

# Process Engineering and Tooling

T.E. Sem. VI [PROD]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	4 Hrs.	100
Practical Exam	–	–
Oral Exam	–	25
Term Work	–	25

## SYLLABUS

### 1. Product Engineering and Process Engineering

Definitions, Factors to be considered while developing the product, product development principles, functions of product engineering department, interaction of product engineering with process engineering. Role of process engineering department in manufacturing organization, organization chart, functions of process engineering department.

### 2. Preliminary Part Print Analysis and Work Piece Control

General characteristics, determining the principal processes, alternate processes, functional surfaces of the work piece, areas for processing, nature of work to be performed, finishing and identifying operations, process picture and its applications and uses, case study for understanding preliminary part print analysis; **Work piece control** : Variables affecting manufacturing process, need for work piece control, work piece control techniques, importance of geometric, dimensional and mechanical control, case studies for explaining work piece control

### 3. Tolerance Design

Rules for adding and subtracting tolerance, tolerance stacks, design and process tolerance stacks, tolerance chart, purpose and use of tolerance chart, definitions and symbols, determining lay-out of tolerance chart, stock removal, constructing and balancing of tolerance chart, geometric dimensioning and tolerancing (GD & T)

### 4. Classifying operations, selection of equipment, process pictures, product and process critical area, selection of equipment, operation planning, operation routing, tool layout for turning and other operations for production Lathe, case studies for detailed process planning with details of sequence of operations, machine or equipment used, machining parameters i.e. cutting speed, feed, depth of cut, tooling and gauge details, cutting tools specifications and gauge details machining time calculations along with process pictures.

### 5. Traub single spindle automat and its tooling, tool layout and cam design for parts production on Traub.

### 6. Discussion of high speed production machines, SPM, transfer line and other mass production machines – Preliminary treatment only, in-process gauging and multiple gauging, Discussion of production on CNC machines.

Computer aided process planning (CAPP), Explanation of CAPP with suitable example.  
(Basic Treatment only)

**Reference:**

1. Process Engineering for Manufacturing (*Donald F. Eary and Gerald E. Johnson*) Prentice-Hall, Inc.
2. Production Technology (*HMT*)
3. Manufacturing Engineering (*V. Danilevsky*) Mir publication, 1973.
4. Tolerance Design and Analysis (*Wade*)
5. Principle of Control Systems (*S.C.Goyal and U.A.Bakshi*) Technical Publications, 2006.
6. Fundamentals of Manufacturing Engineering (*V.M. Kovan et al*) Mir Publications, 1979.
7. HSS and Carbide Tool Catalogues for Turning, Drilling, Milling, Boring etc. from Tool Manufactures.
8. Westerman Tables for the Metal Trade (*Wiley*) Eastern Limited, 1991
9. PMT Catalogue for Traub.



# Design of Press Tools and Metal Joining

T.E. Sem. VI [PROD]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	4 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	25
<b>Term Work</b>	–	25

## SYLLABUS

### 1. Shearing of Sheet Metal

Common Press tool operations, Theory of shear action in metal cutting, clearance, cutting force, stripping force and energy requirement with and without shear on press tools, strip layout for blanking; design of piercing die, blanking die, design and selection of die sets, design of strippers, methods of fixing punches, location stock stops, Fine blanking, shaving, trimming and compound die (basic treatment only)

### 2. Forming of Sheet Metal

Sheet metal forming operations (drawing and bending only), metal flow in forming operations; reduction factors and redrawing limits, draw clearances, drawing and blank holding pressures for cylindrical draws only, draw punch and die radii, defects in drawn as well as bent parts, drawing test, presses for drawing / bending, bend radius, development of blank for above operations, spring back, bending and bottoming forces, Ironing, Bending dies and press brake.

### 3. Progressive Dies for Sheet Metal Parts

Selection progressive dies, stock guides, stock lifters, strippers, pilots, basic types, bridges and carriers, strip layout and development for progressive die, development of die around the strip design, splitting the die block for manufacture basic layout practice, design of various simple progressive dies.

### 4. Equipment for sheet Metal Operations : (preliminary treatment only)

Types of presses, overloading of presses (load, torque and energy considerations)

### 5. Gas and Arc welding, Resistance and radiation welding, Solid state and Thermochemical welding, Soldering and brazing processes.

### 6. Types of Joints

Mechanical and fabricated joints, joint preparations, thermal cutting, basic requirements and setups for joining processes. Weldability, thermal stresses, inspection and testing of welds. Safety in Welding.

### Reference:

1. Fundamentals of Tool Design-ASTME
2. Tool Design-Donaldson
3. Press Working-ary and Reed
4. Press Tools-PaQuin
5. Press Tools-Osterguard
6. Chipless Machining-C.H.WICK
7. Tool Engineers Hand Book-ASTME
8. Hand Book of Press Tools-ASTME
9. Welding Technology-O P Khanna
10. Metals Handbook-ASM



# Operations Research

T.E. Sem. VI [PROD]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	3 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	–
<b>Term Work</b>	–	25

## SYLLABUS

1. Linear Programming, Formulation of problems and graphical solutions, characteristics of solutions, Simplex method, Significance of simplex tableau, Big–M method, Two–phase method, Types of solutions such as feasible/infeasible, generate/degenerate, optimal/suboptimal, unique / alternate / infinite optimal, bounded/unbounded: their interpretations from simplex table, Duality, dual problem formulation, sensitivity analysis for variation of one parameter at a time.  
Assignment, Transportation, Network models: Minimum spanning tree problem.
2. **Dynamic Programming Models**  
Bellman’s optimality Principle functional equation, backward and forward recursions stages.
3. **Game Theory or Competitive Strategies**  
Limited to two person zero sum games, pure and mixed strategies, graphical methods.
4. **Queuing Systems, Queuing Models**  
Poisson–exponential single server model with infinite and finite population.
5. **Simulation Models**  
Monte Carlo or experimenting method based on probabilistic behaviour data and random numbers, application in probabilistic real life problems.
6. **Project Management**  
Programme evaluation and review technique, critical path method, Crashing of Network, Resource Leveling

### Reference:

1. Operations Research-An introduction Hamdy A Taha Macmillan.
2. Operations Research (*Hira and Gupta*)
3. Quantitative Techniques in Management (*N.D.Vora*) TMH New Delhi.
4. Operations Research (*SD Sharma*) Kedar Nath Romnath & Co. Meerut
5. Introduction to Operations Research (*Billy E.Gillet*) TMH
6. Principles of Operations Research (*Harvey M, Wagner*) Prentice Hall
7. Introduction to Operation Research (*Hillier and Lieberman*) McGraw Hill
8. Operation Research (*Gupta and Kanti Swaroop*) S.Chand



# Mould and Metal Forming Technology

T.E. Sem. VI [PROD]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	4 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	25
<b>Term Work</b>	–	25

## SYLLABUS

### 1. Introduction to Casting Metallurgy

Solidification of metals: Freezing of pure metals and alloys; Casting of Iron-based alloys: Role of C, Si and other alloying elements in solidification; Melting practices: Cupola, Arc and Induction furnaces.

### 2. Mould Design and Forming for Casting Metals

Mould materials: Moulding sand; Constituents of moulding sand and its property requirements; Testing of moulding sand – Grain fineness number, Compression strength and permeability. Design and manufacture of Patterns and Cores: Pattern allowances, Types of patterns, Core print, pattern design and manufacture, Core making. Design and manufacturing of gating system: Pouring basin, Sprue, Runners and Ingates. Design and manufacture of feeding system: Caines' equation, Chvorinov's mould constant, Use of chills and padding, risering. Defects in cast components.

### 3. Special Casting Process & Mould Forming for Polymeric Materials

Die design and manufacture for pressure-casting of non-ferrous metals, Principle of Gravity-Hot chamber-and Cold chamber die casting processes, Design and manufacture of die-casting dies and tools for Cold chamber die Casting, Advancements in die casting processes-Squeeze casting, Thixo-casting and Rheo-casting processes; Defects in die cast components. Lost Wax Process and Mould Forming for polymeric materials, Investment Casting : Use of wax as the moulding material; Process description; Features and advantages; Fields of application; Rapid Prototyping for Investment Casting, Injection Mould: Stages in moulding process; Moulding cycle; Layout of injection mould including gating system.

### 4. Introduction to Plastic Forming of Metals

**Tension Test** : True Stress-True Strain, Yield Strength, Hollomon's Equation, Strain Rate, Strain Hardening, Recrystallization, Effect of Friction, Effect of temperature; Compression Test; Problem solving. Von Mises and Tresca's Yield Criteria; Plastic deformation under plane stress and plane strain conditions; Levy-Mises equations; Prandtl-Reuss equations; (No derivation required). Problem solving.

### 5. Forging & Rolling of Metals

**Forging of metals** : Forging hammers, Presses and Horizontal upset forging machines: Construction and principle of operation. Single-and multi-impression closed die forging process; Design and drawing of multi-impression drop-forging, die-set using fuller, edger, bender, blocker and finisher, cavities with flash and gutter. Defects in forged products.

**Rolling of metals** : Longitudinal, Cross and Cross-spiral Rolling; Contact Angle; Neutral angle; Coefficients of spread and Elongation; Forward slip and backward slip; Forces and stresses in longitudinal rolling. Rolling Mills: Blooming-, Billet-, Slabbing, Plate-and Structural mills and their layouts. Design and drawing of Continuous Billet Mill Roll-grooves using diamond, square, oval and round passes. Roll passes for rolling rails, beams, angles and channels; Production of seamless tubes by rolling; Defects in rolled products.

## 6. Extrusion of Metals and Miscellaneous Metal Forming Processes

Types of extrusion (forward, backward, hydrostatic), variables affecting hot extrusion force and pressure, dead metal zone, pattern of metal deformation in extrusion. Analysis of extrusion process, lubrication in extrusion, production of seamless pipe and tubing by extrusion, extrusion defects. Problem solving. **Wire drawing** : Principle of operation and applications.

### Reference:

1. Metal Casting : A Sand Casting Manual for the Small Foundry-Vol. 2 (*Stephen D. Chastain*) (2004), ISBN 0-9702203-3-2.
2. Metal Casting (*T.V. Ramana Rao*)
3. Manufacturing technology (*P.N. Rao*)
4. Foundry Engineering (*P.L.Rao*)
5. Die Casting (*H.H. Doehler*)
6. The Diecasting Handbook-A.C.Street , Portcullis Press, Redhill, U.K. (1990) (2<sup>nd</sup> Edition).
7. Handbook of Lost Wax or Investment Casting (*James E. Sopcak*)
8. From Clay to Bronze-Tuck Langland (1999).
9. Plastics Engineering Handbook of the Society of the Plastics Industry, INC. (*M. L. Berins*) (1994) (5<sup>th</sup> Edition), ISBN 041 2991810 (Publisher ITP).
10. An Introduction to Materials Engineering and Science for Chemical and Materials Engineers (*Brian S. Mitchell*) (2004), ISBN 0471436232, 9780471436232, (Publisher Wiley-IEEE).
11. Mechanical Metallurgy (*George E. Dieter.*)
12. Metals Hand Book–Vol. 14 (Forming and Forging) (*ASM*).
13. Forging Die Design (*Sharan, Prasad and Saxena*)
14. Forging Handbook-Forging Methods (*A. Thomas*) Publisher-Drop Forging Research Association, Shepherd Street, Sheffield, 7BA.
15. Metal Forming Technology (*Dr. R. Narayanasamy*) ISBN 81-7619-002-0 (Ahuja Book Company Pvt. Ltd., New Delhi-110002).



# Production and Operations Management

T.E. Sem. VI [PROD]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	3 Hrs.	100
<b>Practical Exam</b>	–	25
<b>Oral Exam</b>	–	–
<b>Term Work</b>	–	25

## SYLLABUS

### 1. Industrial Engineering

Industrial Engineering and productivity, Methods Study, Work Measurement, Maynard Operations Sequence Technique (MOST), Ergonomics, Design of work place/facilities. Plant Layout, Physical environment: sound, lighting, Ventilation and vibration, Safety.

### 2. Product Engineering

Product research, development and design; design for manufacturing, production systems : Job order, batch production, and mass production; Group Technology, Throughput analysis, Industrial waste, pollution, control and disposal management,

### 3. Production Analysis

Production systems, value adding conversion process, resources and optimum allocation; systems approach, PPC function and its interrelationship with other functions, Line balancing

### 4. Manufacturing Management

Aggregate planning, capacity planning, Batch size decision, Production control, Project management.

### 5. Logistics

Supply chain management, Materials Management, Bill of material, Quality planning, Economic order quantity (EOQ), and different material ordering systems, inventory control and stores systems, ABC analysis.

### 6. Information Support

Integrated approach to the requirement planning and scheduling, MRP–I, MRP–II, ERP, JIT system, SMED, Kanban, Management information System, Computer applications.

### Reference:

1. Computer Aided Production Management (*Mahapatra*) PHE
2. Operations Management Theory and Problems (*J. G. Monks*) MGH International.
3. Elements of Production Planning and Control (*Samuel Eilon*) Universal Publicity Corporations 1991.
4. Operations Management (*McLain J.O. and Thomal L.J.*) Prentice Hall of India Ltd.
5. Production Systems : Planning Analysis and control (*Riggs, J.L.* John Wiley and Sons)
6. Production Control (*Biegel*) J.E. Prentice Hall of India Ltd.
7. Operations Management (*Chary S N.*)
8. Work Study-By International Labour Office, Geneva
9. Work Study and Ergonomics (H.S. Sham) Dhanpatrai
10. Time and Motion Study (Ralph Barnes) Asia Publishing
11. Most Work Measurement Systems–Kelli B. Zandin Marcel Decker Inc N.Y.
12. Human Factors in Engineering and Design-Sanders and Mc Cormack McGraw Hill
13. Introduction to Ergonomics (*R.S. Bridger*) McGraw Hill



# Machine Tool Design

T.E. Sem. VI [PROD]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### 1. Introduction to Machine Tools

Types and capabilities of various machine tools, constructional, design and operational features. General purpose, single and special purpose machine tool. Machine tool structures: Materials of machine tool structures, profiles of machine tool structures, static and dynamic stiffness. Design of lathe bed, bending strength, designing for rigidity, methods of enhancing rigidity. Design of pillar drill column, deflection of column. Design of machine tool guideways: type of guideways – shapes, materials of guideways, guideway clearances and wear compensation techniques. Design of guideways for wear and stiffness. Elementary treatment of hydrostatic guideways.

### 2. Machine Tool Drives

**Design of machine tool drives** : Stepped and Stepless speed outputs, selection of spindle speed ranges, construction of speed diagrams, layout of speeds on arithmetic and geometric progression, kinematic advantages of geometric progression series, selection of values of common ratio and design of gear boxes for feed and speeds having 2–3 stages and 4–12 speeds. **Stepless drives** : Mechanical stepless drives – single disc, double disc and cone disc transmissions, speed regulation by epicyclic gear train, positive infinitely variable drives (PIV drives) – Kopp's and Svetozarav's drives. **Feed boxes** : Quadrant change gear mechanism, speed boxes with gear cone and sliding key, Norton gear drive, Meander gear drives, gear boxes with clutched drive, Schopke drive and Ruppert drive.

### 3. Design of Clutches

Design of plate clutches –Materials of clutch plates, linings & running conditions (wet & dry) clutch plate sizes, design of clutch springs and operating lever.

### 4. Design of Power Screws

Power screw profiles and selection, design of machine tool power screws based on strength, buckling and stiffness, power requirements and efficiency, mounting of power screws elementary treatment of ball recirculating power screws.

### 5. Design of Machine Tool Bearings

Bearing materials, characteristics and selection. Types of bearings – selection and applications, bearing designations (ISI, SAE and SKF designations). Design of ball and roller bearings – static and dynamic load bearing capacities, cubic mean load, selection of bearing from hand book. Design of journal bearings. Assembly, mounting and maintenance of bearings.

### 6. Acceptance Tests on Machine Tool

Significance, safety concepts, performance and geometrical tests on lathe, milling, drilling and shaping machines.

**Reference:**

1. Machine tool design hand book: Central Machine Tool Research Institute, Bangalore.
2. PSG Design Data book: PSG College of engineering and technology, Coimbatore.
3. Principles of machine tools: (*Sen and Bhattacharya*).
4. The design and construction of machine tools: (*H.C.Town*).
5. Machine tool Engineering (G R Nagpal) Khanna Publishers.
6. Design of Machine tool (*S.K. Basu and D.K.Pal*) Oxford and IBH publishing Co.
7. Machine tool design and Numerical Control (*N.K.Mehta*) Tata MGH
8. Machine tools (*Koenigsberger*)

