FACULTY OF ENGINEERING

Syllabus for the

T. E. (Production Engineering-Sandwich)

(w. e. f. 2010-2011)

UNIVERSITY OF PUNE
## UNIVERSITY OF PUNE
## COURSE STRUCTURE FOR
## TE (Production- Sandwich) (2008 Course)

### Semester- I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Teaching Scheme (Hrs)</th>
<th>Examination Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lecture</td>
<td>Pr/Dw</td>
</tr>
<tr>
<td>311121</td>
<td>Industrial In-plant Training for 6 months (2 contact hrs. per student per week)@</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>311122</td>
<td>Manufacturing Technology (self study)$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>311123</td>
<td>Seminar @</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* - Oral based on TW by one internal guide & one external examiner from industry.

$ - Students should study this subject during training & contact supervisor for guidance.

@ - The contact hours are provided for supervision of students under training and for giving guidance regarding the seminar/theory subject to be studied during the training.

### Semester II

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Teaching Scheme (Hrs)</th>
<th>Examination Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lecture</td>
<td>Pr/Dw</td>
</tr>
<tr>
<td>311124</td>
<td>Kinematics Design of Machines</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>311125</td>
<td>Material forming &amp; Mould design</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>311126</td>
<td>Production &amp; Industrial Management II</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>311090</td>
<td>Numerical Techniques and Database. #</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>311091</td>
<td>Production Metallurgy. #</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>311127</td>
<td>Production System Design</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

# - Common to TE (Production).

Th- Theory  Pr- Practical  Dw- Drawing  Tw- Term Work
311121 Industrial Inplant Training

Teaching Scheme
2 hrs/week/student
Duration of Training in industry: 6 Months

Examination Scheme
TW: 150 Marks
Oral: 100 Marks

General guidelines to the institutions running Production - Sandwich degree course and to the students opting for sandwich course.

Students are expected to learn following things during the Industrial Inplant Training of 6 months:

He shall be given training in large or medium size manufacturing unit in various departments.

1. Orientation/Rotational Training: Organizational structure of the company, scale and type of production, types of products, functional departments like manufacturing, process planning and control, quality assurance, assembly, testing, maintenance, stores, purchase, marketing, human resources department, design and drawing department, general administration, packing and dispatching, tool engineering, materials and material handling etc.

2. Industrial Design and Drawing Practice: Design and Drawing standards, study of Mechanical components and introduction to machine design element design such as gears, gear boxes, chain and belt drives, electric motor selection, couplings, shafts, keys, bearings, brackets, bolted and welded connections, sub-assembly and assembly design and drawings, various ISO/BIS/TS standards for design, simple assignments based on the above items, selection of materials, material specifications, heat treatment, and properties of materials.

3. Study of Manufacturing Processes: Study of Processes such as casting, forging, sheet metal working, plastic moulding, extrusion, rolling and machining operations on various machines, study of finishing processes like grinding, lapping, honing, burnishing, buffing, etc. Chipless Manufacturing Processes.

4. Study of Various Manufacturing Machine Tools:
   Lathe, Capstan and Turret Lathe, Planer, Shaper and Milling, Mechanical and Hydraulic Presses, Gear Hobbing, Shaping and Grinding Machines. I

5. Study of special purpose machines, jig boring machines, NC/CNC machines, work centers, transfer lines and automatic machines.

6. Study of single point cutting tools and multipoint tools, form tools, jig and fixtures, special purpose machine tools and press tools, Tool Material and Tool Selection, Study of Cutting Parameters.

7. Study of Material Handling Methods and Equipment.

8. Introduction to Quality and Quality Policy, Need for quality control, National and International Standards on Quality and Reliability, Introduction to Total Quality Management (TQM), Kaizen Practice, 5’ S, Study of various inspection gauges, selection of gauges, comparators, calibration of gauges, standards room etc. Product Performance Test Procedures.


10. Study of various Industrial Engineering Functions, Work Study (Motion Study and Time Analysis), Economic considerations, Plant Layout, Safety aspects of working, safety gadgets used on machines and personal safety.
Students shall be asked to do simple assignments in various departments where he is undergoing training. Industries shall be requested to prepare training program beforehand, covering as much as possible from above mentioned topics depending upon the type of industry. Students shall be encouraged to give monthly reports and presentation (preferably power point presentation) to the college of his/her work in the industry. Students are also should be encouraged for paper presentation at National/International Level based upon the applied knowledge gained during the Inplant Training.

**Term Work**
Term work will consist of a comprehensive report based on his observation, training received and assignments completed during 6 months of training. The report shall also include good drawing figure, process sheets, machine and product specifications.

**Examination**
Oral Examination shall be conducted after training by appointing one internal examiner and one external examiner from industry.
311122 Manufacturing Technology (Self Study)

Teaching Scheme
Self Study

Examination Scheme
Theory: 100 Marks
TW: 50 Marks

Unit I: Non Conventional Machining processes
Detail study with respect to principal, processes parameter, comparative assessment of abrasive jet machining, ultrasonic machining, chemical machining, electrochemical machining, electrodischarge machining, electron beam machining, laser beam machining, plasma arc machining, ion beam machining, wire cut EDM, merits, limitations and applications of each.

Unit II: Plastic Processing
Introduction, types of plastics, elastomers, material for processing plastics, processing plastics, molding processes, calendaring, thermoforming, casting, laminating and reinforcing, foam plastics, fastening and machining plastics, design considerations. Recycling of plastics.

Unit III: Advanced Manufacturing Processes

Unit IV
Metrology I


Measurements by light wave interference: Basic Principle, Optical Flats, Fringe Patterns and Their Interpretation, Testing Of Flat Concave, Convex and Irregular Surfaces, and Checking Of Slip Gauges, Michelson Interferometer, NPL Flatness Interferometer.

Unit V: Metrology II
Angular Measurement: principle and applications of measuring instruments like protractor (optical and bevel), sine bar, angle gauges, spirit level, clinometer, autocollimator, angle dekker, constant deviation prism, and miscellaneous measurement of angle. Methods of measuring surface finish.

Unit VI: Mechanical Estimating and Costing
Estimation of Weights and materials: Introduction, need for scrap, provision for scrap, minimizing manufacturing time, estimation of volume and weight of material, volume and surface area of solids, densities of metals
Reference Books:

311123 Seminar

Teaching Scheme:
Self Study

Examination Scheme
Term work: 50 Marks
Oral: 50 Marks

Seminar is in the form of Technical Paper Presentation which is expected to be on a state-of-the-art technical topic, related to Production Engineering discipline but beyond syllabus. The seminar report and its presentation is to be based on material, mainly collected and analyzed from the latest papers in technical journals. The report is expected to be about 15 A4 size pages, including figures and tables, in addition to certificate, synopsis and reference pages. The presentation is expected to be in front of the audience which must include at least two internal examiners one of them being a guide and both being university approved teachers and one external examiner. The marks distribution is equally divided between the report and presentation/oral examination.
311124  Kinematic Design of Machines

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

Unit I: Analysis and Synthesis of mechanisms and kinematics structure of machine tools: Analysis for four bar mechanism and slider crank mechanism, dimensional synthesis of mechanisms, three position synthesis of slider crank mechanism, Overlay method

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. (10)

Unit II: Design for fluctuating loads
Stress Concentration and remedies, S.N .Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative damage, Sodberg's and Goodman's Diagram, Design of shaft subjected to variable loading. (8)

Unit III: Spur Gears
Various design considerations, Beam Strength, tangential loading, module Calculations, width calculations, types of gear tooth failures, Estimation of dynamic load by velocity factor and Spott's equation.

Helical Gears: Normal Module, Virtual no. of teeth, force analysis, Beam and wear. Strength, Design of Helical Gears. (8)

Unit IV: Rolling Contact Bearings
Types, Static and Dynamic load Capacity, Strubeck's Equation, Concept of equivalent load, Load life Relationship, Selection of bearing from Manufacturer's Catalogue, Design for variable loads and Speeds, Bearings with Probability of Survival other than 90%, Lubrication and Mounting of bearing.


Unit V: Flywheel
Introduction, Coefficient of fluctuation of speed, Fluctuation of energy, Maximum fluctuation of energy, Energy stored in flywheel, Stresses in flywheel rim & Arms, Detail Design and construction of flywheel. (8)

Unit VI: Statistical considerations in design and Optimum Design
Statistical Considerations in Design: Analysis of Tolerances, Design and Natural Tolerances, Factor of safety and reliability in engineering design, Probabilistic design using safety margin.
Optimum Design: Objectives of Johnson's Method of optimum design, normal specification, redundant and incompatible specification, design for normal specification only.

Term Work:
1. Assignments, one each on Units I, II, IV, V & VI.
2. Design Project: - One design project on gear box design, consisting detail design report & Two Full Imperial size sheets one showing the manufacturing drawing of assembly of Gear box and second showing details for the same.
3. Study of Kinematics of Machine Tool Gear Box.
Oral is based on above Term work

Text Books

Reference Books:
311125 Material Forming & Mould Design

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

Examination Scheme:  
Theory: 100 Marks  
Oral: 50 Marks  

Unit I: Fundamental of Material Forming  
Introduction of forming process, Deformation under complex stresses, Maximum shear stress, Principle stresses and principle planes, Theory of plasticity, Mohr’s circle diagram, Slip line theory, Upper and lower bound theory, Yield criteria for ductile material – Von Mises criteria, Tresca criteria. Effect of temperature, strain rate, chemical composition and mechanical properties. Friction and lubrication in metal working, concept of flow stress and flow stress determination. Classification of material forming process on forces and material movement, Concept of formability, formability limit and formability diagram, Concept of redundant work and its impact on metal working operations.  

Unit II: Forging  
Introduction, Forgability tests, design of forging as a product. Friction in forging. New technologies: Liquid metal forging, Isothermal forging, No draft forging, P/M forging, Rotary swaging.  
**Extrusion:** Introduction, Dies for Extrusion, stock penetration, Extrusion ratio, Force requirement, metal flow in extrusion, defects. Role of friction and lubrication, Extrusion plant layout and accessories, Manufacture of seam-less tubes.  

Unit III: Wire Drawing  
**Advance Metal forming Processes:** High velocity forming- principles, Comparison of high velocity and conventional forming processes. Explosive forming, Magnetic pulse forming, Electro Hydraulic forming.  

Unit IV: Rolling of metals  
Scope and importance of rolling, Types of rolling mills - construction and working, Deformation in rolling and determination force required, Process variable, redundant deformation, Roll flattening, Roll bite, Roll Camber and its effect on rolling process, Mill spring, Rolling Mill plant and accessories, Automatic gauge control – concept, need and methods, Roll pass classification.  

Unit V: Design of Casting  
Metal pouring, Gating system- design of gating system, solidification time, riser design, Principles of gating, risering and their design methods. Progressive and directional solidification, casting design consideration, Chvornov’s rule, numericals on casting, defects in casting.  
**Design of Die casting dies:** Design of simple die for die casting. Detail calculation of cavity, core, shrinkage and other allowances, heat transfer consideration, directional solidification, design of cooling system, feed and flow system and ejection system. Role of computers in casting die design.
Unit VI
Design of simple Die for Forging: Open and Closed die, detailed calculations of cavity shapes, shrinkage and other allowances. Heat transfer consideration, Inter cooling system. Design of simple spring/Cam operated ejectors.

Design of Mould: Mould materials used for construction, consideration of plastic material parameters- shrinkage, density, bulk factor etc. Design of simple two plate injection moulds. Design of simple blow moulds for articles like bottle, cans etc. Study of type of ejectors, gate, runner’s c/s; Study of cooling systems and heat transfer consideration. Introduction to Injection molding of thermosetting plastic materials. (8)

Term Work:
1. Assignments on Unit I, II, III & IV.
2. Study of Roll pass Design for structural shapes. (At least Two)
4. Detail design and drawing of die for forging operation. (Use of CAD desirable)
5. Detail design and working drawing of plastic moulds for plastic components for manual and automatic machines. (Use of CAD desirable)

Text Books

Reference Books:
3. Dr. R. Narayanswamy, “Metal Forming Technology”, Ahuja Book Company
4. ASME, “Metal Hand Book”, Vol II and Vol III.
5. Slotten, “The Die Casting Hand Book”.
Unit I: A) Elementary Economics
B) Materials Management: Objective, functions of materials management, material planning analysis (MRP I and MRP II), organization of materials management, ABC Analysis, EOQ Concept, ERP, Industrial Purchasing Producer.
C) Marketing Management: Marketing Function, Marketing Planning, Market Survey and Market Research, Marketing and Selling Concept. (8)

Unit II: Process Planning
Introduction- Production Engineering, Role of Product Engineering department, process engineering functions, coordination of process engineering department with other department, process planning organization
Phases of process planning, process planning principles and process sheet design, factors affecting process design, general considerations in selecting machining methods, study of the machined parts and initial data required for process design from the point of manufacturer, planning the sequence of machining operations, selection of stock preparations and blank material, time estimate and time standard. (8)

Unit III: Process Engineering
Basic Manufacturing processes, supporting operations, study of the functions of the part in the assembly and corresponding finishing operations, study of tooling standard and special tooling, Special of tooling - Conventional tooling methods for commonly machined surfaces, tooling ideas for typical features on job, multi-tooling set up, new tools and tooling methods economics of tooling, make or buy decision, Tolerance chart, Geometric control, Dimensional Tolerances analysis. (8)

Unit IV: Quality Control
Definition of Quality, Quality Characteristics, Introduction to Quality Control, Study of control chart -control chart for variables, control chart for attributes. Acceptance Sampling - Sampling inspection v/s 100 percent inspection, Basic concepts, operating characteristics curves, conflicting interests of consumer and producers, producer's and consumer's risks, AQL, LTPD, AOQL, Single and Double Sampling Plans, Standard Sampling tables. Theory of Work Sampling. (8)

Unit V: World Class Manufacturing-I
Deming’s and Juran’s Approach, Deming’s PDCA, PDSA cycle, 7 QC Tools, 5’S, TPM, Kaizen, Quality Circle, Concurrent Engineering, JIT, Kanban, Quality Function Deployment, House of Quality, Six Sigma, Poka Yoke. (8)

Unit VI: World Class Manufacturing-II
Text Books:
5. P. Rama Murthy, “Production & Operation Management”, New Age Internation (P) Ltd.

Reference Books:
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(1st & 2nd 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- 1st and 2nd order
Interpolation: Lagrange’s formula, Newton forward difference method. (8)

Unit VI: Numerical methods -III

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:

Reference Books:
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,ausforming. (8)

Unit IV: Alloy Steels & Cast Iron

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
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.
4. Study and drawing of microstructures of hardened steel, 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.
10. Testing of Composite materials (Like Hardness, Impact, Tension etc.)

Text-books:

Reference Books:
311127 Production System Design

Teaching Scheme
Practical: 2 Hrs / Week

Examination Scheme
Term work: 50 Marks

Term work consists of writing the journal based on following points. Minimum one assignment on each point.

1. Study and Design of special cutting tools like flat form tool and circular form tool.
2. Study and Design of multipoint cutting tools like milling cutter, drills, reamers and broach.
3. Study of process planning and design of process sheet for machine components under job and mass production. (The process sheet will contain material specifications and estimate, sequence of operations along with in process dimensions, gauging, special tools, jigs and fixtures required as well as time estimate for each operations.)
4. Study and layout design of material handling devices like belt and roller conveyors, cranes, hoist, construction equipments etc.
5. Study of process plant like sugar, paper, cement, chemical, ceramic, etc. (any one). Visit to any such plant and studying the conversion process in detail and drawing the plant layout in the report.
6. Facility and Plant layout design preferably using any Software.
7. Calculations for Capacity planning, Productivity, OEE, etc., for any above process plant or any manufacturing shop.
8. Preparation of Control Chart of various types.
9. Study of MRP & ERP systems.
10. Any one other assignment excluding above points but based on contents of Production and Industrial Management II subject.

Reference Books