FACULTY OF ENGINEERING

Syllabus for the

T. E. (Production Engineering)

(w. e. f. 2010-2011)

UNIVERSITY OF PUNE

UNIVERSITY OF PUNE
COURSE STRUCTURE FOR
TE (Production Engineering) (2008 Course)

SEMESTER- I

Subject Code	Subject	Teaching Scheme(Hrs)		Examination Scheme				
		Lecture	Pr./Dw	Theory	Tw	Oral	Pr.	Total
311081	Metrology & Mechanical Measurement	4	2	100	-	-	50	150
311082	Kinematics of Manufacturing Machines	4	2	100	50	-	-	150
311083	Material Forming	4	2	100	-	50	-	150
311084	Production Management	4	-	100	-	-	-	100
311085	Cutting Tool Engineering	4	2	100	50	-	-	150
311086	Production Practice –I	-	2	-	-	-	50	50
	Total	**20**	**10**	**500**	**100**	**50**	**100**	**750**

SEMESTER II

Subject Code	Subject	Teaching Scheme(Hrs)		Examination Scheme				
		Lecture	Pr./Dw	Theory	Tw	Oral	Pr.	Total
311087	Machine Tool Engineering	4	2	100	50	-	-	150
311088	Tool Design	4	2	100	-	50	-	150
311089	Industrial Engineering & Quality Assurance	4	-	100	-	-	-	100
311090	Numerical Techniques and Database.#	4	2	100	50	-	-	150
311091	Production Metallurgy.#	4	2	100	50	-	-	150
311092	Seminar	-	2	-	-	50	-	50
	Total	**20**	**10**	**500**	**150**	**100**	**-**	**750**

#-Common to TE (Production SW)

Th: Theory Pr: Practical Dw: Drawing Tw: Term Work Or: Oral

311081 Metrology and Mechanical Measurement

Teaching Scheme:	**Examination Scheme:**
Lectures: 4Hrs/Week	**Theory: 100 Marks**
Practical: 2 Hrs./Week	**Practical: 50 Marks**

Unit I: Introduction: Meaning of Metrology, Precision, Accuracy, Errors in Measurement, Calibration.
Linear Measurement: Standards, Line Standard, End Standard, Wavelength Standard, Classification of Standards, Precision and Non Precision Measuring instrument, Slip Gauges.
Angular Measurement: Sine bar, Sine Center, Uses of sine bars, angle gauges, Auto Collimator Angle Dekkor, Constant deviation prism. **(8)**

Unit II: Limits, Fits and Tolerances: Meaning of Limit, Fits and Tolerance, Cost - Tolerance relationship, concept of Interchangeability, Indian Standard System.
Design of limits Gauges: Types, Uses, Taylor's Principle, Design of Limit Gauges.
Inspection of Geometric parameters: Straightness, Parallelism, Concentricity, Squareness, and Circularity.
Comparators: Uses, Types, Advantages and Disadvantages of various types of Comparators. **(8)**

Unit III: Surface Finish Measurement: Surface Texture, Meaning of RMS, CLA, R_m & E methods of measurement, Tomlinson's Surface Recorder, Taylor- Hobson Surface Meter and Talysurf for measuring all characteristics of surface texture, Grades of Roughness, Specifications.
Screw Thread Metrology: External Screw Thread terminology, Floating Carriage Instruments, Pitch and flank Measurement of External Screw Thread, Application of Tool Maker's Microscope, Use of Profile Projector.
Gear Metrology: Spur Gear Parameters, Gear tooth thickness measurement: Gear tooth vernier caliper, Constant chord method, Span Micrometer, total runout od gear.
Interferometry: Introduction, Flatness testing by interferometry, NPL Flatness Interferometer.
Recent Trends in Engineering Metrology-Universal measuring machine coordinate measuring machine, laser interferometer. **(8)**

Unit IV: Mechanical Measurement; Basic concepts
Terminology, Calibration, Standards and units, Generalized block Diagrams of measuring systems, Input-output configuration of measuring systems, Standard deviation and variance.
Introduction to measuring instruments: Ammeter, Voltmeter, Wattmeter, energy meter, potential transformer and current transformer, frequency meter and megger.
Sensors & Transducers
Mechanical detector-transducers element, electrical transducers, transducer classification, transducer sensitivity, variable resistance transducer, thermoelectric transducer, variable inductance transducer, capacitive transducer, piezo electric transducer, photo electric transducer. **(8)**

Unit V: Pressure Measurement

Definition of pressure, Units, Types of pressure measurement devices, Manometers, Dead weight tester, Bourdon tube pressure gauge, Diaphragms and bellows, Low pressure measurement, The Mcleod gauge, Pirani thermal conductivity gauge, Knudsen gauge, Ionization gauge, Piezo electric transducer Selection of pressure measuring devices for specific applications , Calibration of pressure measuring devices.

Temperature Measurement

Temperature scales, Ideal gas, Temperature measuring devices, Thermometer, Bi-metallic strip, Electrical resistance thermometer, Thermostats and thermocouples, Laws of thermocouples and their applications, Construction and calibration of thermocouples, Radiation pyrometers, total radiation pyrometers .

Flow Measurements

Types of flow measuring devices, Constructional features, Obstruction meters like orifice, Venturi nozzle and their calibration, Flow measurement by drag effects (rotameter), Pitot tube, Hot wire anemometers, Magnetic flow Meters, Flow visualization Techniques, Shadowgraph, Interferometer, Laser doppler anemo-meter, Ultrasonic flow meter.

(9)

Unit VI: Miscellaneous Measurements

Basic methods of force measurements, Torque measurement on rotating shaft, Poney brake and eddy current dynamometers, Stress and strain measurements, Types of strain gauges, Electric resistance strain gauges, Wheatstone bridge, Gauge factor of strain gauge, Rosettes, Speedometer and stroboscope, Ballast circuit, Vibration measurement using accelerometer. Calibration systems, maintenance/replacement of measuring equipments. **(6)**

Experiments: (Any Eight)

1. Measurement of straightness, flatness, roundness.
2. Measurement of the Surface roughness.
3. Measurement of angle by sine bar / Sine center.
4. Measurement of Optical surface using Interferometer.
5. Measurement of Screw thread parameters using Floating Carriage Micrometer.
6. Measurement of Gear tooth thickness using Gear tooth Vernier caliper and Span Micrometer.
7. Study and Experiment on Profile Projector.
8. Study and Experiment on any type Comparator.
9. Calibration of instrument using Calibration setup.
10. Alignment Test on Lathe/ Drilling/Milling Machine
11. Calibration of thermocouple.
12. Calibration of Bourdon tube type pressure gauge.
13. Calibration of eccentric orifice meter.
14. Calibration of rotameter.
15. To find out velocity distribution.
16. Hysterisis curve for bourdon tube type pressure gauge.

Text Books:

1. K.J.Hume, “Engineering Metrology”, Kalyani publication ISBN8170290015
2. K.W.B.Sharp, “Practical Engineering Metrology”, Pitman Publication
3. F. M. Gryna, R. Chua & J. Defco, “Jurans Quality Planning and Analysis for Enterprise Quality”, McGraw Hill series. ISBN0070618488
4. Nakra, B.C. and Chaudhry, K.K., “Instrumentation, Measurements and Control”, Tata McGraw Hill, 1985 ISBN0074517910
5. Beckwith, T. G. and W.L. Buck: “Mechanical Measurements”, 2nd Edition, Addison Wesely Publishing Company, Reading, Mass, 2000 ISBN8131702073
6. D. S. Kumar, “Mechanical Measurement & Control”, Metropolitan Book Co. (P) Ltd., ISBN 81-200 0214-8.

Reference Books:

1. R.K. Jain, “Engineering Metrology”, Khanna Publication.
2. I.C.Gupta, “A Text book of Engineering Metrology”, Dhanpat Rai and Sons.
3. Kaoru Ishikawa, “Guide to Quality Control”, Asian Productivity Organisation, Series, Tokyo.

311082 - Kinematics of Manufacturing Machines

Teaching Scheme:
Lectures: 4Hrs/ Week
Practical: 2Hrs / Week

Examination Scheme:
Theory: 100 Marks
Term work: 50 Marks

Unit I

Synthesis and Analysis of mechanisms

Computer Aided Analysis and coupler curves for four bar mechanism and slider crank mechanism, dimensional synthesis of mechanisms, three position synthesis of slider crank mechanism, Over lay method, Bloch Synthesis, Least square technique.

Kinematics analysis of machine tool structure

Machine tool motion and their transmissions, Kinematic balancing equation for motion transmitting elements, Kinematic analysis of machine tool structure: gear hobbling, gear shaping, bevel gear generator. **(8)**

Unit II

Spur Gear:

Terminology, involute and cycloidal profile, path and arc of contact, interference, undercutting, worm and worm gears, bevel gears, terminology, tooth forces.

Gear Trains: simple, compound, epicyclic,torque transmitted, holding torque. **(8)**

Unit III

Turning Moment Diagram & Flywheel

Introduction, Turning Moment Diagram ,Fluctuation of speed, Fluctuation of energy, Coefficient of fluctuation of speed, Maximum fluctuation of energy, Energy stored in flywheel, flywheel & punching press. **(8)**

Unit IV: Cams and Followers

Types of cams and followers, terms used in radial cams, analysis of motion of follower, displacement, velocity, acceleration, and jerk diagrams, and determination of cam profile for various types of follower motions: uniform velocity, SHM, uniform acceleration and retardation, cycloidal motion for roller , knife edge and flat faced followers. Introduction to cams with specified contours: tangent cam, circular arc cam, and eccentric cams. **(8)**

Unit V: Balancing

a. Balancing Of Rotating Masses:

Balancing of single revolving mass by single mass rotating in same plane, balancing of single revolving mass by two masses rotating in different planes, balancing of several masses revolving in same plane, Balancing of several masses revolving in different planes, reference plane concept.

b. Balancing of Reciprocating Masses:

Primary and secondary unbalanced forces of reciprocating masses, Partial balancing of unbalanced primary force in an reciprocating engine, partial balancing of locomotives, effect of partial balancing of reciprocating parts of two cylinder locomotive – variation of tractive force, swaying couple and hammer blow, balancing of coupled locomotives,

balancing of (primary and secondary forces of multicylinder) inline engine, balancing of radial engine, static and dynamic balancing machines. **(8)**

Unit VI: Vibrations

Elements constituting vibration system, types of vibrations, free undamped vibration for single degree of freedom system, determination of equation of motion by various methods, free damped vibrations for single degree of freedom system, types of dampers, forced damped vibrations for single degree of freedom system, vibration isolation and transmissibility, vibration measuring instruments – seismic instruments and frequency measurements, critical speed of shaft carrying single rotor. **(8)**

Practical:

1. To write a computer program for analysis and animation of any mechanism and test it.
2. To draw a conjugate profile for any general shape of gear tooth.
3. Determination of holding torque in epicyclic gear train.
4. Detail design and drawing of flywheel.
5. To draw a cam profile for specific follower motion.
6. Experiment on balancing of mass.
7. Experiment on free undamped and free damped vibration of single degree of freedom system

Text Books:

1. S.S.Ratan , “Theory of Machines”, Tata McGraw Hill ISBN0070591202
2. R.S.Khurmi, J.K.Gupta , “Theory of Machine”, S Chand Co. Delhi. ISBN812192524X
3. P.L.Ballaney, “Theory of Machine”, Khanna Publisher.
4. G.C. Sen & A. Bhattacharya, “Principles of Machine Tools”.ISBN8173811555

Reference Books :

1. Thomas Bevan, “The Theory of Machines”, CBS Publication
2. J. E. Shigley and J.J.Uicker Jr., “Theory of Machines and Mechanism”, McGraw Hill ISBN019515598X
3. Dr. Jagdish Lal, “Theory of Mechanisms and Machines”, Metropolitan Book Company. ISBN8120000749.
4. John Hannah and R.C. Stephens, “Mechanics of Machine-Advanced Theory and Examples”, Edward Arnold.
5. G K Grover’, “Mechanical Vibration”, Nemchand and brothers. ISBN8185240752
6. Dr. D C Sharma, “Mechanical vibration analysis”, Khanna Publication
7. Hall A S., “Kinematics and linkage Design”, Prentice Hall

311083 Material forming

Teaching scheme:
Lectures: 4 Hrs/Week
Practical: 2 Hrs/Week

Examination scheme:
Theory: 100 Marks
Oral: 50 Marks

Unit I: Fundamentals of Material Forming
Introduction of forming processes. Strain hardening Concept of flow stress determination, Theory of plasticity, Yield criteria for ductile materials- Von mises criteria, Tresca criteria. Effect of temperature, strain rate, metallurgical microstructure, chemical composition and mechanical properties, for Classification of material forming process. Concept of Formability, formability limits s. and formability diagram. **(10)**

Unit II: Forging
Introduction, classification of forging processes. Forging equipment- Hammers, presses, furnaces etc. construction working capacities and selection of equipment. Basic forging operations such as drawing, fullering edging, blocking etc. wing Forgability tests, design of forging as a product, friction in forging. Forging defects and r the remedies. New technologies: Liquid metal forging, isothermal forging, No draft forging, P/M forging, Rotary swaging, roll forging, Lubrications in forging. **(10)**

Unit III: Wire and Tube drawing
Introduction rod and wire drawing machines - construction and working. Preparation of stock for wire drawing. Wire drawing dies, material and design. Patenting heat treatment. Variables in wire drawing, Maximum reduction in wire in one pass, forces required in drawing. Multiple drawing, work hardening, lubrication in wire drawing. Tube drawing: Methods, force calculation, stock penetration. lubrication in tube drawing **(6)**

Unit IV: Rolling of metals
Scope and importance of rolling. Types of Rolling Mills- Construction and working. Roll bite, reduction, elongation and spread. Deformation in rolling and determination forces required. Process variables, redundant deformation. Roll flattening, Roll camber - its effect on rolling process, mill spring. Defects in rolling. Automatic gauge control- Roll pass classification & design. Lubrication in rolling **(8)**

Unit V: Extrusion
Types: Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock penetration. Extrusion ratio Force equipment (with and without friction), metal flow in extrusion, defects. Role of friction and lubricants. Manufacture of seam-less tubes. **(8)**

Unit VI: Advanced metal forming processes
High velocity forming- principles, comparison of high velocity and conventional Forming processes. Explosive forming, Magnetic pulse forming, Electro hydraulic Forming.Microforming, Microcoinig, microextrusion,Microbending
Stretch forming, coining embossing, curling spinning, flow forming advantages, limitations and application of the process. **(10)**

Term work;

Term work shall consist of

1. Assignment based on each topic of syllabus
2. Study of roll pass design for two structural shapes -Round & Square.
3. A report on factory visit, comprising of product range, processes, plant layout. AuxilIary equipment, process parameters etc.

Text Books:

1. Dieter, “Mechanical Metallurgy” ISBN0071004068
2. P.N. Rao, “Manufacturing Technology”, TataMcGrawHill ISBN0070087695
3. G.W. Rowe, “Principles of industrial metal working process”, Edward Arnold ISBN8123904282.

Reference Books:

1. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co.ISBN8176190020
2. Surender Kumar, Principles of Metal Working.
3. ASM Metal hand book Vol: 4 Forming.

311084 Production Management

Teaching Scheme **Examination Scheme**
Lectures: 4 Hrs/week **Theory: 100 Marks**

Unit I: Scope of Production Management
Scope of production/operation management, relationship with other functions, history of operation management, types of production system, operation, organization, operation strategies: competing on cost, quality, flexibility, speed, productivity, efficiency & effectiveness. **(8)**

Unit II: Production Planning &Control
Need for production planning & control, preplanning functions, product design & development, product life cycle, new product development process, marketing aspects, product characteristics, production aspects, economic aspects, cross functional product design, concurrent engineering. **(8)**

Unit III: Facility Planning
Facility location, important factors affecting location decision, location theories, basic layouts, layout planning & designing for job, batch, mass production layout, hybrid layouts, computerized layout planning, design of operation line, line balancing, material handling systems, principles of material handling, types of material handling equipment. **(10)**

Unit IV: Demand Forecasting
Importance of forecasting, long term & short term forecasting techniques, forecasting errors, method planning, routing & estimating, capacity planning-strategies, analysis of machine capacity, aggregate capacity planning & manpower planning. **(6)**

Unit V: Loading & Scheduling
Concept of loading & scheduling, master production schedule, basic sequencing & scheduling techniques-Johnson method, critical ratio scheduling, uses of CPM & PERT, RAMPS (Resource Allocation & Manpower Scheduling), dispatching rules, expediting & evaluating the production plans, design of production planning & control system for intermittent & continuous production. **(8)**

Unit VI: Advanced topics in Production Management
Computerized production management system, Supply chain management, Advanced manufacturing philosophies, just in time & Lean manufacturing, world class manufacturing, Agile & reconfigurable manufacturing, green production, energy conservation & energy audit. **(8)**

Text Books:

1. Adam EE & RJ Ebert, “Production and operation management:, Prentice Hall Englewood Cliff, N.J. ISBN8120308387.
2. Riggs. J. L., “Production system, planning, analysis and control”, John Weily and sons, New York.ISBN0471858889.
3. James Dilworth, “Production and operation management”, McGraw Hill Book Company, New York.
4. Martand Telsang, “Industrial Engineering and Production Management”, S Chand & Co, New Delhi.ISBN8121917735
5. Prasanna Chandra, “Project Planning Analysis Selection Implementation and Review”.ISBN0074620495.

Reference Books:

1. Buffa. E.S., “Modern production and Operation Management”, Willey, New Delhi.ISBN9971511630.
2. Barry Shore, “Operation Management”, McGraw Hill Book Company, New York.
3. Samuel Eilon, “Production planning and control”.ISBN8185027099.
4. Joseph Monks, “Operation Management Theory and Problems”, McGraw Hill Book Company, New York.ISBN007100579X.
5. Koontz & Weihrich, “Essentials of Management by”, TMH. ISBN007062030X.
6. F. L. Francis, J. A. White, L. F. McGinnis, “Facilities Layout and Location”, Prentice Hall of India Pvt. Ltd., ISBN 81-203-1460-3. 8120314603.
7. Richard Muther, “Systematic Layout Planning
8. Paneerselvam R., “Production and Operations Management”, Prentice Hall India 2005.

311085 Cutting Tool Engineering

Teaching scheme:
Theory : 4 Hrs/W eek
Practical: 2 Hrs/Week

Examination scheme:
Paper: 100 Marks
Term Work : 50 Marks

Unit I: Theory of metal cutting
Cutting tools, tool geometry, concept of speed, feed, depth of cut & cutting action & effect of these on cutting forces, types of chips, Merchant circle of forces. Estimation of cutting forces. Empirical relations. Tool force dynamometers. Measurement of cutting forces and power required in turning, drilling & milling. **(10)**

Unit II: Cutting tool standards and materials
Tool signature ORS & ASA methods, tool standards: Single point cutting tool, drills, broach, reamer, milling cutters. Cutting tool materials, heat treatment of tools. Non-conventional tool geometry: Koleshov tool, Advance tool materials, coating on tool, throwaway inserts. **(6)**

Unit III: Heat generation, tool life & Economic of cutting tools
Heat generation in cutting, cutting fluid, tool wear, Tool life equation of Taylor. Factors affecting tool life, Machinability and its rating, criteria for Machinability. Economics of machining. Criteria for minimum cost & maximum production. **(8)**

UNIT IV: Design of cutting tools
Single point cutting tool, Form tool: design of circular & tangential form tools, drills, reamers, milling cutters and Broaches. Manufacturing of Cutting tools.

(8)

Unit V: Fundamentals of Jigs and fixtures
Significance and purpose of jigs and fixtures and their functions in manufacturing processes. Classifications of jigs and fixtures. Designs features of main elements of Jigs and fixtures such as locating, clamping and guiding elements and their integrations. Indexing, locking and auxiliary elements. Bodies and bases or frames of Jigs and fixtures. Economics of Jigs and fixtures, Pneumatics & Hydraulics for jig & fixtures. **(6)**

Unit VI: Design of jigs & fixtures
General guidelines & procedures for design of Jigs and fixtures. Design & selection of standard elements, Analysis of number of clamping forces required & their magnitude, concept of modular fixtures & tool presetting fixtures. **(8)**

List of Experiments:
1. Experiments on chip formation.
2. Verification of Metal cutting Theories.
3. Measurement of cutting forces (anyone) in Turning / Milling / Drilling.
4. Effect of tool geometry, cutting speed, feed, depth of cut on cutting parameters.
5. Design and working drawing of any three of following cutting tools:
6. Single point tools, Form tool, Reamer, Milling cutter, Broaches, Drills.
7. Design and Working drawing of one jig. (Drilling, Reaming, Tapping)
8. Design and Working drawing of one fixture. (Turning, Milling, Broaching)

Text Books:

1. Wilson, “Fundamentals of tool design”, A.S.T.M.E.
2. M.H.A. Kempster, “Introduction to Jigs and fixtures design”.ISBN8185617856.
3. Dolyle, “Manufacturing processes and material for engineers”.
4. G. Kuppuswamy, “Principles of metal cutting”, university press, ISBN 81 73710287.
5. Basu, Mukherjee and Mishra, “Fundamentals of tool Engineering and Design”, Oxford and ffiH publishing. ISBN812040016X.

Reference Books:

1. P C Sharma, “Production Engg”. , Khanna publishers. ISBN8121904218.
2. P.C. Sharma, “Machine tools & Tool Design”. ISBN812192362X.
3. Richard Kibbe, John E.Neely, Meyer, White, “Machine tool practices”. ISBN8120315006.
4. Dolalson, Lecain and Goold, “Tool design”, Tata McGrawhill.ISBN0070992746.
5. Hoffman, “Introduction to Jigs and fixtures”.
6. “Tool Engineering Handbook”, A.S.T.M.E.
7. R. K. Jain, “Production Technology”, Khanna Publishers.ISBN8174090991
8. Milton Shaw, “Metal cutting principle”
9. P .H. Joshi, “Jigs & Fixtures”. ISBN0074601695.
10. Surender Kumar, “Production Engineering Design”

311086 Production Practice-1

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
Practical: 50 Marks

Each candidate shall be required to complete and submit the following term work.
Composite job involving different machining operations.

Part A:-

1. **Lathe:** external and internal threading (Vee, Square or Acme threads), taper turning, grooving, knurling, drilling operations on lathe.
2. **Milling**: helical or bevel gear cutting on a milling machine.

Part B:- Journal consisting of :

1. Preparation of journal consisting of calculation and procedure for above gear cutting on milling machine.
2. Safety aspects used in the machine shop:- Precautions and care to be taken while working on various machine tools e.g. lathe, milling, drilling, grinding etc.

Note: - A practical examination of 12 hours duration shall be conducted at the end of semester based on the part A

311087 Machine Tool Engineering

Teaching Scheme: -
Theory: 4 hrs /week
Practical: 2 Hrs/Week

Examination Scheme: -
Paper: 100 Marks
Term Work-50 Marks

Unit I: **Automats**
Automation Concepts, Automatic and Semiautomatic Machine Tools and their Classification, Turret and Capstan Lathes. Single Spindle and Multi-spindle Automats, setup of automatics and semiautomatics. Tooling Layout and Operation Sheet, Cam Tool Layout for Single spindle automat. Concepts of Transfer Machines/Lines. **(8)**

Unit II: NC/CNC/DNC Machining
NC/CNC Machining: Introduction to NC,CNC,DNC Machines, Comparison between NC and Conventional Machine Tools, Basic Principles of NC Machines, its Advantages, Tooling Requirements, Introduction to Turning and Machining Center. **(8)**

Unit III: Material Handling Systems
Material Handling: Objectives, engineering & economic considerations, principles of material handling, selection & classification of material handling equipments.
Automated Guided Vehicles (AGV), Principle of its Working, Types of AGV's, its Control, its capabilities
Automatic Storage and Retrieval System (ASRS) Interfacing of Advanced Material Handling Equipment with Manufacturing Equipment. Use of Advance Technology for Material Handling Equipment like Vision System, Adaptive Control System, etc.
(8)

Unit IV: Non-conventional machining process
Detail study with respect to principle process parameter, theoretical analysis, experimental results and comparative assessment of abrasive jet machining, Ultrasonic machining, Chemical machining, Electrochemical machining, Electro discharge machining, Electron beam machining, laser beam machining, Plasma arc machining, Ion Beam machining, wire cut EDM. **(8)**

Unit V: Control & Reliability of machine Tool
Machine Tool Operator's Control Systems: Need of Standardization, Classification, Controls in Conventional and NC/CNC Machines, Adaptive Control.
Machine Tool Installation and Maintenance, Selection of Machine Specification, Chip Disposal Systems, Recovery of Material from Disposal. Cutting Tool Manufacturing Machines, Cutting Oil/Coolant Type and Selection.
Control in conventional and NC CNC machines, installations and maintenance of machine tool ,reliability of machine tool and its components, analysis of reliability, availability and maintainability **(8)**

Unit VI: Special manufacturing Processes

Different methods of Gear manufacture – Gear hobbing and gear shaping machines - specifications – gear generation – different methods – gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching. **(8)**

Term Work:

Term work shall consist of

1. Assignments based on each topic of the syllabus.
2. A industrial visit to any gear manufacturing/automation industry and report based on it.

Text Books:

1. HMT, “Production Technology”
2. Chapman; “Workshop Technology”, Edward Arnold Publishers,ISBN 0 7131 3287 6
3. P. N. Rao, “Manufacturing Technology, Foundry, Forming and Welding”, Tata McGraw Hill, ISBN 0 07 451863 1.
4. K.K AHUJA - “Production and Operations Management ", Prentice Hall of India, 1995.
5. Allegri Theodore, “Material Handling Principles and practice” (CBS Publisher Delhi)

Reference Books: -

1. Degarmo, Black and Kohser; “Material and Processes in Manufacturing”, Prentice Hall of India LTD,Delhi.
2. PC Sharma; “Production Technology” (Manufacturing Processes),S Chand & Co.,ISBN 81 219 114 1 .
3. Roy Lindberg; “Processes and Materials of Manufacture”, Prentice Hall of India.
4. Kalpak Jain S, “Manufacturing Engineering and Technology”, Pearson Education.
5. Pabla Adithan, “CNC Machines”, New age International Pub,ISBN 81 7808 157 1
6. Kundra B S,P N Rao,M Tiwari; “Numerical Control and Computer Aided Manufacturing “TATA McGraw Hill Pub. ISBN 0 07 451740 6.
7. Mikell P. Groover; “Automation, Production Systems and Computer Integrated Manufacturing” ,Prentice Hall of India LTD,Delhi,ISBN 81 203 0618 X
8. G C Sen. and A.Bhattacharya,“Principles Of Machine Tools”, New Central Book Agency Pvt LTD,Calcutta,ISBN 81 7381 155 5.
9. PH Joshi, “Cutting Tools”, Press Tool Design & Constuction, Wheeler Pub., ISBN 81 85814 465.
10. Pande Shan; “Modern Machining Processes”.
11. Ghosh Amitabh,A. Malik; “Manufacturing Science”,East-West Press Pvt LTD,ISBN 81 85095 85 X.
12. Surenderkumar and Umeshchandra; “Production Engineering Design”
13. P.N.Rao, “CAD/CAM/CIM Principles”, Tata McGraw Hill Publication, ISBN 0 07 058373 0.
14. RadhaKrishanan P., Subramayan S., “CAD/CAM/CIM” ,New Age International Pub.Delhi,ISBN 81 224 1248 3.
15. D. E. Mulcahy, “Material Handling Handbook”, McGraw-Hill

311088 Tool Design

Teaching scheme:
Theory: 4 Hrs/W eek
Practical: 2 Hrs./ Week

Examination scheme:
Paper: 100 Marks (4 Hrs)
Oral: 50 Marks

Unit I: Introduction to press working:
Press working terminology, Basic operations, types of presses- mechanical, hydraulic, pneumatic and their mechanisms, elements of die sets, types of die sets, types of dies simple, compound, progressive, combination and inverted dies, types of punches, Methods of reduction of shear force, types of strip layouts, types of strippers, types of pilots, types of stoppers, selection of dowel pins and allen screws. Design of blanking die. **(8)**

Unit II: Design of Drawing and Bending Dies
Design of shallow and deep drawing die calculation of blank size by area and graphical method and standard formula, evaluate percentage reduction in each stage ,number of draws, drawing force, blank holding force, press capacity, ironing force. Types of Bending dies, developed length calculation, bending force, spring back & methods used to overcome it in a press brake. **(8)**

Unit III: A) Design of Progressive, compound and combination dies
Calculation of force, press capacity, clearances, die and punch size, center of pressure, strip layout, percent utilization. Design and drawing of die.
B) Die castings dies: Die casting machines-Hot & cold chamber, metals for die casting, die locking methods, interlocks & safety devices, specific details of die constructions, casting ejection, cores, slides, loose die pieces, types of cores, directional solidification, types of feeders, die venting, water cooling, classification of dies- single, combination, multi-impression. General details of die design, inserted impressions, die casting defects & their remedies, die lubrication- types & methods **(10)**

Unit IV: Design of Forging Dies
Design of forging die for multi-impression die-: selection of parting line, drafts, fillet & comer radii, ribs and webs, stock size calculation, flash and gutter, design of fullering, edging, blocking, finishing impressions, trimming dies, Die block dimensions, die inserts. Rules for upset forging. **(8)**

Unit V: Plastics processing
Compression, transfer, injection, extrusion, blow & rotational moldings Thermoforming. General construction of injection moulds, types of nozzles splits, side cores & side cavities, molding internal undercuts. **(6)**

Unit VI: Design of Injection mould
Determination of number of cavities, types of cooling system, design of cooling channels, heat transfer considerations, types of ejectors, determination of mould opening force & ejection force, types of runners & gates, design of runners & gates, use of CAD for mould design. **(8)**

Term Work (Any four of the following)

1. Design and drawing of Progressive die.
2. Design and drawing of die.
3. Design and drawing of Forging die.
4. Design & Drawing of Blanking die.
5. Design and drawing of single cavity injection mould.

(All drawings on A2 size drawing sheet)

Text Books:

1. Donaldson, Lecain and Goold, “Tool Design”, Tata McGraw Hill, ISBN 0 07 099274 6.
2. J R Paquin, “Die design Fundamentals”, Industrial Press Inc., ISBN 0 8311 1172 0.
3. Doehler H.H, .”Die Casting”, McGraw Hill
4. P.N. Rao, “Manufacturing Technology,Foundry,Forming and Welding ”, TataMcGrawHill,ISBN 0 07 451863 1.

Reference Books:

1. P.H. Joshi, “Press Tools Design & Consturction”, Wheeler Pub.,ISBN 81 85814 46 5.
2. P.C.Sharma, “Production Engineering”, S. Chand,ISBN 81 219 0421 8.
3. Dr. Surender Kumar, “Production Engg.Design” (Tool Design), Satya Prakashan
4. R.G. W. Pye, “Injection Mould Design(Design manual for plastic industry)”, EWP
5. A.S. Athalye, “Plastics Materials handbook”, Multitech Pub. Co., ISBN 81 7671 007 5.

311089: Industrial Engineering and Quality Assurance

Teaching Scheme **Examination Scheme**
Lectures-4 Hours/Week **Theory -100 Marks**

Unit I: Industrial Engineering: History, Development, Definition, Functions & Applications of Industrial Engineering**.** Tools and techniques of industrial engineering Contribution of F.W.Taylor, Gilberth, Gantt and Maynard to the field of Industrial Engineering.

Productivity Engineering

Productivity: factor productivity, total productivity; labor Productivity, measurement of productivity, improvement techniques of productivity. Development and implementation of Productivity improvement programme. Work content: Basic work content, added work content, ineffective time due to short comings of management. **(8)**

Unit II: Method Study

Steps, Tools and Techniques used in the Method Study, outline process Chart Flow process Chart, Symbols, Flow Diagrams, Two Handed Chart, String diagram Multiple Activity Chart, 5W and 1 H, Use of Motion Pictures and its analysis. SIMO chart, cyclegraph Chronocylegraph. Developing, Presentation, Installation & Maintenance of new Methods.Principles of motion economy. **(8)**

Unit III: Work Measurement

Time Study: Aim & Objectives, Terminology & Tools, Use of stopwatch procedure in making Time Study. Time Study Forms, Performance rating, allowances and its types. Calculation of Standard Time. Time Study for indirect functions such as Maintenance and Marketing. Criticism of Time Study.

Work Sampling: Definition, Objectives. Theory of Work samplings, Confidence level, Sample Size, Determination of Standard time using work Sampling, Other application of Work Sampling, Errors in Work Sampling study.

Synthetic & Standard data Methods: Concepts, Introduction to PMTS, MTM1, WFS, and Basic Motion Time Study. MTM2 & Other second Generation Methods, MOST**. (8)**

Unit IV:

Introduction to Quality Control

Meaning of Quality, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, Difference between Inspection, Quality Control and Quality Assurance, Role of Quality in Present day environment. Introduction to Quality Control: Statistics in Selective inspection. Introduction to Statistical Quality Control: Control Charts, X, R, P and C Charts, Sampling inspection, OC Curves and Sampling Plan, Process Capability Index (PCI), Concept, Methods of determining PCI and uses of PCI. **(8)**

Unit V:

Quality Assurance systems

Total quality management (T.Q.M):- Approaches- Deming's Approach, Juran's Approach, Cause and Effect Diagram, Pareto Analysis, Q.F.D., Quality Circles, Taguchi's quality engineering, Kaizen, six sigma, T.P.M. Technical Specification (T.S) TS 16949 Standards.

Reliability Engineering: - Concept, Design of experiment: meaning, objective, types of research, approaches. **(8)**

Unit VI:

ISO Standards

ISO 9001-2000 Series of Standards- History and Evolution of ISO 9000 Series, importance and overview of ISO 9000- 1998 Series standards, structure of ISO 9000-2000 Series standards, clauses of ISO 9000 series standards and their interpretation and implementation, quality system documentation and audit.

ISO 14000:- Environmental management concepts, and requirement of ISO 14001, benefit of Environmental Management Systems, Malcom Baldrige national quality award and other quality awards. **(8)**

Text Books:

1. M. Telsang, "Industrial Engineering and Production Management", S. Chand Publication,ISBN 81 219 1773 5.
2. L.C. Jhamb, "Industrial Engineering", Everest Publication,Pune
3. F. M. Gryna, R. Chua & J. Defco, "Juran's Quality Planning and Analysis for Enterprise Quality", McGraw Hill Pub.Co.LTD, New Delhi, ISBN 0 07 06 1848 8.
4. R. M. Brans, "Motion & Time study design & measurement of work", John Wiley & Sons Inc.NY 7th edition,ISBN 0 471 08335 6.
5. O. P. Khanna, "Work Study", Dhanpat Rai Publications,New Delhi.
6. M. Mahajan, "Statistical Quality Control", Dhanpat Rai & Company.

Reference Books:

1. H. B. Maynard and others, "Industrial Engineering Handbook", IVth edition - McGraw Hill Publications, ISBN 0-07-041084-4.
2. "Introduction toWork Study", ILO Universal Pub. Co,B'bay,ISBN 81 85027 06 4
3. Juran J M "Quality Control Handbook", Tata McGraw Hill,ISBN 0 07 033175 8.
4. E.L.Grant & R.S. Leavenworth, "Statistical Quality Control", Tata McGraw Hill,ISBN 0 07 024162 7.
5. Kaoru Ishikawa, "Guide to Quality Control", Asian Productivity Organization, Tokyo.
6. Singh A N , "ISO 9000 Quality System",Dolphin Books,Delhi.
7. "ISO 9000 Quality Management System", International Trade Center, Geneva.

311090: Numerical Techniques and Database

Teaching scheme: **Examination Scheme:**
Lectures :04 Hrs/Week . **Paper: 100 Marks.**
Practical: 02 Hrs/Week. **Term Work: 50 Marks.**

Unit I: **Introduction to Databases**
Introduction, Organization & component of database management system(DBMS), data models, entity relationship model, advantages & disadvantages in database processing, hierarchical & network databases.
Introduction to oracle, SQL, Database creation, database retrieval, use of compound conditions like AND, OR, Joining and updating tables. **(8)**

Unit II: Database Management:
Database design- dependencies and normalization(1^{rst} & 2^{nd} order), database storage and querying, aggregate functions. – Group by, having order by, sub-queries and various SQL operators. **(6)**

Unit III: Information technology for competitive Advantages
Introduction to information technology, Inter-organizational and global information systems, Electronic Data Interchange(EDI) and Electronic Fund Transfer(EFT).
Functional and Enterprise system- Production & operation systems, human resource management systems, marketing and sales systems, human resource management systems, marketing and sales systems.
Intelligent systems in Business- Artificial intelligence and intelligent systems, expert systems, intelligent agents.
Electronic Commerce(E-Commerce)- foundations, business-to-consumer and business-to-business applications. **(8)**

Unit IV: Numerical methods-I
Revision of 'C' syntax. Errors & approximations: types of errors, error propagation.
Numerical solution of algebraic and transcendental equations by bisection method, Newton-Raphson Method.
Numerical solution of Linear Simultaneous Equations by Gauss Elimination Method, Gauss-Siedel Method, methods of moments of curve fitting. **(8)**

Unit V: Numerical methods -II
Curve Fitting: Least square criterion- 1^{rst} and 2^{nd} order
Interpolation: Lagrange's formula, Newton forward difference method. **(8)**

Unit VI: Numerical methods -III
Manufacturing Optimization- Method of Lagrange multipliers, Generalised reduced gradient Method. Ordinary Differential Equations.- Runge-Kutta Method. Partial Differential Equations -Finite difference method **(8)**

Term Work:
1. A database related language such as Oracle/VB/V FoxPro should be covered.
2. Creation of database using SQL.
3. Addition/Deletion Modification of existing Database using VB/FoxPro.

4. Creation of Database format for Purchase/Manufacturing/Logistics and its report generation.
5. Solution of Algebraic/ Transcendental Equation using C
6. Solution of Linear simultaneous equations using C.
7. Solution of Curve Fitting using C.
8. Solution of Numerical Interpolation using C.
9. Study on any two of the following:
   a)Inter-organizational and global information systems
   b)Functional and enterprise system
   c)Intelligent systems in Business.
   d)electronic Commerce(E-Commerce).

Text Books:

1. Silberschatz, Korth H F, Sudarshan, "Database System Concepts", McGraw Hill Intl., 4th Edition, 2002, ISBN 0 07 100529 3.
2. A.M. Muzumdar and P. Bhattacharya, "Database management System", Tata McGraw Hill Publication, New Delhi,ISBN 0 07 462 239 0.
3. Turban, Rainer & Potter-John, "Introduction to Information Technology", Wiley & Sons, 2000,ISBN 81 265 0968 6.

Reference Books:

1. Rajashekhar Sundarraman, "Oracle91 Programming:Primer",APearson Education, 2004,ISBN 81 297 0362 9.
2. Dr. Sadhu Singh, "Computer aided Design and Manufacturing", Khanna Publication, New Delhi.
3. Y. Kanetkar, "Let Us C", BPB Publications, 4th revised edition 2002,ISBN 81 7656 621 7.
4. B.S. Gottfried, "Programming with C", McGraw Hill Intl., Schaum's Outline Series, ISBN 0 007 100621 4.
5. S.C. Chapra, R.P. Canale, "Numerical Methods for engineers with programming and software applications", Tata McGraw Hill Co.Ltd,New Delhi,ISBN 0 07 115895 2.

311091 Production Metallurgy

Teaching Scheme:
Lectures: 4Hrs / Week
Practicals: 2Hrs / Week

Examination Scheme:
Theory: 100 Marks
Term work: 50 Marks

Unit I: Steels
Introduction to Metallography, micro and macro examination, metallurgical microscope, etching.
Steels: iron-iron carbide equilibrium diagram, Critical temperatures, Allotropy, cooling curve and volume changes of pure iron. Microstructure, non-equilibrium cooling of steel, widmanstatten structure, structure property relationship. Classification and applications of steels, specifications of some commonly used steels like BIS, EN, AISI, SAE. **(8)**

Unit II: Heat treatment of Steels
Introduction to heat treatment furnaces and Furnace atmospheres, Transformation products of austenite, Time-temperature- transformation diagrams, Critical cooling rate, Continuous cooling transformation diagrams. Heat treatment of steels Quenching media, Annealing" Normalizing" Hardening" Retention of austenite" Effects of retained austenite" Elimination of retained austenite, Tempering" Secondary hardening, Temper embrittlement, Quench cracks, Hardenability testing" Defects due to heat treatment and remedial measure. **(8)**

Unit III: Surface Hardening & Isothermal Treatments
Carburising, heat treatment after carburising, Nitriding, Carbonitriding, Flame hardening and Induction hardening. Commercial heat treatment practice of gears of different sizes, tools, springs. Isothermal heat treatments such as austempering, patenting, isoforming, martempering,ausforrning. **(8)**

Unit IV: Alloy Steels & Cast Iron
Alloy Steels - Effects of alloying elements, classification of alloying elements. Stainless Steels, Sensitization of stainless steel, weld decay of stainless steel. Tool steels and tool materials, Heat treatment of high-speed steel. Special purpose steels with applications.
Cast irons- Classification, Gray cast iron, White cast iron, Malleable cast iron" Ductile Iron, Chilled and alloy cast irons. Effects of various parameters on structures and properties of cast irons, Heat treatments of cast iron. Applications of cast irons for different components of machine tool, automobiles, pumps etc. **(8)**

Unit V: Non-Ferrous Alloys
Copper alloys - Brasses, Bronzes-: Tin, Aluminium, Beryllium, Silicon Copper nickel alloys, Nickel - Silver, Aluminium and aluminium alloys. Solders, Bearing materials and their applications, Precipitation hardening alloys. High Temperature materials such as Nimonics, Super alloys, Ti-alloys etc. **(8)**

Unit VI: Modern Engineering Materials
Composites- Types, Characterization, Production techniques & applications. Metal - Matrix composites, Particulate & Fiber composites. Biomaterials, Nano materials, Sports materials. **(10)**

List of Experiments (Any eight)

1. Study and drawing of microstructures of mild steel, medium carbon steel, eutectoid steel and hypereutectoid steel.
2. Study and drawing of microstructures of white, malleable, grey and nodular cast iron.
3. Study and drawing of microstructures of alpha brass, alpha-beta brass, aluminum bronze, tin bronze and bearing metal.
4. Study and drawing of microstructures of hardened steel, tempered steel.
5. Hardening of steel- study of effect of carbon on hardness of hardened steel.
6. Tempering of steels - study of effect of temperature on hardness of tempered steel.
7. Study of change in microstructure on annealing and normalizing of tempered steel.
8. Sulphur print test on a steel specimen & flow lines examination of a forged component.
9. Jominy Hardenability test on a steel sample.
10. Testing of Composite materials (Like Hardness, Impact, Tension etc.)

Text-books:

1. Kodgire V. D., "Material science and metallurgy for Engineers", Everest Publishing House, Pune,ISBN 81 86314 00 8.
2. K. G. Bundinski , M. K. Bundinski , “Engineering Materials” Prentice Hall of India Pvt. Ltd., New- Delhi.
3. Higgins "Engineering Metallurgy", Part I Applied Physical Met~llurgy, English Language book Society / Edward Arnold.
4. Smith W. F., “Principles of Material Science and Engineering", McGraw- Hill Inc. Book Co.,ISBN 0 07 122920 5.

Reference Books:

1. Rollason E. C., "Metallurgy for Engineering", ELBS Publishing.
2. Clark D.S.and Vamey W. R. "Physical Metallurgy for Engineers", East-West Press Pvt. Ltd., New Delhi.
3. Avner, *"An* introduction to physical metallurgy", TMH publication.
4. Donald R. Askeland & Pradeep Phule. ,” The science and engineering of materials”, Thomson Asia Pvt.LTD, ISBN 981 243 855 6.

311092 Seminar

Teaching Scheme **Examination Scheme**
Practical: 02 Hrs/Week **Oral: 50 Marks**

a). The objective of Seminar is to test the student on his/her ability for self-study and his/her ability to communicate - Written and oral.

b). Seminar will be in the form of a report submitted by the student:

It will be -

1. Done by a student individually, on topic of his/her choice based on literature survey/ a case study wherever applicable/possible, and approved by the staff- in- charge,
2. A report with 15-20 pages of A-4 size paper, 1.5 spaced typed material, and appropriately bound.
3. Title font/figures/graphs shall be black and white.

c) The Oral examination will be based on the report submitted and (orally) presented.

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