FACULTY OF ENGINEERING

Syllabus for the

B.E. (Production Engineering – Sandwich 2008 Course)

(w. e. f. 2011 – 2012)

UNIVERSITY OF PUNE
PUNE
# BE (Production-Sandwich) 2008 Course structure
## Semester- I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Teaching Scheme (Hrs)</th>
<th>Examination Scheme</th>
<th>Lecture</th>
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<td>411121</td>
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Total of Part I = 750 marks

## Semester II

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<th>Subject Code</th>
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Total of Part I & Part II = 1400 marks

$ - Students should study this subject during training & contact college supervisor for guidance. He has to submit the assignments as a hard copy or soft copy through E-mail as a term work at the term end for regular students.

@ - The contact hours are provided for supervision of students under training and for giving guidance regarding the theory subject to be studied during training.
* - Oral based on TW & Project done by one external examiner from industry.

**Elective I**

1) Machine tool design  
2) Automobile Engineering  
4) Plastic Engineering

**Elective II**

1) Ergonomics and Human Factors in Engineering.  
2) Materials Management & Logistics.  
3) Financial Management & Cost Control.  
4) Product Development.

**Elective III**

1) Supply Chain Management.  
2) Plant Engineering & Maintenance.  
3) Industrial Relations & Human Resource Management  
4) Marketing Management
411121: OPERATIONS RESEARCH AND MANAGEMENT

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<td>Practical: 2 hrs/week</td>
<td>Oral: 50 Marks</td>
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**Unit I: Linear programming**


**Unit II: Transportation and assignment problem**


**Unit III: Sequencing Model:**

Scheduling and sequencing, Assumptions in sequencing models, processing ‘n’ jobs on ‘m’ machines, processing of two jobs on machines with each having different processing order.

**Inventory control**

Discount Models, Safety stocks, Service level, Probabilistic models, Inventory models under risk and under uncertainty.

**Unit IV: Queuing theory**

Operating characteristics, Poisson single and multi channel queuing system M/M/1: ∞ / FCFS, MCSR.

Games Theory: Introduction, two -person zero sum game, minimax and maximin principle, saddle point, methods for solving game problems with mixed strategies, Graphical and iterative methods.

**Unit V: Simulation**

Introduction, application, Monte Carlo simulation of queuing system, inventory system, capital budgeting, new product planning etc.

**Replacement & Investment models**

Replacement of capital equipments that deteriorates with time, time value of money (a) remains same (b) changes with constant rates during period.

Equipment renewal policy, group and individual replacement.

Payback Period and IRR Method.

**Unit VI: Project Management**

Construction of networks, critical paths, forward and backward pass, floats and their significance, crashing for optimum duration and the cost, resource allocation and leveling,
Time estimates, construction of networks, probability of completing projects by given date.

**Term Work:**
One exercise on each unit. At least one Computer software package such as Lindo/Lingo, MS-Project, MATLAB, MS-Excel and Tora should be used.

**Text Books:**

**Reference Books:**
### 411122: MECHATRONICS AND ROBOTICS

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</tr>
</tbody>
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#### Unit I: Introduction
Elements of control system, Microprocessors based controllers
System Response
Amplitude linearity, phase linearity, distortion of signals, dynamic characteristics of systems, zero order systems, first order systems.
Signal Processing
Operational amplifiers, requirement for protection and filtering, comparators and Rheostat Bridge, ADC-DAC converter, multiplexes, Data acquisition using DAQ boards, principle of digital signal processing, principle of pulse modulation.

#### Unit II: Digital Control Architectures
Digital representations, combination logic & logic classes, timing diagrams, sequential logic, TTL and CMOS integrated circuits, integrated system circuit design.

#### Microprocessors
Basic structure of microcomputer, microprocessor and micro controller, programs using flow charts or Pseudo Codes.

#### Unit III: Assembly Language & Input output Systems
Use assembly language to write programmes
Identify interface requirements, buffers, hand shaking and serial interfacing. Function of synchronous communication, interface adapters.

#### Unit IV: Programmable logic controllers
Basic structure of PLC, programme of PLC, logic functions, latching and sequencing, develop programmes involving timers, internal relays, counters, shift registers. sensors and transducers, Performance or commonly used sensors, sensors used in measurements of displacements, position proximity, velocity and motion, force, fluid pressure, liquid flow, liquid level, temperature, stress and strain, vibration and accelerometer, sensors and micro chemical devices

#### Unit V: Actuators
Electrical actuator systems: - solenoids, relays, solid state switches, thyristors, tripolar transducers, MOSFET, Solenoid actuator system, DC Motors, AC motors and steppers.
Vacuum grippers, Mechanical gripper & Magnetic gripper.
Control Actions: On-Off, proportional, proportional +integral, P+D, proportional + integral+ derivative control actions.
Mechanical actuator systems: Involving linkages, gears, ratchet and pawl, belt and chain drives and bearings.

#### Unit VI: Basic concepts in Robotics
Automaton and robotics, robot anatomy, basic structure of robots, resolutions, accuracy and repeatability, applications of robots in manufacturing, Robot Programming.
Classification structure of robotic system: Point to point and continuous path system. Control loops of robotic systems, the manipulators, the wrist motion and grippers.

**Term Work:**

The term work shall consist of following experiments and one assignment on each unit.
1. Study of control system using Hydraulic and Pneumatic kit.
2. Program on microcontroller / microcontroller simulator.
3. Ladder diagram and programming using PLC.
4. Study of process control loop including sensors, controllers and final control elements/actuators.
5. Study of ADC/DAC used in Data Acquisition System (DAQ).
6. One experiment on pick and place robot (2D robot).
7. Study of displacement level and pressure controls.
8. Measurements of Speed and Temperature.

**Text Books:**


**References Books:**

3) Gopal, *Control systems*, Tata McGraw hill
41123: ADVANCED PRODUCTION TECHNOLOGY

Teaching Scheme: Examination Scheme
Lectures: 4 hrs/week Theory: 100 Marks
Practical: 2 hrs/week Term Work: 50 Marks

Unit I: Advanced Machining Process
High Speed Machining
Definition and physical aspects of high speed machining, Machining of monolithic parts,
Basic Applications of HSM Technology.
Dry and Semi-Dry Machining
Dry machine tools and equipments, Dry machining operations, Near Dry Machining System,
Near Dry Machine tools and Machining Operations
Hard Part Machining
Definition and Basic features of hard-part machining, Physical aspects and applications of
Hard Part Machining, Surface finish produced by HPM.

Unit II: Nano Technology & Nanomanufacturing
Basic aspects of Nano-Manufacturing, Ultra-precision machines and Nano-scale Machining
operations, Examples of Nano-Products, Introduction to Nano Metrology
Fine Finishing Process: Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing
(MAF), Magnetic Float Polishing (MFP)

Unit III: Computer Integrated Manufacturing (CIM)
Computer application in manufacturing automation, computer aided inspection and quality
control. Computer integrated production management system, inventory, material
requirement planning, manufacturing resource planning, enterprise resource planning,
Introduction to Rapid Prototyping
Group Technology: Part families, part classification and coding, Cell formation techniques,
production flow analysis; machine cell Design, Cellular Manufacturing Systems.

Unit IV: Factory Automation
Transfer systems-Continuous, intermittent, Indexing mechanisms, vibratory bowl feeders,
non-vibratory feeders, hopper feeders, rotary disc feeder, centrifugal, revolving feeder,
assembly systems, automated assembly, design for automated assembly, automated work-
piece handling synchronous and non synchronous material transfer, industrial robots,
Automated Guided Vehicles, Automated factory, Components of FMS, FMS Planning,
Analytical Model of FMS, CANQ, Deterministic Model, Petrinets, Automated warehouse,
Introduction to Toyota Production System- Features, Philosophy , Frame work.Toyota
Production System.

Unit V: Hydraulics and Pneumatics Systems
Principles of hydraulics, hydraulic fluids, filtration technology, hydraulic pumps, valves and
actuators, hydraulic servo mechanism, proportional valves, selection of standard
components, Operational principles and application, air compressors, pneumatic cylinders &
air motors.
Unit VI: Design of Hydraulic & Pneumatic Circuits for automation

Basic hydraulic circuits such as regenerative circuits, sequencing circuit, meter in & meter out circuit, standards in circuit diagram representation, power pack design layout, design of pumps, reservoir, accumulators and intensifiers, pneumatic circuit design, Design of Pneumatic circuits

Term Work:

The term work shall consist of record of assignments on following topics.
1. Study of control valves, actuators, accumulators & pumps.
2. Study of hydraulic circuits: - hydraulic press, machine tools, automobile systems, etc
3. Performance analysis of positive displacement pumps.
4. Study of Hydraulic Circuits – Meter-in, Meter-Out, and etc.
5. Study of pneumatic circuits.
6. Study of automation in material handling system and AGV.
7. Study of Control system in various types of feeders.
8. Study of manufacturing resources planning.
10. Report on Industrial visit to study FMS, Automated Plants etc.

Text Books:


Reference Books:

2. Vickers manual on hydraulics
8. Machining, Fundamentals and Recent Advances - Davim, J. Paulo (Ed.) 2nd Printing. 2008,
411124: MACHINE TOOL DESIGN (ELECTIVE I - I)

Teaching Scheme
Lectures: 4 hrs/week
Practical: 2 hrs/week

Examination Scheme
Theory: 100 Marks
Term Work: 50 Marks

Unit I: Drives
Design considerations for drives based on continuous and intermittent requirement of power, Types and selection of motor for the drive, Regulation and range of speed based on preferred number series, geometric progression. Design of speed gear box for spindle drive and feed gear box.
Stepless drives: Design considerations of Stepless drives, electromechanical system of regulation, friction, and ball variators, PIV drive, Epicyclic drive, principle of self locking,

Unit II: Design of Machine Tool Structures
Analysis of forces on machine tool structure, static & dynamic stiffness. Design of beds, columns, housings, bases and tables.

Unit III: Design of Guideways & Power Screws
Functions & types of guideways, design criteria & calculation for slideways, design of hydrodynamic, hydrostatic and aerostatic slideways, Stick-Slip motion in slideways.
Design of power screws: Distribution of load & rigidity analysis.

Unit IV: Design of Spindles & Spindle Supports
Design of spindle and spindle support using deflection and rigidity analysis, analysis of anti-friction bearings, preloading of antifriction bearing.

Unit V: Dynamics of machine tools
Dynamic characteristic of the cutting process, Stability analysis, vibrations of machine tools.
Control Systems: Mechanical & Electrical, Adaptive Control System, relays, push button control, electrical brakes, drum control.

Unit VI: Advances in Machine Tool Design
Design considerations for SPM, NC/CNC, and micro machining, Retrofitting, Recent trends in machine tools, Design Layout of machine tool using matrices.

Term work:
Term work shall consist of record of assignments on following topics.
1. Design and working drawing of speed gear box
2. Design and working drawing of feed gear box
3. Study of stepless drives
4. Design of bed or column.
5. Design for spindle or power screw.
6. Design for guideways and slideways.
7. Internet assignment based on any one of the topics above.
Text Books:


Reference Books:

411124: AUTOMOBILE ENGINEERING (ELECTIVE I - II)

Teaching Scheme: Examination Scheme
Lectures: 4 hrs/week Theory: 100 Marks
Practical: 2 hrs/week Term Work: 50 Marks

UNIT I: Vehicle Specifications, Chassis and Fuel Supply Systems: (8)
Vehicle specifications, classification of vehicles and chassis, different layouts, chassis and frame, main components of an automobile, articulated vehicles.
SI Engines: Carburation, air fuel requirements for SI engines under various operating conditions, essential parts of a modern carburettor, different circuits, carburettors used on automobiles, fuel injection in SI engines.
CI Engines: Functional requirements of an injection system, typical arrangement of solid injection system, individual pump and; nozzle system, unit injectors, distributor system, fuel injectors, types of nozzles, governing of IC engines.

UNIT II: Cooling System: (8)
Temperature variation in various parts of IC engines, and their cooling, necessity of cooling, under cooling and overcooling, types of cooling systems.
Components and working of pressurized forced thermostatic cooling system used in automobiles, coolant recovery, fan power and saving devices, additives

UNIT III: Lubrication and Ignition Systems: (8)
Lubrication Systems:
Types of friction, functions and properties of lubricants, additives, pressure feed system used in automobiles, blow bye.
Ignition Systems:
Battery ignition system, magneto ignition system, electronic ignition systems, waste spark ignition system. Different starting systems used in automobiles.

UNIT IV: Study of Clutches and Gear Boxes: (8)
Types of clutches, single plate, multiplate, centrifugal clutches, clutch operating systems, wet clutches, fluid coupling, clutch plate material.
Functions of gear box, various resistances to motion, rolling, air and gradient resistance, total resistance and tractive effort, variation of tractive effort with speed, power required for acceleration and gradability, selection of gear ratio, sliding mesh, constant mesh and epicyclic gear boxes, synchromesh devices, automatic gear boxes, torque converters, overdrive, propeller shaft.

UNIT-V Study of Suspension and Steering Systems: (8)
Suspension Systems:Objects of suspension, principles of suspension design, spring and unspring mass, types of springs, variable rate springs, torsion bars, rubber springs, shock absorbers, independent suspension, air suspension, interconnected suspension, hydro pneumatic suspension, self leveling suspension.
Steering Systems: Requirements of good steering systems, steering geometry, camber, steering axis inclination, included angle, scrub radius, castor, toe in, toe out, turning radius,
wheel balancing, steering linkages, steering gears, cornering force, slip angles, under steer, 
over steer, cross play and radial tyres, power steering.

UNIT- VI Study of Braking Systems and Automobile Maintenance Techniques: (8)

Braking Systems: Braking systems used in automobiles, layout and working, antiskid 
braking.

Automobile Maintenance: Preventive maintenance, troubleshooting and diagnosis for the 
systems that constitute a automobile.

Term work:
Term work shall consist of record of six assignments on above topics.

Text Books:

Reference Books:
1. Newton, Steeds and Garrett. "Motor Vehicle", The English Language Book Society, 
   Distributors,(2009), ISBN8180141241
   New Delhi, 1991.
411124 : COMPUTER INTEGRATED MANUFACTURING AND INDUSTRIAL ROBOTICS (ELECTIVE I - III)

Teaching Scheme
Lectures: 4 hrs/week
Practical: 2 hrs/week

Examination Scheme
Theory: 100 Marks
Term Work: 50 Marks

Unit I: CIM Models and Rapid Prototyping (8)
Methods of rapid prototyping: stereolithography, Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), selective laser sintering, solid ground curing, 3D Printing system, Application of rapid tooling methods to press tool manufacture

UNIT II: Robot arm kinematics and dynamics (8)
Basic structure of robots, Configuration of robots, arm body, wrist motion , The direct kinematics problem, the inverse kinematic solution, Homogeneous transformation. Denavit - Hartenberg's convention for dynamic analysis of Joints, Global & Local Coordinates for analysis.
Advanced synthesis of planar mechanisms for ISP, MSP and FSP, Burmester theories and analytical techniques, Applications, Lagrange-Euler formation, generalised D'Alembert equations of motion, Spatial mechanisms. Axodes, kinematics of open and closed loop mechanisms.

UNIT III: Robot Drives, Control and Transmission System: (8)
Hydraulic systems, DC servo motors, basic control systems concepts and models, control system analysis, robot activation and feed back components. Positional and velocity sensors, actuators. Power transmission systems, robot joint control design.
Transmission System : Basic Motion Conversion Systems, Efficient power transmission for robotics systems, Concepts and related terms of power transfer.

UNIT IV: Robot Grippers (8)
Classification, Design consideration, Materials for hostile operation. Cylindrical Cam type; Grippers using pneumatic, hydraulic and electrical motor for transmission; Vacuum Grippers, ultrasonic grippers. finite element analysis in designing for gripper pressure for fragile & visco-elastic material.mechanical,hydraulic & pneumatic manipulator.

UNIT V: Sensors in Robotics (8)
UNIT VI: Robot Application (8)

Term Work:

Practical: Journal must contain detailed report of any five of the following practical, essentially with one demonstration, one gripper design and an industrial visit.

1. Demonstration of Cartesian/cylindrical/spherical robot.
2. Demonstration of Articulated/ SCARA robot.
3. Virtual modelling for kinematic and dynamic verification anyone robotic structure using suitable software.
4. Design, modelling and analysis of two different types of grippers.
5. Study of sensor integration.
6. Two program for linear and non-linear path.
7. Study of robotic system design.
8. Setting robot for anyone industrial application after industrial visit.

Text Books:


Reference Books:

411124 : PLASTIC ENGINEERING (ELECTIVE I - IV)

Teaching Scheme       Examination Scheme
Lectures: 4 hrs/week       Theory: 100 Marks
Practical: 2 hrs/week       Term Work: 50 Marks

Unit I: Basic chemistry for plastic material
Structure, Organic structure, Polymerization, Addition, Condensation, Classification of plastic, Additives of the plastic, Common alloys and blends, Coloring of plastics

Unit II: Injection Moulding
Equipment, mould ability features, injection moulding cycle, effect of processing on mechanical properties, Injection mould designs considerations, functions of register ring, sprue bush, cavity & core inserts, ejection of mold& cooling of Injection moulds.

Unit III: Extrusion
Introduction to extrusion, single and twin screw extruder, vented barrel extruder, Blown film extrusion.
Extrusion of pipes, sheets and filaments, Coextrusion of films and sheets, multiplayer films, dwell lip air ring, typical extruded dimensions
Special features of extrusion dies, Extrusion coating and lamination, Extrusion problems and Extruder performance.

Unit IV: Blow Moulding
Basic principles of blow moulding, Types of blow moulding, comparison of injection blow & extrusion blow molding processes, Materials for blow moulding, Basic design considerations in blow molding, Bottle design concept, Surface treatment of container, Rotary injection blow molding, Stretch blow molding.

Unit V: Thermoforming
Major Thermoforming processes, process factors in thermoforming, straight vacuum forming technique, plug assist-forming thermoforming of PP sheets, problems in thermoforming, twin sheet thermoforming, and maintenance.

Unit VI: Finishing and Machining of Plastics
Filing, tumbling, ashing, buffing and polishing of thermosetting and thermoplastic. Machining of plastics - principle considerations, guidelines for tool geometry, drilling and reaming, tapping and trading, turning and milling, sawing, piercing, trimming and routing of thermosetting and thermoplastics.

Term Work:
Any six assignments based on the above syllabus (One from each unit)

Text Books:

References:
411125 : ERGONOMICS AND HUMAN FACTORS IN ENGINEERING
ELECTIVE II - I

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Theory: 100 Marks

Unit I: Introduction to Human Factors: (8)
Human criteria's, human physical activities, features of the human body, Measures of physiological functions such as: energy expenditure, gross body activity, local muscular activity, work load, work efficiency, work and rest. Type of movements of body members. Performance criteria for physical activity such as: Strength & endurance, speed of movements, accuracy of movements, manual material handling (MMH).

Unit II: Applied Anthropometry and Work Space: (8)
Introduction to anthropometry, use & principles of anthropometry data, work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design. Physical space & arrangement, principles of arrangement of component,

Unit III: Design of Displays: (8)
Information input & processing, visual displays of static & dynamic information. Auditory, textual & olfactory displays, general location of controls & displays within workspace, concept of visibility. Human Controls of Systems
Functions of controls, types of controls, factors in control design, design of specific hand operated controls, foot controls and special control devices.

Unit IV: Working Conditions: (8)

Unit V: Ergonomics and Work Organization: (8)
Human factors applications in system design, characteristics of system design, human factors data for interface design, ergonomic safety & health management, case studies of ergonomically designed product.

Unit VI: Advanced Time and Motion Study: (8)
Predetermined Motion Time Analysis (PMTS) Method Time Analysis (MTA), work factor system (WFS), method time measurement (MTM-1, MTM-2, MTM-3), Maynard’s operation sequence technique (MOST),

Text Books:

References:

411125: MATERIALS MANAGEMENT AND LOGISTICS

ELECTIVE II - II

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Theory: 100 Marks

Unit I: Materials Management
Introduction to Material Management functions, scope, objectives, tools and techniques. Make or buy decision. Material Requirement Planning (MRP1).

Value analysis
Value analysis / Value analysis engineering, concepts, advantages, applications, problem recognition, role of creativity, analysis of functions, use, esteem and exchange values elimination of unnecessary costs, value engineering techniques.

Unit II: Purchase Management
Objectives, functions, purchase cycle, documents in purchasing, purchasing with 5 R’S (Quality, Quantity, Time, Supplier, Price), vendor rating and vendor development. Import and Import Substitution: Factors affecting National and International markets, Import procedure and documents (Bill of lading, letter of credit etc.)

Unit III: Stores Management
Functions of stores, types of stores, stores identification, receipt-issue, recording system, stock taking system.
Waste Management: Importance of waste management and techniques. waste management system, Disposal of surplus and obsolete items. Mechanical and thermal disposal system.

Unit IV: Logistic Management
Operating Responsibility, Logistical performance Cycle, Work of Logistics, Functional areas of logistics
Warehouse Management: Nature and importance of warehousing, warehouse location, warehousing operations and Facility development. Economic and service benefits of warehouse.
Transportation management: Transport planning parameters, Basic Economics & pricing factors affecting transportation cost.

Unit V: Inventory management
Types of inventory, Cost related to Inventory management, selective control of inventories, economic order quantity (EOQ) models, quantity discount model.

Unit VI: Inventory control of finished goods:
Economic manufacturing quantity (EMQ), Fixed order quantity and fixed order interval system, Probabilistic models, Safety stocks, service levels, inventory control of finished goods, single order inventory policies. Inventory models under risk and under uncertainty.

Text Books:

Reference Books:
411125 : FINANCIAL MANAGEMENT AND COST CONTROL
ELECTIVE II – III

Teaching Scheme
Lectures: 4 hrs/week

Examination Scheme
Theory: 100 Marks

Unit I: Financial Management

Unit II: Capital Budgeting
Control of Capital Expenditure, Evaluation Process-Payback approach, Accounting of Rate of Return, Present Value Method Vs Internal Rate of Return. Replacement cost and discounted cash flow.

Unit III: Working Capital Management
Concept and design of Working Capital, types of working capital, sources of working capital, time value of money, cost and capital, cost of capital. Funds Flow Analysis: Concepts, Objectives, and Techniques of Funds Flow Statement.

Unit IV: Costing

Unit V: Budgetary control and variance Analysis:

Unit VI: Types of Costing Methods

Text Books:

Reference Books:

UNIT I: Introduction to Product Design & Development  
Definition of product design, design by evolution and innovation, factors in product design, morphology of product design (seven phases), standardization, simplification and specialization in product design, modern approaches- concurrent design and quality function deployment, product development, product development versus product design, types of design and redesign, modern product development process, product development team and product development planning with reference to ISO standard, difference between product verification and production validation, introduction to prototyping, rapid prototyping methods.

UNIT II: Product Development - Technical and Business Concepts  

UNIT III: Product Development from Concept to Product Function  
Generating concepts, information gathering, and brainstorming, morphological analysis, concept selection-design evaluation, estimation of technical feasibility, concept selection process, Pugh's concept selection charts, numerical concept scoring, process of concept embodiment, system modeling, FMEA, functional modeling and decomposition, fast method, subtract and operate procedure, establishing system functionality, augmentation and aggregation.

UNIT IV: Product Development in the Context of Reverse Engineering  

UNIT V: Design for Manufacture, Assembly and Environment  
Design guidelines, design for manufacture, design for assembly, design for piece part production, manufacturing cost analysis, need and importance of design for environment, global, local and regional issues, basic DFE methods-guidelines and applications, life cycle assessment - basic method, weighed sum assessment method, life cycle assessment method, DFX, product testing, product validation, field trials, virtual trials, iterations.

UNIT VI: Introduction to Product Life Cycle and Product Data Management  
Background, Overview, Need, Benefits, and Concept of Product Life Cycle,

Text Books:
1. A.K. Chitale; R.C. Gupta, “Product Design and Manufacturing” Prentice - Hall India

References:
411126: COMPUTER APPLICATIONS IN PRODUCTION ENGINEERING

Teaching Scheme                                                                 Examination Scheme
Practical: 2Hrs/Week                                                              Term Work: 50 Marks

Term work consisting of writing the journals based on following points. Any six assignments from following.

2. One Assignment based on 3-D Transformations like 3D translation, rotation, scaling. Coding in Programming Language.
4. Finite Element Analysis of a component using any of solver like for any one application like Static, Thermal, Vibration Analysis.
5. Formability analysis of sheet metal part using any software.
8. Study of Computer Application in Process Planning, Quality Control (CAPP & CAQC) & Rapid Prototyping (RP)
9. Case study of implementation of product data management (PDM) & Product Life Cycle management (PLM) in industry.
10. Actual product design with virtual product validation
11. Computer application in QFD and FMEA

Reference Books:

- CAD/CAM/CIM by Radhakrishana
- User Manuals of UG, Nastran, Hypermesh etc
411127: INDUSTRIAL INPLANT TRAINING

Teaching Scheme                                  Examination Scheme
2 Contact hours/Week                             Term Work: 150 Marks
                                                Oral: 100 Marks

The student shall undergo industrial training for the period of 6 months in an industrial establishment and spend about 8 weeks for observational training and solving minimum three assignments given by the organization. The remaining period shall be utilized for project (411128). Students are expected to analyze the problems systematically and offer suggestion / concluding remarks.

Training

The student shall undergo training program prepared by the industry in following manufacturing and functional area.

1. Plant Engineering:
   - Plant Layout, Plant Maintenance, Housekeeping, Material Handling & safety.

2. Production Planning And Control, Quality Assurance.

3. Material Management:
   - Inventory Control, Vendor Development, Vendor Rating, Raw Material and Finished Goods stores.

4. Industrial Engineering:

5. Costing and Cost Control.

8. Import Export Procedures.
10. Quality Assurance, Quality Improvement.
11. Improvement in tool layout, tool selection machine selection.
12. Maintenance of machines, housekeeping, safety precautions.
14. Incentive schemes, labor laws, factory laws.

The students shall submit a detailed report on his training and assignments.
411128: PROJECT

Teaching Scheme
2 Contact hours/Week

Examination Scheme
Term Work: 100 Marks
Oral: 100 Marks

The student shall submit a report on project, suggested by industry where he is undergoing for Inplant training. The scope of the project shall be such as to complete it within the time schedule.

**Project may be of the following types:**

1. Manufacturing / Fabrication of a prototype machine including selection, concept Design, material selection, manufacturing the components, assembly of components, Testing and performance evolution.

2. Improvement of existing machine / equipment / process.

3. Design and Fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, and inspection gauges, measuring instruments for machine tools.

4. Computer aided design, analysis of components such as stress analysis.

5. Problem related to productivity improvements.

6. Problem related to value engineering.

7. Problem related to material handling system.


10. Product design and development


13. Quality system and management, Total quality management.

14. Quality improvements In-process Inspection Online gauging.
15. Low cost Automation, Computer aided automation in Manufacturing.

16. Time and Motion Study, Job evaluation.

17. Safety.

18. Management Information System.

19. Market analysis in conjunction with production, planning and control.

20. Any other relevant topic.

The student shall submit a detailed report based on the project work.

Format of the project report should be as follows:

1. **Paper:**
The Project report should be types. printed on white paper of A-4 size.

2. **Typing:**
The typing shall be with single spacing and on one side of the paper.

3. **Binding:**
The Industrial Inplant Report should be submitted with front and back cover in black hand bound, with golden embossing.

4. **Margins:**
Left - 1.25", Right - 1". Top & Bottom 1 ".

5. **Sequence of Pages:**
5.1. Title page
5.2. Certificate form Institute
5.3. Completion Certificate form Industry, if sponsored.
5.4. Acknowledgement
5.5. Abstract
5.6. Index
5.7. Nomenclature & Symbols
5.8. Actual Content
5.9. Conclusion
5.10. References.

6. **Front cover:**
The front cover shall have the following details in block capitals
6.1 Title at the top.
6.2 Name of the candidate in the centre, and
6.3 Name of the Institute, Name of Industry, if sponsored and the year of submission on separate lines, at the bottom.
7. Blank sheets:
No blank sheets be left anywhere in the report.

8. Project Completion Certificate:
The approval sheet follow the title sheet and shall be as shown with proper spacing.

<table>
<thead>
<tr>
<th>CERTIFICATE</th>
</tr>
</thead>
</table>
| This is to certify that Mr./Ms ............................................. 
| has carried out a Project entitled ........................................ (Name) 
| .............................................................. during the course of his 
| (Name of Project) 
| 
| training at .................................................. 
| (Name of Industry) 
| in partial fulfillment of the requirement of the B.E. 
| Production Sandwich Course of University of Pune 
| at ........................................... during the academic Year 
| .................................................. (Name of Industry) 
| Date: .......................................................... (Guide) 
| Place: 
| (Examiner) ........................................ (Head of Department) |

9. Two copies of Industrial Implant Training & Project shall be submitted to the college. The student shall present their project before the examiners. The oral examination shall be based on the term work submitted, and jointly conducted by an internal and an external examiner from industry.
Technical Paper Presentation shall be based on deep study of any topic related to Production Engineering; Format of the report shall be as follows:

1. **Paper:**
   - The Technical Paper Presentation report should be typed/printed on white paper of A-4 size.

2. **Typing:**
   - The typing shall be with single spacing and on one side of the paper.

3. **Binding**
   - The Technical Paper Presentation report should be submitted with front and back cover of card paper neatly cut to size and spiral bound together with the text.

4. **Margins**
   - Left - 1.25", right - 1", Top & Bottom 1".

5. **Sequence of Pages:**
   - Title Page
   - Report Approval Sheet.
   - Acknowledgement
   - Abstract
   - Contents
   - Nomenclature & Symbols
   - Actual Content
   - Conclusion
   - References

6. **Front cover:**
   - The front cover shall have the following details in block capitals.
     i. Title at the top.
     ii. Name of the candidate in the centre, and
     iii. Name of the Institute and the year of submission on separate lines, at bottom.

7. **Blank Sheets**
   - No blank sheet be left any where in the report.

8. **Title sheet**
   - The title sheet shall be the first sheet and shall contain following details with proper spacing.
Technical Paper on
(TITLE)

By

(Name)

{Examination No. (Roll No.)}

Under Guidance of

9. Report Approval sheet:
The approval sheet shall follow the title sheet and shall be as shown with proper spacing.

| This is to certify that the Technical Paper entitled ……………………………… submitted by………………………… Examination No………………………… is approved for the award of degree of B.E. (Production Engineering Sandwich) of University of Pune, Pune during the academic year……………………………………… |
| Date:                                                                          (Guide) |
| (Examiner)                                                                (Head of Department) |

10. The format of the Technical Paper report:
i. The report shall be presented in the form of a technical paper.
ii. The introduction should be followed by the Literature survey.
iii. Report of any analytical or experimental work done should follow the literature survey.
iv. Figures should be drawn on separate sheets and inserted on the page on which the text is typed. The figures are drawn in either permanent black, ink or printed on paper. The figures should be numbered.
v. Tables shall be typed in text. A separate sheet may be used, if necessary. the table shall be numbered.
vi. Mathematical portion of the text shall be preferably. If this is not possible, it should be written in permanent black ink, Lengthy Mathematical derivations shall not be included. Only the important steps and expressions shall be given.
vii. Discussions and conclusions shall form the last paragraph of the text.

11. References
The references shall form the last section and shall be followed by 'Appendix' if any. They should contain list of works (Papers, Books, etc.) referred to in the body of the text. The numbering shall be done in numerals (e.g. 1, 2, ) indicated as superscript along with the author's name in the text. For any paper, the name of journals, the volume number, the page number and the year of publication in parenthesis. In case of references from journals and books in languages other than English the titles of the journal or book shall be translated into Latin script. For any book the information shall contain the names of authors, title, publisher and the year of publication in parenthesis. For papers and books with joint authorship the names of all the authors shall be introduced in the same order. The author's name shall be last name followed by initials.
12. The total number of typed pages excluding the cover should be from 15 to 20 only. All the pages should be numbered.

13. Two copies of report shall be submitted to the college. The students shall present the Paper before the examiners.
### 411130 : SUPPLY CHAIN MANAGEMENT - ELECTIVE III – I

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
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</thead>
<tbody>
<tr>
<td>Self Study</td>
<td>Theory: 100 Marks</td>
</tr>
<tr>
<td></td>
<td>Term work: 50 Marks</td>
</tr>
</tbody>
</table>

#### Unit I: Introduction to Supply Chain Management
Building a Strategic framework to Analyze Supply Chains: Understanding the supply chain, supply chain performance, Supply chain drivers & obstacles (8)

#### Unit II: Planning Demand & Supply in Supply Chains:
Demand forecasting in supply chain, aggregate planning in supply chain, planning demand & supply in supply chains (8)

#### Unit III: Planning & Managing Inventories in a Supply in Supply chains:
Managing economies of scale in a supply chain: cycle inventory, managing uncertainty in supply chain: safety inventory, determining optimal level of product availability (8)

#### Unit IV: Design consideration in Supply Chain
Transportation, Network Design, & Information technology in a supply chain: Transportation in supply chain, facility decisions: network design in a supply chain, information technology in a supply chain (8)

#### Unit V: Supply Chain Coordination
Coordinating in a Supply Chain & role of E- Business: Coordination in a supply chain, E- business & the supply chain (8)

#### Unit VI: Financial consideration in Supply Chain
Financial factors Influencing Supply Chain Decisions: Financial evaluation of supply chain decisions, the impact of financial factors on supply chain decisions, evaluating supply chain decisions using decision trees (8)

**Term Work:**
Any six assignments based on the above syllabus (One from each unit)

**Text Books:**

**Reference books:**
### 411130 : PLANT ENGINEERING AND MAINTENANCE
**ELECTIVE III – II**

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
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</tr>
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<tbody>
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<td>Self Study</td>
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</tr>
<tr>
<td></td>
<td>Term work: 50 Marks</td>
</tr>
</tbody>
</table>

#### UNIT I: Organisation of Plant Engineering:

#### UNIT II: Plant Facilities and Layout Planning:
Basic Plant facilities, (a) Building: Types of Building structures, Ventilation and lighting, Roads and parking. (b) Electrical power generation, distributions, utilisation, stand by units. (c) Heating, ventilation and Air conditioning. (d) Water supply, Purification, use and disposal. (e) Sanitation. (f) Planning and estimation of auxiliary services, such as water, steam, compressed air. Layout of facilities-Types of layouts, selection of layout. Group technology aspect. P. Q. Analysis, PQRST analysis, material flow, REL charts, space requirements, space diagram. Use of computer for optimization of layouts.

#### UNIT III: Maintenance Management Practice:
Various types of maintenance, breakdown, preventive, periodic or predictive, condition based maintenance as predictive preventive maintenance. Online or off-line, concept of health as well as usage monitoring. Quantitative decision making for selection of maintenance system & management classification of material, MICLASS, CUSDD, Software for Classification and Coding. Maintenance problems occurring in product and process type industries and Power plants and their management.

**Spare Parts Management**- Simulation and Software needed for spare parts management and inventory planning.

#### UNIT IV: Preventive Maintenance and Life Cycle Costing:
Periodic Preventive Management - Scheduled maintenance and period for P.M. Life cycle cost taking into consideration maintenance, reliability, hazard function etc. Life cycle costing: Rigorous models, mathematical formulation etc.

#### UNIT V: Plant Safety issues and Energy conservation:

UNIT VI: Advanced topics in Maintenance Engineering: (8)
Condition based maintenance, using Vibration Signature, SOAP, ferrography, hot ferrography, Infra Red Camera, fluorescent dye, Particle Analysers and other diagnostic techniques. Reliability Centered Maintenance.
Total Productive Maintenance: Organisation, merits and demerits, Terotechnology and its influence on plant engineering and maintenance, specific application areas, Overall effectiveness of equipment (OEE).
RAM analysis: Inherent Availability, Operational Availability, etc.

Term Work:
Any six assignments based on the above syllabus (One from each unit)

Text Books:

Reference books:
411130 : INDUSTRIAL RELATIONS & HUMAN RESOURCE MANAGEMENT ELECTIVE III - III

Teaching Scheme | Examination Scheme
Self Study | Theory: 100 Marks

Term work: 50 Marks

Unit I: Industrial Relations (8)
Status labour relations, cause and effects of strained relations, organized labour and Trade Union, History of Indian Trade Union movement, Role of Trade Union, Responsibilities and functions of trade unions, Collective bargaining, its effects on industrial relations, Financial and non financial incentives for improving industrial relations.

Unit II: Human Resources (4)
Management - Introduction and Importance - Evolution - Difference between Personnel Management and HRM - Role of HR Manager - Structure of HR Department - Duties and responsibilities of HR Manager

HRD Systems: (4)
Evolution - Goals - Elements and their interrelationship - HR Strategies - HR Strategies and Organizational Strategies

Unit III: Manpower Planning (4)
Objectives - Estimating manpower requirement - Recruitment and selection process - Main resources of recruitment - Assessment Devices - Retention of manpower - Succession Planning

Merit Rating: (4)
Promotions - Transfers - Job Description - Job Evaluation - Job Enlargement - Job Enrichment - Job Rotation

Unit IV: Training and Development (8)
Training Process and Methodology - Need and objectives - Training Procedure - Methods of Training - Tools and Aids - Evaluation of Training Programmes

Unit V: Performance Appraisal Management System (8)
Definition, Ethics and Concepts of Performance Management - Different methods of Performance Appraisal - Rating Errors

Unit VI: Retirement / Separation (8)
Kinds of Retirement - Resignation, Discharge, Dismissal, Suspension, Retirement, Layoff, Voluntary Retirement / Separation Schemes, Golden handshake. Role of HRD in developing Industrial Relations - Concept - Industrial Democracy - Industrial Peace
Term Work:
Any six assignments based on the above syllabus (One from each unit)

Text Books:
2. R.S.Dwiwedi, Managing Human Resources.

Reference books:
5. Arun Monappa, Managing Human Resources.
411130 : MARKETING MANAGEMENT - ELECTIVE III – IV

Teaching Scheme
Self Study

Examination Scheme
Theory: 100 Marks
Term work: 50 Marks

Unit I: Introduction to Marketing Management (8)
Marketing philosophy of business, an industrial marketing perspective, Understanding and monitoring the environment

Unit II: Customer Behavior (8)
Understanding consumer’s decision processes, analyzing Consumer Behaviour, perspectives of organizational buyers in industrial markets

Unit III: Market Segmentation (8)
Gathering marketing information, segmenting markets and positioning products, formulating marketing strategies, planning marketing programmes, managing products

Unit IV: Marketing Organization for New Product (8)
Developing new products, marketing intermediaries, managing market logistics, Price theories, Establishing and managing prices, designing and managing product promotions

Unit V: Sales Management (8)
Managing sales force and sales territories, Services marketing, marketing and technological innovations, Non-profit and social marketing

Unit VI: Market Research (8)
Marketing research and its importance, scope, structure and methods, role of quantitative techniques and tools in marketing research

Term Work:
Any six assignments based on the above syllabus (One from each unit)

Text Books:

Reference books:
2. Philip Kotler and Gary Armstrong, Principles of Marketing 9th Edition -
3. Bovee and John Thill, Marketing