6. Metal Cutting and Tool Design - Dr. Ranganath - Vikas Publishing House.
7. Metal Cutting Principals - Shaw M.C. - Oxford Calrendon Press, 1984.
8. Theory of Metal Forming and Metal cutting by Sinha, Prasad (Dhanpat Rai).
9. Machine Tool Engineering: K. R. Nagpal, Khanna Publication.
10. Tool Engineering handbook - ASTME, Frank Wilson (Editor) (TMH)
11. Text Book of Production Engineering (Tool Design) by K. Surendar and Umesh Chandra.
12. Commercial catalogues of tool manufacturers like SANDVIK, KENNAMETAL, TAEGUTECH, ISCAR, MITSUBISHI, Grindwell Norton, Carborundum Universal etc.

T. E. (Production Engineering) – Semester V

5. METAL FORMING & PLASTICS TECHNOLOGY

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objective

To introduce the students to the theory and practices of metal forming and plastics processing.

SECTION I

1. Theory of Plasticity : Flow curve, Concepts of true stress and true strain, stress tensor and strain tensor, yield criteria and their comparison., plastic stress-strain relationships (5)

2. Rolling: Classification of rolling processes, rolling mill types, deformation of metal in rolling, roll bite, elongation, reduction, defects in rolling, rolling of sheets, plates, bars, sections and tubes, applications (4)

3. Forging : Basic operations, types of forging, forging hammers/ presses, forging stress and force calculations, die design considerations, forging defects, applications (4)

4. Extrusion: Equipment and principles, types of extrusion, direct, indirect, impact, hydrostatic, tube extrusion, metal flow in extrusion, defects, factors affecting extrusion load, (3)

5. Drawing: Types of Drawing, Rod/wire drawing, equipment and principles of process, defects, Tube drawing, Seamless pipe manufacturing. (2)

6. Advanced Metal forming Processes: Explosive forming, Electro-hydraulic forming, Electromagnetic forming, Magnetic pulse forming,. (2)

SECTION II

7. Fine Blanking: Process, die design considerations, equipment (1)

8. Plastic Materials: Types, raw materials for plastic, properties, thermosetting plastics, thermoplastics, laminated and reinforced plastics, plastisols, additives, applications. (4)

9. Injection Molding: Process, equipment, applications, product design for injection molding, general mold construction, nozzles, runners and gates (5)

10. a) Plastic extrusion: Process, equipment, extruders,
b) Compression molding: Process, equipment, compression mould, transfer molding (3)

11. a) Blow molding: Principles, material characteristics in blow molding, production of parison, b) Rotational molding process for making hollow plastic articles (3)

12. Thermoforming- Process, heating equipment, basic forming methods, thermoform packaging; Calendaring- various calendaring processes, applications (2)

TERM WORK

1. Die design for a simple forged component including calculations and drawing
2. Numerical exercise on Roll Pass Design including calculations and schematic drawing
3. Designing layout for multi-pass wire drawing
4. Making simple components of suitable material using the following processes / equipment (Any four different components for a group of maximum four students each).

a) Hot Forging
b) Wire Drawing
c) Extrusion
d) Rolling
e) Injection Molding
f) Plastic Extrusion

5. Industrial visits (minimum two) for studying the metal forming and plastic processing and submission of reports
6. Study of die clamping and die handling for plastic molding processes

REFERENCE BOOKS

1. Mechanical Metallurgy (S.I. Units) - Dieter, McGraw Hill
2. Manufacturing Processes – Begman, Amstead etc.(John Wiley)
3. Rowe, Principles of Industrial Metal working Processes,
4. ASM Handbook on Forming.
5. Forging and Forging Die Design - Sharan, Prasad, Saxena.
6. Rolling of Metals: Ivankove and Chaturvedi (Yantrik Publications, Mumbai)
7. Extrusion - Pearson (McGraw Hill)
8. Manufacturing Technology: Foundry, Forming and Welding by P.N. Rao (TMH)
9. Plastic Technology: Theory, Design & Manufacture – William J. Patton
10. Plastics-6/e, J. Harry DuBOIS, Frederick W. John, Van Nostrand Reinhold Co.
11. Manufacturing Engineering Technology by Kalpakjian (Addison Wesley)
12. Manufacturing Processes for Engineering Materials by Kalpakjian (Addison Wesley)
13. Injection Mold Design, R.G.W. Pye 4/e, Affiliated East West Press Pvt. Ltd. New Delhi.
14. Plasic Manufacture: Properties & Applications – N. J. Miss, ELBS
15. Plastics for Industrial Use- Sasse John

T. E. (Production Engineering) – Semester V

6. METROLOGY

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks
Practical examination:25 Marks

Course Objectives

To understand principles of measurement and its techniques.
To study design, construction and accuracy features of various instruments.
To acquire hands-on skills of measurement by using different instruments and gauges.

SECTION – I

1. Fundamental Principles and Measurement System Analysis:

Definition and scope of metrology, definition of measurement, primary, secondary tertiary and working standards, line and end standards, advantages of optical standard as a primary standard sources of errors in measurement, precautions to minimize errors, measurement system and its characteristics: accuracy, precision, repeatability, reproducibility, linearity and stability of a measurement system, maintenance & calibration of instruments (4)

2. Instruments and Accessories

Vernier calipers, micrometers, height and depth gauges, - types, design considerations, specifications, applications, sources of errors and handling precautions, selection and general care of measuring instruments

Slip gauge box - Grades, materials, wringing, setting to sizes, precautions while use and storage

Accessories - Bench centers, surface plates, V-blocks, angle plates - types, applications Principle of digital measurement instruments and examples, Instrument-computer interface, Introduction to coordinate measuring machines (CMM),
(6)

3. Gauges and Gauge Design
Concept of limit gauging, Taylor's principle, various types of plug, ring and snap gauges for plain and taper dimensions, gauge design for a given dimension for workshop, inspection and general grade gauges (IS:919, Part 1, 1993-ISO system for limits, fits and tolerances, is to be used for gauge design)
(4)

4. Magnification and Comparators
Need for comparators, comparison of principles, sensitivity, repeatability and magnification of mechanical, pneumatic, optical and electrical and electronic instruments, dial indicator, bore gauges and master rings, optical profile projector, toolmakers microscope, electrical and electronic comparators, differential pneumatic comparator, and applications of pneumatic gauging
(6)

SECTION – II

5. Measurement of Angles, Tapers and Radius
Bevel protractor, clinometer, sine bar, angle dekor, angle slip gauges, optical dividing head, measurement of taper, angle and radius with the help of simple inspection set-ups using standard pins and balls
(3)

6. Geometrical Features and Alignment Tests
Measurement of straightness, flatness, parallelism, squareness, circularity, roundness, concentricity, symmetry, distance between axes and other geometrical features Straight edge, level beam comparator, autocollimator, fixtures and gauges for measurement of pitch circle diameter, center distance between holes, positioning of holes and surfaces, various alignment tests on machine bed, spindle and slides of lathe, milling machine and drilling machine
(8)

7. Measurement of surface properties
Waviness and roughness, causes of variation in surface quality, different parameters for assessment of surface roughness, methods of calculation, instruments for surface roughness measurement
(3)

8. Measurement of Screw Threads
Basic terminology, measurement of major, minor and effective diameter, Screw thread micrometer, floating carriage diameter measuring machine, two wire and three wire method, measurement of pitch and pitch error, thread pitch gauges, limit gauges for thread measurements
(3)

9. Measurement of gears
Basic terminology, measurement of pitch, lead, run out, back lash and tooth thickness, constant chord and base tangent method, gear tooth vernier caliper, David Brown tangent comparator, errors in gear geometry, measurement of composite error, Parkinson gear tester
(3)

Note: Students shall use IS:919, Part 1, 1993-ISO system for Limits, Fits and Tolerances, for designing of gauges during the theory examination.

TERM WORK

1. One industrial visit to study inspection practices and submission of the report
In addition, any **seven** experiments from the following.
2. Measurement of linear dimensions using vernier, micrometer and bore gauge

3. Measurement of height and steps by using dial indicator and slip gauge box
4. Measurement of angle by using bevel protractor and sine bar
5. a)Measurement of radius by using inspection setup like rollers and pins b) Dimensional measurement by using pneumatic comparator
6. Measurement of effective diameter of a screw thread by using floating carriage diameter measuring machine
7. a)Measurement of roundness and concentricity by using dial indicator b)Measurement of gear tooth thickness by using gear tooth vernier caliper
8. a) Measurement of roughness of machined surface b)Assessment of profile of a component by using profile projector
9. Alignment tests on lathe/ drilling machine/ milling machine (any one)

Practical Examination: Each candidate shall perform individually, one assigned experiment from the above list and submit the result, followed by an oral examination.

REFERENCE BOOKS

1. Engineering Metrology, -K. J. Hume, McDonald London
2. Engineering Metrology, -D. M. Anthony, Oxford University Press (I)
3. The Quality Technician's Handbook,- Garry Griffith, Prentice Hall
4. Engineering Metrology,- I. C. Gupta, Dhanpat Rai Publications
5. Principles of Machine Tool Design, -Sen, Gupta, New Central Book Agency
6. Basic Machine Technology, -C. Thomas Olivo, Bobbs-Merrill Educational Publishing
7. Machine Tool Practices,- Kibbe, Neely, Meyer, White, Prentice Hall
9. Engineering Metrology, -R. K. Jain, Khanna Publishers, Delhi
8. Testing of Machine Tools, -Dr. George Schlesinger, Pergamon Press
9. Basic Rules on using Measuring Tools, -Mitutoyo Metrology Institute
10. A Manual of Measurement System Analysis, Ford, General Motors, Chrysler Corporation
11. Metrology Laboratory Manual, -R. Bahl, M. Adithan, Technical Teacher's Training Institute, Chandigarh
12. A Text Book of Metrology, -M. Mahajan, Dhanpat Rai and Co.

T. E. (Production Engineering) - Semester V

7. BASIC CNC LABORATORY

Teaching Scheme:
2 Hrs/batch/week

Examination Scheme:
Term Work: 25 Marks

Course Objective

To introduce the student to the practical CNC technology followed in the industry.

The Term Work shall consist of following exercises.

1. a) Selection of cutting parameters including tool specifications for various operations on CNC machines for at least one job on each of the machine type – Turning Center and Machining Center.
   b) Study of the features of the controller of the CNC machines (e.g. FANUC, SINUMERIC, MAZAK etc.)- including Tool offsets, Wear Compensation etc.
2. Manual CNC Part Programming for (using cutter radius compensation)
   a) Lathe – at least two parts (using fixed cycles) along with selection of cutting parameters / tools.
   b) Machining Center – at least four parts involving operations like milling, drilling, boring etc. (using fixed cycles) along with selection of cutting parameters / tools.
3. Simulation of the above programs using any suitable CNC simulation software.
4. Preparing a simple CNC part program and executing it on a CNC machine for a given part (One job for Lathe and One job for Machining Center) in a group of four students each.

The journal shall consist of the printouts and report of the above exercises.

Reference Books:

1. CAD / CAM, Principles & Applications by P. N. Rao (TMH)
2. Programming Manuals of various CNC machines (Lathes and Machining Centers) e.g. FANUC, SINUMERIC, MAZAK etc.
3. Catalogs of Commercial Tool Manufacturers e.g. SANDVIK, KENNAMETAL, ISCAR, TAEGUTECH, MITSUBISHI etc.
4. Manuals of CNC Simulation Software

T. E. (Production Engineering) – Semester V

8. WORKSHOP PRACTICE - V

Teaching Scheme:

Practical: 2 Hrs. / Week/ Batch during

Examination Scheme:

Term work: To be assessed Semester VI

Course Objective

To train the students to plan and work on various metal cutting machines.

Contents

One composite job assembly consisting of 5 to 6 parts requiring the machining processes like turning, drilling, threading, tapping, milling, grinding etc. is to be completed under Workshop Practice - V and VI by each student

Note :

1. The composite job assembly is to be carried on to Semester VI under Workshop Practice VI.
2. The practical examination of 50 marks based on Workshop Practice - V and VI will be conducted at the end of Semester VI
3. The student shall maintain a diary of the work consisting of the process plan and work done.

Semester- VI

T. E. (Production Engineering) – Semester VI

1. METALLURGY - II

Teaching scheme:
Lectures: 3 Hrs per Week
Practical: 2 Hrs per week per batch

Examination scheme:
Theory Paper: (3 Hrs) - 100 Marks
Term Work: 25 Marks

Course Objective:

Study of various heat treatment processes for different engineering materials, thermo-mechanical and surface treatments and powder metallurgy.

SECTION I

1. Introduction to Heat Treatment: Definition of heat treatment, process variables, purposes.
(1)

2. Principles of heat treatment of steels:
a) Formation of austenite on heating - mechanism and kinetics of austenite formation, austenite grain size - important factors affecting austenite grain size, inherent and actual grain size, methods of determination of austenite grain size, ASTE grain size specifications.
b) Isothermal transformation of austenite - TTT curves, kinetics and mechanism of austenite to pearlite, bainite and martensite transformations.
c) Transformation on continuous cooling - CCT curves
d) Effect of carbon, alloying elements and grain size on phase transformations, effect on TTT diagrams.
(5)

3. Heat treatment process of steels and cast irons**:**
a) Annealing and Normalizing - Classification of annealing process, types of annealing process and applications. normalizing process and applications, comparison between annealing and normalizing, patenting.
b) Hardening - Hardening process, factors affecting hardening process, hardenability - definition, factors affecting hardenability, determination of hardenability, Grossman's and Jominy end quench test, characteristics of martensitic transformation, retained austenite, preparation of articles for hardening; hardening methods - continuous cooling, cooling in two media, stepped quenching, austempering, martempering, sub- zero treatment, mechanism of heat removal during quenching, quenching stresses, quenching media used in hardening, properties required.
c) Tempering - Purposes of tempering, types of tempering, structural changes during tempering , secondary hardening, temper brittleness
d) Cast Irons - Stress relief annealing, normalizing, hardening, surface, hardening and malleablising, annealing.
(6)

4. Surface and case hardening processes:
a)Case Hardening- Introduction, steels used for case hardening,
b)Carburizing:- Pack , liquid and gas carburizing, post carburizing heat treatments, case depths obtained and applications.
c) Nitriding - Liquid and gas nitriding, plasma nitriding, case depths obtained, white layer , elimination of white layer, applications.
d) Surface Hardening :- Steels used for surface hardening, flame hardening, induction hardening, electron beam hardening and laser hardening, comparison of surface hardening processes, advantages and limitations, case depths obtained and applications.
e) Case depth measurement - hardness method, chemical method, microstructure method.
f) Metallizing :- Types - aluminizing (calorizing), silicon-diffusion, chromizing, boron-diffusion, applications, comparison of case hardening processes, advantages and limitations.
(6)

SECTION II

5. Heat treatment furnaces, atmospheres, defects and energy economy
a) Heat treatment furnaces, control systems, equipments, furnace atmospheres.
b) Heat treatment defects: - causes and remedies.
c) Energy economy in heat treatment through change in material, heat treatment practice and processes.
(3)

6. Heat Treatment of non-ferrous metals and alloys: introduction to heat treatment processes carried out on copper, aluminum, magnesium and titanium metals and alloys (1)

7. Precipitation Hardening:
a) Basic requirements of alloys that can be precipitation hardened, precipitation hardenable ferrous and non-ferrous alloys and their applications.
b) Steps in the process of precipitation hardening - Solutionizing, quenching, aging
c) Effect of variables like- aging time, temperature, cold working, impurity, alloy composition on the properties of precipitation hardened alloys.
d) Mechanism of precipitation hardening:- coherent lattice theory and G.P. Zone theory.
(4)

8. Thermomechanical Treatments - a) Classification of TMT, b) Controlled rolling and cold rolling c)Ausforming and isoforming. d) Marstraining and cryoforming, thermo-mechanical annealing e)TMT of non-ferrous alloys.
(2)

9. Strengthning Mechanisms
(a) Cold Worked Structures - Strain hardening, strain aging
(b) Strengthening by alloying - Solid solution strengthening,
(c) Strengthening from fine particles - dispersion hardening
(d) Grain refinement, micro-alloyed steels
(e) Transformation hardening - martensitic hardening (2)

10. Powder Metallurgy.
(a) Importance of powder metallurgy as a manufacturing technique, advantages and limitations of powder metallurgy
(b) Methods of powder manufacture, characteristic and testing of metal powders, powder conditioning - heat treatment, blending and mixing.
(c) Powder compaction - Methods of compaction, compaction pressures, types of compaction, property changes during compaction.
(d) Sintering - Types of sintering, structure and property changes during sintering, sintering atmospheres and their importance.
(e) Finishing operations - Sizing, heat treatment, surface treatment, electroplating and impregnation treatments.
(f) Applications - Self lubricating (porous) bearings, electric contact materials, filters, magnets, sintered friction materials, cutting tools and cermets, flow charts for manufacturing of above components.
(5)

TERM WORK

1. Study of grain size measurement
2. Study of annealing heat treatment
3. Study of Normalizing heat treatment
4. Study of hardening and Tempering heat treatment
5. Study of heat treatment furnaces
6. Study of micro structure of Carburized, Nitrided, Induction Hardened and Welded steels
7. One presentation of 10 minutes by each student related to the subject and submission of the write up on the presentation. (Optional)

8. Industrial visits (minimum two) for observing various heat treatment processes, furnaces, control systems and equipment carrying out heat treatment of ferrous & non-ferrous metals and alloys and powder metallurgical processes.

REFERENCE BOOKS

1. Heat treatment principles and technique - Rajan Sharma & Sharma.
2. Introduction to Physical Metallurgy, -Avner, TMH
3. Engineering Metallurgy Vol. I & II - R.A.Higgins (ELBS)
4. Engineering Metallurgy - E. C. Rollason, (ELBS)
5. Introduction to Engineering Materials - B.K.Agrawal (TMH)
6. Mechanical Metallurgy (S I Metric ed.), Dieter, (TMH)
7. Engg Materials, Properties and Selection, Kenneth G. Budunski (PHI)
8. Engineering Physical Metallurgy - Lakhtin, C.B.S. Publishers & Distributors
9. Physical Metallurgy - Vijendra Singh , Standard,Publishers Distributors, New Delhi
10. Materials Science & Metallurgy - Dr. Kodgire (Everest, Pune)
11. Powder Metallurgy - A.K.Sinha, (Dhanapat Rai & Co.)

T.E. (Production Engineering) – Semester VI

2. INDUSTRIAL MANAGEMENT

Teaching Scheme:
Lectures: 3 Hrs./Week

Examination Scheme:
Theory Paper (3 Hrs.): 100 Marks

Course Objective

To study various functions of management essential for efficient working of industrial organization

SECTION – I

1. INTRODUCTION: Management – meaning, definition, scope, importance, functions of management, development of management thought, contribution by Fayol, Taylor, Drucker, different approaches to management – scientific, operational, human and system approach, role and social responsibilities of a manager (3)

2. PLANNING: Meaning, definition, scope, importance, objectives of planning, steps in planning, decision making, strategic planning, management by objectives (MBO) (3)

3. ORGANIZING: Meaning, definition, principles of organization, delegation of authorities and decentralization, span of management, types of organization – line, staff, project, functional and informal organizations (3)

4. STAFFING: Definition, functions of staffing, selection process, training and development, performance appraisal (2)

5. DIRECTING: Definition, principles of direction, importance motivation, theories of motivation – theory X and theory Y, Maslow's hierarchical needs, Herzberg theory, leadership – meaning, styles of leadership, types of leaders, trait theories, behavioral theories – managerial grid, Rensis Likert's leadership systems communication – importance, types of communication, barriers to effective communication, methods to overcome barriers (5)

6. CONTROLLING: Definition, steps in control process, requirements of effective control process, various control techniques (2)

SECTION – II

7. FORMS OF ORGANIZATION: Proprietor, partnership firms, private limited, public limited, co-operative organizations, joint stock and public sector undertakings – structure of management, advantages and limitations, authorities and liabilities of owners (3)

8. HUMAN RESOURCE MANAGEMENT: evolution, objectives, functions, organization, introduction to industrial relations, trade unions and their functioning, significance of labor laws, human behavior at work, supervisor's role (3)

9. FINANCE MANAGEMENT: Objectives, functions, kinds of capital, sources of capital, financial planning and control, profit planning, basic terms in financial accounting, reading and interpretation of balance sheet and profit and loss account (4)

10. MARKETING MANAGEMENT: Objectives, functions, difference between marketing and selling, introduction to marketing mix, product planning, pricing policies, channels of distribution, advertising, market research (3)

11. PRODUCTION AND MATERIALS MANAGEMENT: Primary and secondary objectives, functions, organization, types and procedure of purchasing (3)

12. INDUSTRIAL PSYCHOLOGY: Basic concepts of psychology, industrial psychology, scope, causation of behavior, individual differences, differences in psychological characteristics – intelligence, interest, physique, learning ability, perception, concept of psychological test (2)

REFERENCE BOOKS

1. Management by James A. F. Stoner, R. Edward Freeman, PHI
2. Management Today: Principles and Practice by Gene Burton and Manab Thakur, TMH
3. Essentials of Management by Koontz and O'Donell, TMH
4. Organizational Behavior by Keith Davis, TMH
5. Management (Tasks, responsibilities and Practices) by Peter Drucker, Harper Business
6. Production Management by Lockyer, ELBS
7. Modern Production Management by E. S. Buffa (John Wiley)
8. Financial Management by Vanhorne, PHI
9. Financial Management (Theory and Practice) by Prasanna Chandra, TMH
10. Marketing Management by Philip Kotler, Pearson Edition
11. Marketing Management by Rajan Saxena, TMH
12. Personnel Management by Edward Flippo, TMH
13. Managing Human Resources by Gorrez, Balkin, Candy, PHI

T. E. (Production Engineering) – Semester VI

3. INDUSTRIAL HYDRAULICS AND PNEUMATICS

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks
Practical examination: 25 Marks

Course Objective

To study of fundamental concepts, components, circuits and applications in industrial hydraulics and pneumatics

SECTION – I

1. Fundamental concepts of fluid mechanics: Classification of fluids, derivation of Pascal's law, continuity equation and Bernoulli's equation (3)

2. Introduction to fluid power: Types, advantages and applications, ISO symbols for hydraulic and pneumatic systems; hydraulic fluids- functions, desirable properties and technical specification for selection, conditioning of fluids, study of reservoirs, strainers, filters, heat exchangers (3)

3. Hydraulic system elements: pumps – types, working, characteristics and applications; types of conductors and connectors, their selection, seals and packing – types, materials, applications, hydraulic actuators – linear and rotary - types, working, cushioning effect, mounting, calculation of force and velocity of piston, system components: accumulators, intensifiers, their types, working, applications. (5)

4. Control Elements: a)construction and working of pressure control valves – direct acting type, pilot operated, sequence, counterbalancing, unloading, pressure reducing, b)Direction control valves – types, construction and working, spool actuation methods, spool center positions, c)Flow control valves – compensated and non compensated types, construction and working. (4)

5. Hydraulic circuits and their applications: Speed control circuits, regenerative, sequencing, counterbalancing, interlocking, synchronizing circuits, use of accumulator and intensifier, methodology to design hydraulic circuits. (3)

SECTION – II

6. Pneumatics: Basic principle, applications, comparison with hydraulic system. (1)

7. Pneumatic system elements: Piping, materials and pressure ratings, piping layout, calculation of pressure drop in pneumatic line; air compressors, types, selection criteria; FRL unit- construction and working; pneumatic cylinders and air motors- construction, working and types, calculation of force and air consumption, comparison of air, hydraulic and electric motors. (5)

8. Pneumatic system control elements: Direction control valves- types and working, flow control valves, working of variable flow control, quick exhaust, time delay and shuttle valve. (4)

9. Pneumatic circuits: Basic circuit, impulse operation, speed control, sequencing, time delay circuits and their applications, pneumatic clamping systems, pneumatic power tools (3)

10. Hydro pneumatic systems: concept, working and applications (descriptive treatment only) (2)

11. Fluidics: Concept, study of logic gates and applications. (2)

12. Fluid power maintenance, troubleshooting and safety. (1)

TERM WORK

1. Verification of Bernoulli's Theorem on Bernoulli's apparatus.
2. Study of pressure, direction and flow control valves in hydraulics and pneumatics using cut section models
3. Speed control circuits on hydraulic trainer (Meter-in, Meter-out and Bleed-off)
4. Construction and operation of Sequencing, Counterbalancing, Synchronizing, Interlocking, pressure reducing circuits on hydraulic trainer.
5. Manual / automatic forward and reverse and sequencing circuit on pneumatic trainer.
6. Operations of basic logic and sequencing circuits on pneumatic trainer.
7. Design of a hydraulic circuit for a given application and selection of components from commercial catalogs.
8. At least one industrial visit to study industrial applications of hydraulics and pneumatics with submission of the relevant report.

Note: Practical examination will consist of performing an actual experiment by a group of maximum two students, from the above list (Sr. Nos. 3 to 6) and to show working / results by the candidates, followed by oral examination.

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Recommended Books

1. Industrial Hydraulics by J. J. Pipenger, Hicks (McGraw Hill)
2. Hydraulics and Pneumatic Power for Production by H. L. Stewart (Industrial Press)
3. Fluid Power with Applications by A. Esposito (Pearson)
4. Fluid mechanics by R.K.Bansal, Laxmi publications. New Delhi.
5. Engineering Fluid Mechanics by Gadre, Mirajgaonkar (Nem Chand and Brothers)
6. Mechanics of Fluids by Shames, Irving H. (McGraw Hill)
7. Oil Hydraulic Systems by S. R. Majumdar (TMH)
8. Industrial Hydraulics Manual by Vickers Sperry
9. Pneumatic Systems-Principles and Maintenance by S. R. Majumdar (TMH)
10. ABCs of hydraulic Circuits by H. L. Stewart and J. M. Storer (Taraporwala)
11. ABCs of Pneumatic Circuits by H. L. Stewart and J. M. Storer (Taraporwala)
12. Hydraulic Text Book Basic Level (Festo Controls Pvt. Ltd. Bangalore, (Part No. 93281)
13. Pneumatic Text Book Basic Level (Festo controls Pvt. Ltd. Bangalore) (Part No. 93131)
14. Pneumatics and Hydraulics by H. L. Stewart (Taraporwala)
15. Hydraulics and Pneumatics, A Technician's and Engineer's Guide by Andrew Parr (JAICO)

T. E. (Production Engineering) – Semester VI

4. DESIGN OF JIGS, FIXTURES & DIES

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (4 Hrs): 100 Marks
Term work: 25 Marks
Oral examination: 25 Marks

Course Objective

To introduce the students to the design practices of toolings (Jigs and Fixtures) and die design for presswork.

SECTION – I

1. Introduction to Jigs and Fixtures : Necessity, applications and types, basic concept of jigs and fixtures for different manufacturing processes, dependency of jig and fixture design on operation sequence, (3)

2. Location and clamping system : Principles, types, applications, locating pins, pads, diamond pins, adjustable supports, Vee and post locators, clamping system - principle, types, screw clamp, strap, lever, hinge type, cam operated, toggle clamps, centralizer and equalizer clamp, multiple clamping, quick acting clamps, pneumatically operated clamps. (5)

3. Design of Jigs: Principles of jig design, types of jigs- plate, template, box, channel, sandwich, latch, tumble, turn-over, tumble jig etc., types of bushes, selection of bushes and liners, construction of jig and fixture bodies, use of standard parts. (5)

4. Design of fixtures: Principles of fixture design, types of fixtures- gang, straddle, vertical, slot, string milling fixture etc, selection of the suitable type, design of milling fixtures, use of setting block, tennons, T-bolts etc, design of turning fixture for lathe (5)

5. Indexing System: Necessity, different indexing systems for jigs and fixtures. (2)

Section – II

6. Introduction to press tools: Dies, punches, types of presses, types of dies, simple, compound, combination and progressive dies, press tools for operations like blanking, piercing, drawing, shaving, trimming, etc. (4)

7. Design of die set for cutting operations : Theory of metal cutting, cutting force and lank holding force estimation, punch and die clearance, scrap strip layout, design of punches, design of dies, pilots, strippers, stock stops, finger stops, auto stops, center of pressure, selection of die set (6)

8. Design of drawing die: blank size determination, no. of draws, stage wise achievement of drawn component, stage wise component drawings, drawing radii and clearance, drawing forces, defects in drawing, (6)

9. Miscellaneous dies like- cut off dies, trimming, shaving, bulging, rubber, lancing, slitting, horn type, side cam dies, bending, forming, curling dies etc. (theoretical treatment only) (3)

TERM WORK

Note: All standard components shall be selected using relevant IS codes in the following exercises.

1. At least one industrial visit to study industrial practices related to the subject and submission of the visit report.
2. Study of various elements of jigs and fixtures
3. Design and drawing of two drilling / reaming jigs. (Details of at least one sheet showing manufacturing drawing with tolerances, material specification and heat treatment.)
4. Design and drawing of two milling fixtures. (Details of at least one sheet showing manufacturing drawing with tolerances, material specification and heat treatment.)
5. Design and drawing of one progressive die.
6. Design and drawing of one drawing die.

REFERENCE BOOKS

1. Tool Design, Donaldson, (TMH)
2. Tool Design, Pollock, Reston Pub. Co. Inc.
3. An Introduction to Jig & Tool Design, M.H.A. Kempster, (ELBS)
4. Fundamentals of Tool Design, Ed. Frank Wilson, ASTME (TMH)
5. Jigs and Fixture Design Manual, Henirkson (Industrial Press, NY)
6. A Text Book of Prod. Engineering, P. C. Sharma, S. Chand
7. Handbook of Die Design- Suchy, (McGraw Hill)
8. Die Design Fundamentals, J. R. Paquin, R. E. Crowley, Industrial Press Inc.
9. Jigs and Fixture, P. H. Joshi, Tata Mc-Graw Hill Pub. Co
10. Techniques of Press Working of Metals by Eary and Reed
11. CMTI Machine Tool Design Handbook, (TMH)
12. Design Data Handbook –PSG College of Tech., Coimbtore

T. E. (Production Engineering) – Semester VI

5. QUALITY MANAGEMENT

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objective

• To familiarize the student to the core concepts and the emerging trends in Quality Management.
• To develop hands-on-skills on tools and techniques of Quality Management for industrial problem-solving.

1. Introduction to quality management, historical background, contribution by quality gurus (2)

2. Quality Planning: Designing for quality, capturing voice of customer, quality function deployment, quality loss function, parameter design and optimization, tolerance design, Poka-yoke.
(9)

3. Organizing for quality: Quality line function and staff function, quality systems: ISO 9001 and TS 16949, certification requirements, introduction to ISO 14000. (3)

4. Quality Control: Stages of inspection, control of non-conforming products, sampling plans, product vs. process control, statistical quality control, variable (Xbar –R) and attribute (p, np, c and u) charts, tools of quality control.

5. Quality Improvement: Process approach, single parameter experiments, statistical inferences, analysis of means, analysis of variance-ANOVA (one-way), process capability, variance reduction, correlation analysis, linear regression models (10)

6. Introduction to Six Sigma methodology, D-M-A-I-C approach. (2)

TERM WORK

Any eight assignments using suitable software like MS-EXCEL, MINITAB, SYSTAT etc. on following topics.

1. Quality loss function
2. Parameter design and tolerance design
3. Case study of quality function deployment
4. Variables control charts
5. Attributes control charts
6. Industrial case study on quality audit
7. Process capability study
8. Single parameter experiment and statistical inferences using one-way ANOVA
9. Correlation and regression analysis

REFERENCE BOOKS

1. Armand V. Feigenbaum, Total Quality Control, McGraw Hill Inc. New York
2. J. M. Juran, F. M. Gryna, Quality Planning and Analysis, Tata McGraw Hill Publishing Co., New Delhi
3. E. Grant, R. Leavenworth, Statistical Quality Control, McGraw Hill International Book Co.
4. John Hardesky, Total Quality Management Handbook, McGraw Hill Inc.
5. D. H. Besterfield, Total Quality Management, Pearson Education
6. Logothetis, Managing for Total Quality, PHI Publication
7. Gregory Hutchins, Introduction to Quality, Maxwell McMillan International
8. Genichi Taguchi, Quality Engineering in Production Systems, McGraw Hill
9. John M. Ryan, Total Quality Control, Tata McGraw Hill Publishing Co.
10. P. F. Wilson, L.D. Dell & L.F. Anderson, Root Cause Analysis, A Tool for Total Quality Management, Tata McGraw Hill Publishing Co.
11. Montgomery D (2004). Introduction to Statistical Quality Control, 5/e, (John Wiley & Sons)
12. Ross, Phillip J. (1996) – Taguchi Techniques for Quality Engineering, 2/e. (New York, McGraw Hill)
13.Montgomery D (2001). Design and Analysis of Experiments, 5/e, (New York, John Wiley & Sons)
14. Montgomery D, Peck E, Geoffrey Vining G (2003). Introduction to Linear Regression Analysis, 3/e, (New York, John Wiley & Sons)
15. Phadke, M (1989). Quality Engineering using Robust Design, (Prentice Hall.)

T. E. (Production Engineering) – Semester VI

6. MACHINE TOOLS AND PRODUCT DESIGN

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objective

Study of procedure to design various machine tool members under different loading conditions and study of concept of product design.

Section – I

1. Introduction to Machine & Machine Tool: Types, capabilities, features of construction like working and auxiliary motions in machine tools, parameters defining the working motions of a machine tool, machine tool drives, general requirements of machine tool design, methodology for machine tools design considering quality, quantity of production and economic aspects (4)

2. Principle of Machine Tool Design from the point of view of quality, production rate, strength, rigidity, assembly, ergonomics, aesthetics, maintenance and inter-changeability (2)

3. Analysis of forces affecting machine tool elements, determination of motive power for different operating conditions. use of handbooks.
(2)

4. Kinematics of Machine Tools: Classification of various driving systems, basic considerations in the design of drives, aims of speed and feed regulations, stepped regulations of speeds, design of gear box, laws of stepped regulations, selection of range ratio, G.P. ratio, break up of speed steps, structural diagram and speed chart, design of feed box, machine tool drives using multiple speed motors, general recommendations for developing gearing diagram, determining number of teeth of gears, step less regulations of speed and feed rates. (8)

5. Design Considerations and Selection of Standard Components: Drives systems with pulleys, belts, ropes and chains; selection of oil seals, gaskets and electric motors from standard catalogues.
(3)

Section II

6. Design of Spindle & Spindle Support: Functions of spindle unit and requirements, materials and construction, spindle ends, spindle support, design calculations, mounting arrangements of spindle bearings, spindle bearing lubrication.
(3)

7. Selection of Machine Tool Bearing: Journal, rolling and hydrostatic bearings: basic principles, assembly, mounting and maintenance, procedure for selection of bearings from manufacturer's catalogue based on load and life considerations.
(4)

8. Design of Machine Tool Structures: Functions and their requirements, design criteria, materials, static and dynamic stiffness, profiles of machine tool structures, basic design procedure, design of beds, columns, housings, rams etc., causes of vibration in machine tools and methods of elimination.
(4)

9. Design of Guide ways
Functions and types of guide ways, materials, design criteria and calculations of slide ways based on wear and accuracy, design of anti-friction guide ways, hydrostatic and hydrodynamic lubrication of guide ways. (4)

10. Product Design and Development: Product design by evolution and innovation, essential factors of product design, analysis of the product, product characteristics, 3 S's-simplification, standardization and specialization, basic design considerations, functional design practice, product value, design for safety, reliability and environmental conditions, ergonomic design of controls and displays, introduction to rapid prototyping. (3)

TERM WORK:

1) Design of a gear box for speed and feed drive, Design of shafts and gears with assembly drawing.
2) Selection of bearings from manufacturer's catalogues for different given applications (Minimum four).
3) Study of different machine tools from the point of view of types of machine parts
4) Exercise on design of machine tools from ergonomics aspects suitable in India.
5) One case study on product design and development. (Report to be submitted)

RECOMMENDED BOOKS:
1. Machine Tool Design, N. K. Mehta, (TMH)
2. Machine Tool Design Handbook, C.M.T.I. Bangalore, (TMH)
3. Principles of Machine Tools, Gopal Chandra Sen and Amitabha Bhattacharayya (New Central Book Agency)
4. Design Data Handbook –PSG College of Tech., Coimbtore
5. Design of Machine Elements, Dobrovalsky
6. Design of Machine Tool, Dr. S. K. Basu (Oxford IBH)
7. Engg. Design, a Materials & Processing Approach, G. Dieter, (Tata McGraw-Hill Publishing Company Ltd.)
8. Design of Machine Elements, V. B. Bhandari, Tata McGraw-Hill Publishing Company Ltd.
9. Elements of Machine Design, N. C. Pandya and C. S. Shaha, Charotkar Publishing House
10. Design Data HandBook, K. Mahadevan and K. Balveera Reddy, C.B.S. Publishers & Distributors
11. Product Design and Manufacturing, (3/e), A. K. Chitale and R. C. Gupta, Prentice-Hall of India Pvt. Ltd.
12. Catalogues of Bearings Manufacturers e.g. SKF, NACHI, TIMKEN, NRB etc.

T. E. (Production Engineering) – Semester VI

7. WORKSHOP PRACTICE – VI

Teaching Scheme:

Practical: 2 Hrs. / Week/ Batch

Examination Scheme:

Term work: 25 Marks for the total work done under Workshop Practice V and VI

Practical Examination: 25 marks (6 Hours)

Course Objective

To train the students to plan and work on various metal cutting machines and assembly of parts.

Contents:

One composite job assembly consisting of 5 to 6 parts requiring the machining processes like Turning, drilling, threading, tapping, milling, grinding etc. carried on from Semester V under Workshop Practice-V is to be completed and assembled under Workshop Practice - VI.

Note :

1. The student shall maintain a diary of the work consisting of the process plan and work done.
2. The term work will be assessed on the basis of total work done during Workshop Practice-V and VI.
3. The practical examination shall be conducted at the end of Semester VI (duration – six hours). It will be based on the work prescribed for Workshop Practice V and VI.

T. E. (Production Engineering) – Semester VI

8. SEMINAR

Course Objective

To train the students to the techniques of compiling specific information and presenting it in front of a group.

Teaching Scheme: Examination Scheme:
Practical: 2 Hr. / Week Term work: 25 Marks

Contents:

Before the end of Semester VI, each student will deliver a seminar on a subject related to production engineering. The seminar topic should be **latest and ahead of the scope of curriculum.** The Seminar guide shall help the student in topic selection.

The student, as a part of the term work, shall submit the write-up of the seminar topic in duplicate, typed on A4 size sheet in a prescribed format and bound. The report should be compiled and edited for continuity and mere copying-and-pasting should be avoided.

The student shall present the seminar in front of the class. The performance of the student shall be judged by the seminar guide along with one more colleague appointed by the Head of Department, for awarding term work marks, on the basis of the contents, the presentation and discussions during the seminar talk.

Shivaji University, Kolhapur

Equivalences of T.E. Production for repeater students

The students from old syllabus program shall appear for the equivalent subjects, if they do not pass in the old syllabus program subject/s in the specified number of attempts.

Sr. No.	Subject in T.E.(Prod. Engg.) **Old** Syllabus	**Equivalent** subject in T.E. (Prod. Engg.) **New** Syllabus	Remarks
1	Metallurgy - I	Metallurgy - I	At T.E.(Prod. Engg.) Sem. V
2	Theory of Machines – II	Theory of Machines – II	At T.E.(Prod. Engg.) Sem. V
3	Design of Machine Elements	Design of Machine Elements	At T.E.(Prod. Engg.) Sem. V
4	Tool Engineering – I	Metal Cutting Technology	At T.E.(Prod. Engg.) Sem. V
5	Advanced Manufacturing & Forming Processes	Metal Forming & Plastics Technology	At T.E.(Prod. Engg.) Sem. V
6	Metrology	Metrology	At T.E.(Prod. Engg.) Sem. V
7	Work Shop Practice-V	Work Shop Practice-V	At T.E.(Prod. Engg.) Sem. V
8	Metallurgy - II	Metallurgy - II	At T.E.(Prod. Engg.) Sem. VI
9	Industrial Management	Industrial Management	At T.E.(Prod. Engg.) Sem. VI
10	Industrial Hydraulics & Pneumatics	Industrial Hydraulics & Pneumatics	At T.E.(Prod. Engg.) Sem. VI
11	Tool Engineering – II	Design of Jigs, Fixtures & Dies	At T.E.(Prod. Engg.) Sem. VI
12	Industrial Engineering	Advanced Industrial Engineering	**At B.E.(Prod.Engg.) Sem.VIII (New) July 2010**
13	Machine Tools & Product Design	Machine Tools & Product Design	At T.E.(Prod. Engg.) Sem. VI
14	Work Shop Practice-VI	Work Shop Practice-VI	At T.E.(Prod. Engg.) Sem. VI