FACULTY OF ENGINEERING

Syllabus for the

B.E. (Production Engineering 2008 Course)

(w. e. f. 2011 – 2012)

UNIVERSITY OF PUNE

PUNE
# B.E. (Production Engineering) – 2008 Course

## Semester- I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Teaching Scheme (Hrs)</th>
<th>Examination Scheme</th>
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<tr>
<td></td>
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<td>Lecture</td>
<td>Pr/Dw</td>
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<tr>
<td>411081</td>
<td>Machine Tool Design</td>
<td>4</td>
<td>2</td>
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<tr>
<td>411082</td>
<td>Manufacturing Automation</td>
<td>4</td>
<td>2</td>
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<tr>
<td>411083</td>
<td>Operations Research</td>
<td>4</td>
<td>2</td>
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<tr>
<td>411084</td>
<td>Elective I</td>
<td>4</td>
<td>2</td>
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<tr>
<td>411085</td>
<td>Elective II</td>
<td>4</td>
<td>-</td>
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<tr>
<td>411086</td>
<td>Project Work**</td>
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<tr>
<td><strong>Total</strong></td>
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<td>20</td>
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** It is mandatory to submit preliminary project report for the grant of the term I

## Semester II

<table>
<thead>
<tr>
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<tr>
<td></td>
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<td>Lecture</td>
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<tr>
<td>411086</td>
<td>Project Work</td>
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<tr>
<td>411087</td>
<td>Computer Integrated Design and Manufacturing</td>
<td>4</td>
<td>2</td>
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<tr>
<td>411088</td>
<td>Process Planning and Tool Selection</td>
<td>4</td>
<td>2</td>
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<tr>
<td>411089</td>
<td>Elective III</td>
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<tr>
<td>411090</td>
<td>Elective IV</td>
<td>4</td>
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<tr>
<td>411091</td>
<td>Manufacturing Costing &amp; Analysis</td>
<td>2</td>
<td>-</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>16</td>
<td>14</td>
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<tr>
<th>Th: Theory</th>
<th>Pr: Practical</th>
<th>Dw: Drawing</th>
<th>Tw: Term Work</th>
<th>Or: Oral</th>
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<tbody>
<tr>
<td>1. Plastic Engineering</td>
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<td>2. Industrial Robotics</td>
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<td>3. Powder Metallurgy</td>
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<tr>
<td>4. Microprocessor Applications</td>
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**Elective II**

1. Ergonomics and Human Factors in Engineering

**Elective I**

Page 2 of 48
2. Materials and Logistic Management  
3. Simulation and Modeling  
4. Plant Engineering and Maintenance  

**Elective III**  
1. Automobile Engineering  
2. Mechatronics  
3. Metal working Tribology  
4. Finite Element Analysis  

*** Student can select any Elective IV from Mechanical/Industrial Engineering course 2008 or subject designed by the college on the basis of Industry inputs, which has been approved by the University before the start of the semester.
411081: MACHINE TOOL DESIGN

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

Examination Scheme
Theory: 100 Marks
Term Work: 25 Marks
Oral: 50 Marks
Duration: 3 Hours

Unit I: Drives: (8)
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.

Unit II: Design of Machine Tool Structures (8)
Analysis of forces on machine tool structure, static and dynamic stiffness. Design of beds, columns, housings, bases and tables.

Unit III: Design of Guideways (8)
Functions and types of guideways, design criteria and calculation for slideways, design of hydrodynamic, hydrostatic and aerostatic slideways, Stick-Slip motion in slideways.

Unit IV: Design of Spindles, Spindle Supports and Power Screws (8)

Unit V: Dynamics of machine tools (8)

Unit VI: Special Features of Machine Tools (8)
Design considerations of Stepless drives, electromechanical system of regulation, friction, and ball variators, PIV drive, Epicyclic drive, principle of self locking.

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. Oral shall be based on term work.

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:**

411082: MANUFACTURING AUTOMATION

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

Examination Scheme
Theory: 100 Marks
Practical: 50 Marks
Term Work: 25 Marks
Duration: 3 Hours

Unit I: Basics of Automation and Industrial Hydraulics (8)
Principles of hydraulics, Hydraulic fluids, Filtration technology, Hydraulic pumps, Hydraulic valves, and hydraulic actuators, Proportional valves

Unit II: Hydraulic Systems (8)
Design considerations for hydraulic circuit, Standards in circuit diagram representation, Power pack design layout, Basic hydraulic circuits such as regenerative circuits, sequencing circuit, meter in and meter out circuit, Design of reservoir based on heat transfer considerations, Design of accumulators and intensifiers, Selection of standard components for hydraulic circuits.

Unit III: Pneumatic Systems (6)
Operational principles and application, air compressors, Pneumatic cylinders and air motors, Pneumatic valves, Design of pneumatic circuits, hydro-pneumatic, Control in pneumatic system.

Unit IV: Programmable Automation (10)
Introduction to microprocessor, Microcontroller, Microcontroller based manufacturing systems, Logic gate and control, Computer process controls - any manufacturing case study

Unit V: Control System (7)
Data conversion (ADC/DAC), Programmable logic controller, Interfacing circuits, Actuating signals, relays, contactors, Types of control systems- P, PI, PID , Optimal control system.

Unit VI: Factory Automation (9)
Basic concepts of automated system, Advanced automated functions, Levels of automation, Transfer systems-Continuous, intermittent, Indexing mechanisms, vibratory bowl feeders, non-vibratory feeders, hopper feeders, rotary disc feeder, centrifugal, revolving feeder, assembly systems, Synchronous and non-synchronous material transfer, industrial robots, Automated Guided Vehicles and FMS, Automated warehouse.

Term Work:
The term work shall consist of record of following assignments/experiments.
Oral shall be based on the above term work and practical

1. Study of control valves, actuators, accumulators and pumps.
2. Study of hydraulic circuits - hydraulic press, machine tools, automobile systems, etc
3. Performance analysis of positive displacement pumps.
4. Comparative studies on hydraulic circuit design for suitable industrial applications.
5. Study of pneumatic circuits.
6. Study of automation in material handling system.
7. Use of microprocessors: Applications in manufacturing engineering.
8. Study and experiments in programmable logic controllers: Ladder logic programming

Text Books:

Reference Books:
7. Vickers manual on hydraulics
### 411083: OPERATIONS RESEARCH

<table>
<thead>
<tr>
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<td>Lectures: 4 hrs/week</td>
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<tr>
<td>Practical: 2 hrs/week</td>
<td>Term Work: 50 Marks</td>
</tr>
<tr>
<td>Duration: 3 Hours</td>
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**Unit I: Linear programming (LP)**


**Unit II: Transportation and Assignment problem**


**Unit III: Introduction to Integer, Dynamic and Non-linear programming**

Integer programming, Branch & Bound Method, Goal Programming, Dynamic Programming Introduction, application, capital budgeting, different problems solved by dynamic programming

**Introduction to Geometric and Goal Programming.**

Geometric and Goal Programming. Definition, Introduction, application of Geometric and Goal Programming

**Unit IV: Replacement models**

Replacement of capital equipments that deteriorates with time, time value of money: cases of remains same and changes with constant rates during period.

Equipment renewal policy, group and individual replacement.

**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, Solution using LP.

**Unit V: Queuing theory:**

Operating characteristics, Poisson single and multi channel queuing system M/M/1: ∞ / FCFS, Monte Carlo simulation of queuing systems

**Inventory Theory:**

Introduction. Meaning of Inventory Control. Functional classifications of Inventories. Advantages of Inventory Control. Costs associated with Inventories. Advantages of Inventory Control. Costs associated with Inventories. Deterministic Inventory Models : economic lot size with instantaneous replenishment with and without shortage costs, economic lot size with finite replenishment with and without shortage, economic lot size models with quantity discount
Unit VI: Network modeling

Fundamentals of CPM. and PERT networks, CPM: Construction of networks, critical paths, forward and backward pass, floats and their significance, crashing for optimum and/or minimum duration and the cost, resource allocation and leveling.

PERT: 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, MATLAB, MS-Excel/MS-Projects and Tora should be used.

Text Books


Reference Books

411084 PLASTIC ENGINEERING (ELECTIVE I – I)

Teaching Scheme:                                                                 Examination scheme:
Theory: 4 hrs. / week.                              Paper: 100 marks.
Practical: 2 hrs / week     Term work: 50 Marks
Duration: 3 Hours

Unit-I : Basic chemistry for plastic material (8)
Structure, Organic structure, Polymerization, Addition, Condensation, Classification of plastic, Additives of the plastic, Common alloys and blends, Coloring of plastics

Unit II : Injection Moulding (8)
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 (8)
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 (8)
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 (8)
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 (8)
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:
411084: INDUSTRIAL ROBOTICS (ELECTIVE – I - II)

Teaching Scheme
Lectures: 4 hrs/Week
Practical: 2 hrs./Week

Examination Scheme
Theory: 100 Marks
Term Work: 50 Marks
Duration: 3 Hours

Unit 1: Basic Concepts in Robotics (8)
Automation and robotics, robot anatomy, Development of industrial Robots and manipulators, basic structure of robots, resolution, accuracy and repeatability. Classification, Configuration of robots, arm and body motions, wrist motions, mechanical, hydraulic and pneumatic Manipulators.

Unit II: Robot Arm Kinematics and Dynamics (8)
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, generalized D’Alembert equations of motion, Spatial mechanisms. Axodes, kinematics of open and closed loop mechanisms.

Unit III: 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.

Unit IV: Sensors in Robotics (8)

Unit V: Robot Drives, Control and Robot Programming (8)
Hydraulic systems, DC servo motors, basic control systems concepts and models, control system analysis, robot activation and feed back components. Positional and velocity actuators. Power transmission systems, robot joint control design.
Methods of Programming the robot, Languages, Robographics, Introduction to Artificial Intelligence
Unit VI: Advanced Applications of Robots and Robot Interfacing (8)


Term Work

The term work shall be based on the following assignments
1. Study of configuration of robots and motion of robot manipulator
2. Study of direct kinematics and inverse kinematic solutions (Numerical Problems)
3. Study of robot grippers (includes the problems based on gripper force)
4. Study of machine vision system
5. Study of robot drives and control
6. Study of robot interfacing with PC
7. Study on advanced industrial applications of robots
8. Programming the robot for pick and place operation

Text Books:


Reference Books

411084: POWDER METALLURGY (ELECTIVE I - III)

Teaching Scheme
Lectures: 4 hrs/week
Practicals: 2 hrs./Week

Examination Scheme
Theory: 100 Marks
Term Work: 50 Marks
Duration: 3 Hours

Unit I: Powder Production and Characterization (10)
Historical development, Introduction to basic principles, techniques,
Production of metal powders: Reduction, Atomization, Mechanical methods, Evaporation and electrolysis.

Unit II: Powder Compaction and Sintering (8)
Fundamentals of compaction, presses used, selection of presses, Automation and Handling of powder, tool clearances, Die design principles, wear reclamation, Die and punch materials selection and heat treatment, surface treatment, compact density variations, effect of blending powders, lubricants and lubrication in process. Details of cold pressing and pressure less compaction.

Unit III: Sintering (8)
Principle, time temperature effects, theories of sintering mechanism. Sintering methods, sintering furnaces- characteristics and selection. Dimensional and property changes after sintering, sintering atmosphere, Liquid phase sintering, Activated sintering

Unit IV: Special P.M. processes (8)
Isostatic pressing, Hot isostatic pressing, merits, demerits and typical applications. Powder Metal products with polymer blends, Roll compaction. P.M. forging, Spray deposition, Explosive compaction and injection moulding.

Unit V: Quality Aspects and Recent Developments (7)

Unit VI: Powder Metallurgy Applications (7)
As structural parts, gears, levers, ratchets, etc. lamp filament and filament support, refractory metal components, electrical contact material, Cemented Carbide tools and wear parts, brakes and clutch lining material, porous bearings and filters, catalytic components etc.
Term work:

The term work shall be based on the following assignments

1. Characterization and testing of metal powders
2. Metal powder manufacturing methods
3. Study of pre-compaction powder handling and various compaction approaches
4. Principles of sintering
5. Sintering furnaces and surrounding atmospheres
6. Powder metallurgy applications
7. Report of visit to any powder metallurgy industry

Text Books:

2. Thumler, “Powder Metallurgy Science”

Reference Books:

1. ASM HandBook Vol. II.
411084: MICROPROCESSORS APPLICATIONS (ELECTIVE I - IV)

Teaching Scheme                                         Examination Scheme
Lectures: 4 hrs/week                                    Theory: 100 Marks
Practicals: 2 hrs./week                                 Term Work: 50 Marks
Duration: 3 Hours                                       

Unit I: Introduction to microcomputer:                 (8)
Functionality of Microcomputer, Microprocessor, Microcontroller, Processor architecture, Harvard and Von Neumann Architecture, RISC Processors, CISC Processors, Applications areas.

Unit II: Microprocessor 8085 operations:               (8)
instruction fetch, instruction decode, instruction execute, Bus organization: Address bus, DATA Bus, Control Bus, Address Decoding, Memory Interface, I/O Interface, Interrupts

Unit III: 8051 Microcontroller: features:              (8)
Internal architecture, Register banks, SFR, I/O port structures, ALU, Pin description, power on reset, Timers & Counters, Program Counter, stack and stack pointer, Mode of operations, 8051, Memory Organization, internal & external memory interface, Data pointer, Serial Communication, Interrupts

Unit IV: 8051 instruction set:                         (8)
Assembly language programming, Data Transfer instructions, Arithmetic instructions, Logical instruction, Boolean processor, Branch instructions Programming concepts, IDE: Software Development tools

UNIT V: Study of PLC applications in detail:           (8)
Ladder Diagram development, Application of PLC to CNC machine, boiler, Furnaces, cooling equipment as case studies.
Interfacing: LED interface, 7 segment LED interface, LCD interface, Matrix keyboard interface, ADC interface, DAC interface, Stepper motor interface

UNIT VI: Microprocessor based systems [Case Studies]: (8)
Data Acquisition system, Water level Controller, Pressure measurement system, Speed Measurement system etc. Communication protocols in PC and Microprocessor based systems such as RS232, RS485, USB, I²C.

Term Work:                                            
Any eight assignments based on the above syllabus (At least one from each unit)
Text Books:

3. Myke Predko” Programming and Customizing the 8051 Microcontroller” Tata McGrawHill

Reference Books

1. Intel Manuals.
411085: ERGONOMICS AND HUMAN FACTORS IN ENGINEERING (ELECTIVE II - I)

Teaching Scheme                                          Examination Scheme
Theory: 4Hrs/week                                        Paper: 100 Marks
Duration: 3 Hours

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 and Controls  (8)
Information input & processing, visual displays of static & dynamic information. Auditory, textual & olfactory displays, general location of controls & displays within workspace, concept of visibility. 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)
Illumination: Color systems, energy consideration, effect of lighting on performance.

Unit V: Energy Expenditure  (8)
Muscle mechanism, BMR, Heart Rate variations, Oxygen consumption, Rest allowances, Rate of energy expenditure, Manual Material Handling Capacity determination, Effect of environmental conditions and work design on Energy Expenditure.

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

Text Books

References
411085: MATERIALS AND LOGISTIC MANAGEMENT (ELECTIVE II - II)

Teaching Scheme                                      Examination Scheme
Theory: 4 Hrs/week.                                 Paper: 100 Marks

Unit I: Materials Management (8)
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 (8)
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 (8)
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 (8)
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: Supply Chain Management (8)
Introduction, Types of supply chain, Components, Drivers, Role of supply chain in
manufacturing, Supply chain performance and its measurement, Planning, Demand and supply
in supply chain, Risk in supply chain and managing the risk, Coordination in supply chain

Unit VI: Inventory control of finished goods (8)
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:
411085: SIMULATION AND MODELING (ELECTIVE II - III)

Teaching Scheme: Lectures: 4 hrs/Week
Examination Scheme
Theory: 100 Marks
Duration: 3 Hours

Unit I: Principles of Simulation and Modeling  (8)
A review of basic probability and statistics, Definition and concepts of simulation and modeling, steps in a simulation study, Modeling concepts, Advantages, Disadvantages and Applications areas of simulation
Basic principles of simulation modeling, Model based problem solving

Unit II: System Simulation  (8)
Types of simulation: Physical vs. Mathematical, Static vs. Dynamic, Deterministic vs. Stochastic, Continuous vs. Discrete simulation models,
Continuous, Discrete event, Monte-Carlo simulation methods and their applications in inventory and queuing problems (single server queuing system) – problem organization and logic.

Unit III: Input Data Analysis  (8)
Nature of simulation, Roots of simulation input modeling, Data collection, Identifying distribution, Histograms, practical methods for testing assumptions
Random Number Generation: Introduction, Desired properties, Generation of pseudo random numbers

Unit IV: Random Variate Generation  (8)
Introduction, Factors considered in selecting generator, Generating continuous random variates like Uniform, Exponential, Weibull, Normal
Output Data Analysis
Introduction, Types of simulations with regard to output analysis – terminating and non terminating simulation

Unit V: Simulation of Manufacturing Systems  (8)
Need of simulation in manufacturing and material handling systems, Components of manufacturing systems – product, resources, demand, control; Downtime, Rework and reentrancy, Random events and performance measures used in manufacturing systems with a case study on any manufacturing system
Material Handling Systems – Input parameters for automated material handling systems, Conveyor and vehicle systems, job shop with material handling and flexible manufacturing systems.

Unit VI: Simulation Software  (8)
Simulation software: Introduction, Comparison of simulation software with programming languages – SLAM, SIMAN. Desirable software features, Classification of simulation software, General purpose and object oriented simulation software packages – ARENA/SimFactory/Promodel/ Witness
Text Books:

References:
**411085: PLANT ENGINEERING AND MAINTENANCE (ELECTIVE II - IV)**

**Teaching Scheme**
Theory: 4 Hrs/week

**Examination Scheme**
Paper: 100 Marks
Duration: 3 Hours

**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.

Muther’s plant layout procedure, Layout generation using REL chart

**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 Analyzers and other diagnostic techniques. Reliability Centered Maintenance.

Total Productive Maintenance: Organization, 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.

Text Books:

Reference Books:
The student shall take up a suitable project, the scope of the project shall be such as to complete it within the time schedule, The term work shall consist of,

1. Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Above work shall be taken up individually or in groups. The group shall not be more than 4 students,

OR

Extensive analysis of some problems done with the help of a computer individually or in a group not exceeding two students.

2. A detailed report on the work done shall include project specification, design procedure, drawings, process sheets, assembly procedure and test results etc.

Project may be of the following types:
1. Manufacturing / Fabrication of a prototype machine including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
2. Improvement of existing machine / equipment / process.
3. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problems related to Productivity improvements/Value Engineering/Material Handling Systems
8. Product design and development.
11. Quality improvements, In-process Inspection, Online gauging.
12. Low cost automation, Computer Aided Automation in Manufacturing.
13. Time and Motion study, Job evaluation and Merit rating
14. Ergonomics and safety aspects under industrial environment
15. Management Information System.
16. Market Analysis in conjunction with Production Planning and Control.

OR

Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. When a group of students is doing a project, names of all the students shall be included on every certified report copy. Two copies of Project Report shall be submitted to the college. The students 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, at the end of second semester. Format of the project report should be as follows:

1. Paper: The Project report should be typed/printed on white paper of A-4 size.
2. Typing: The typing shall be with one and half spacing and on one side of the paper.
3. Binding: The Industrial Implant Report should be submitted with front and back cover in black hard bound, with golden embossing.

4. Margins: Left - 1.25", Right - 1". Top and Bottom 1"
5. Sequence of Pages:
   1. Title page
   2. Certificate form Institute
   4. Acknowledgement
   5. Abstract
   6. Index
   7. Nomenclature and Symbols
   8. Actual Content
   9. Conclusion
   10. 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, 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 follows the title sheet and shall be as shown with proper spacing.

   CERTIFICATE
This is to certify that Mr. /Ms ...........................................(Name)................................. has carried out a Project entitled,
............................................................during the course of his
(Name of Project)
training at..............................................................in
(Name of Industry)
partial fulfillment of the requirement of the B.E. Production Engineering Course of
University of Pune
at ...........................................during the academic Year ...............
(Name of Industry)

Date:                                     (Guide)
Place:

(Examiner)                                   (Head of Department)
# 411087: COMPUTER INTEGRATED DESIGN AND MANUFACTURING

<table>
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<tr>
<th>Teaching Scheme</th>
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<td>Lectures: 4 hrs/week</td>
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</tr>
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<td>Duration: 3 Hours</td>
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## Unit I: Computer Aided Design (CAD) (8)

## Unit II: Computer Applications in Engineering Analysis (8)

## Unit III: Computer Aided Manufacturing (CAM) (8)
CAD hierarchy, Integrating CAD, NC and CAM, Numerical control of machine tools, Devices of NC system, data processing unit, Motion and axes of Machine Tools, linear and circular interpolation control loops, positioning control loops, contouring control loops, increment and absolute systems, Point to Point and Continuous Path Machining, CNC and DNC system.

**CNC Programming:**
- Machine Tool Co-ordinate System, Machine zero, Job zero, Cutter Programming, Tool Offsets, Programming Steps, NC Programming Languages, G-codes and M-codes. Turning Center programming, Machining Center programming, Advance features of Controller

## Unit IV: Computer Integrated Manufacturing (CIM) (8)
Computer application in manufacturing automation and Robotics, Robot programming, computer aided inspection and quality control. Computer integrated production management system, inventory, material requirement planning, manufacturing resource planning, enterprise resource planning

**Concurrent Engineering**
Sequential engineering versus Concurrent engineering, Mathematical model for understanding between design and manufacturing, concurrent engineering techniques, Characterization of the CE environment.

## Unit V: Group Technology and FMS (8)
Part families, part classification and coding, Cell formation techniques, production flow analysis; machine cell Design, cellular Manufacturing systems.

Components of FMS, FMS planning, automated work piece handling, layout, cost feasibility typical application and emerging areas: Automated factory, remote control, analytical models of
FMS: CANQ, deterministic models, Petri nets.

Unit VI: CIM Models and Rapid Prototyping  (8)

Term Work:
The term work shall consist of assignments based on the following topics. Evaluation of practical will be based on Oral examination.

2. Programming on CNC Lathe/Milling.
3. Programming on Robot application.
6. Simulation of a simple mechanical system.

Text Books

Reference Books
411088: PROCESS PLANNING AND TOOL SELECTION

Unit I: Product Engineering (8)

Process Engineering: Organizational activities, functional activities, relation with other departments, classification of processes, manufacturing operations, operational elements - machining, handling, setting, inspection and approach for selecting and planning a process: determining machining sequences - criteria, classification of operations and manufacturing sequence, criteria for analysis for selection of best process.

Unit II: Analysis of Part Print (8)
Method of reading and interpreting Part dimensions, part specification, identification of nature of work to be performed, identification of functional surfaces, grouping of related surfaces to be machined, size and shape needing, special handling, identification of basic process for processing, sequences of operation from part print. Study of function of parts in assembly and operations needed

Dimensional Analysis: Types of dimensions, concept of baseline dimension, basic geometrical surfaces, concept of straightness, squareness, roundness, and concentricity. Surface Quality and surface integrity, surface finish affecting product properties and product cost. Baselines, datum surfaces selection, dimensional chain and linkage analysis, fixing in process dimensions

Unit III: Tolerance analysis (8)
Producing accuracies and attainable accuracies - process capability relation with statistical accuracies, prime accuracies, Size and form, grades of tolerances, tolerance grade calculations, Tolerance Stacks, Tolerance analysis for Assembly, purpose, use, and layout of Tolerance charts development and balancing the Tolerance Chart, individual size maintenance and automatic size maintenance

Work piece control: Causes of Work piece variation, shape of part affecting processing, Variables influencing Work piece control, Mechanical, Geometric and Dimensional Control, Equilibrium Theories. Concept of Location - fundamental of Locating datum features, errors in locating and clamping, establishing process areas, guide lines for identifying holding areas, supporting areas and critical areas.

Unit IV: Selection of Proper Equipment (8)
Process capability of Equipments, prime accuracies and producible accuracies of Equipments, Factors influencing make or buy decisions, relation between Process
selection and Machine selection, basic factors in machine selection in terms of cost and design factors. Determining machining conditions and computing manufacturing times.

**Selection of Tooling**
Factors affecting selection of Tooling, commercial tooling, special tooling, selection of Tools: jigs, fixtures, gauges, form tool in relation to process selected. Use of multi-tooling set up, tooling economics as applied to Process Engineering.

Stock preparations and blank selection with material estimates.

**Unit V: Selecting and Planning the Process**
Study of Basic Processes Operations, Principal Processes and Auxiliary Processes. Identification of major, critical, qualifying, re-qualifying and supporting operations. Selection of single or combined operation, identification of finishing operations, establishing of manufacturing sequence through classifying operation - critical analysis in determining best operation sequence by selecting best process sequence.

Computer Aided Process Planning (CAPP): CAPP - variant approach and generative approach. CAD database, work center database, Automatic time standard system (ATS), sequencing operations and grouping, selection of datum surfaces and holding devices, including inspection stages into computer program, structured process planning software system, Computerized report generation, Introduction to expert system for process planning.

**Unit VI: Process Sheet Design**
Study of the parts to be processed, Logical design of a process plan, stock preparations, blank selection with material estimates, Selection of datum features, identification of machining surfaces, incorporation of dimensions including tolerance analysis, selection of machining methods with time estimates and time standard for each operation, Process Picture sheet including process symbols, processing dimensions. Process plan sheet design for complete manufacturing part.

**Term Work:**
The term work shall consist of assignments based on the following topics. *Oral shall be based on the Term work.*

1. One case study of process documentation as per International Standards (ISO, QS, TS etc) using cutting tool manufacturers’ catalogues.
2. Part print analysis of one industrial component drawing.
3. Process Sheet design of one component on GPM for batch production.
4. Process Sheet design of one component for mass production.
5. Time estimation for assembly using flow-charting techniques.
6. Industrial visit to study process designing and its report.

**Text Books:**

Reference Books:
411089: AUTOMOBILE ENGINEERING (ELECTIVE III - I)

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

Examination Scheme
Theory: 100 Marks
Term work: 50 Marks
Duration: 3 Hours

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: Carburetion, Air fuel requirements for SI engines under various operating conditions, 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 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 gradiability, selection of gear ratio, sliding mesh, constant mesh and epicyclic gear boxes, synchromesh devices, automatic gear boxes, torque converters, overdrive.

Unit V: Study of Suspension and Steering Systems (9)
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 levelling 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 (7)
Braking Systems: Braking systems used in automobiles, layout and working, antiskid braking.
Automobile Maintenance: Preventive maintenance, troubleshooting and diagnosis for the systems that constitute an automobile.

Term Work

The term work shall be based on any Six of the following assignments

1. Study of fuel injection systems for SI and CI engines.
2. Study of cooling systems in an automobile.
4. Study of different types of clutches.
5. Study of transmission system in an automobile.
6. Study of wheel alignment.
7. Study of different types braking system.
8. Study of independent suspension system.
9. Study of preventive maintenance, troubleshooting for clutch, steering, brake, suspension and gear box systems in an automobile.

Text Books


Reference Books

411089: MECHATRONICS (ELECTIVE III - II)

Teaching Scheme          Examination Scheme
Lectures: 4 hrs/Week      Theory: 100 Marks
Practicals: 2 hrs/Week    Term work: 50 Marks
Duration: 3 Hours

Unit I: Introduction to Programmable Controllers
Definition, A Historical Background, Principles of Operation, PLCs Versus Other Types of Controls PLC Product Application, Ladder Diagrams and the PLC Advantages of PLCs

Logic Concepts
The Binary Concept, Logic Functions, Principles of Boolean Algebra and Logic, PLC Circuits and Logic Contact Symbology

Processors, the Power Supply, and Programming Devices
Introduction, Processors, Processor Scan, Error Checking and Diagnostics, The System Power Supply, Programming Devices

Unit II: The Discrete Input/Output System
Introduction to Discrete I/O Systems, I/O Rack Enclosures and Table Mapping, Remote I/O Systems, PLC Instructions for Discrete Inputs, Types of Discrete Inputs, PLC Instructions for Discrete Outputs, Discrete Outputs, Discrete Bypass/Control Stations, Interpreting I/O, Specifications, Summary of Discrete I/O

Unit III: The Analog Input/Output System
Overview of Analog Input Signals, Instructions for Analog Input Modules, 7-3 Analog Input Data Representation, Analog Input Data Handling, Analog Input Connections Overview of Analog Output Signals, Instructions for Analog Output Modules, Analog Output Data Representation, Analog Output Data Handling, Analog Output Connections Analog Output Bypass/Control Stations

Unit IV: Special Function I/O and Serial Communication Interfacing
Introduction to Special I/O, Special Discrete Interfaces, Special Analog, Temperature, and PID Interfaces, Positioning Interfaces, ASCII, Computer, and Network Interfaces, Fuzzy Logic Interfaces, Peripheral Interfacing

Unit V: Programming Languages
Introduction to Programming Languages, Types of PLC Languages, Ladder Diagram Format, Ladder Relay Instructions, Ladder Relay Programming, Timers and Counters, Timer Instructions, Counter Instructions, Program/Flow Control Instructions, Arithmetic Instructions, Data Manipulation Instructions, Data Transfer Instructions

Unit VI: Data Measurements and Transducers

Term Work: Term work shall be based on any six assignments based on the above syllabus
Text Books:


Reference Books:

411089: METAL WORKING TRIBOLOGY (ELECTIVE III – III)

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

Examination Scheme
Theory: 100 Marks
Term work: 50 Marks
Duration: 3 Hours

Unit I: System Analysis and its Applications in Tribo Environments
Contact theory of surface, Ergodicity and Stationarity of a surface, Abbot's bearing area curve and distribution of asperities heights. Apparent evaluation of contact stiffness of a joint.

Unit II: Friction
Adhesive and Abrasive theories of friction with modifications, Methods of measuring dynamic coefficient of friction, Stick slip motion

Unit III: Wear
Definition of wear and its various forms. Theories of Wear, Parameters affecting wear and friction, Adhesive, Abrasive, Erosive wear etc. and analytical as well as experimental methods of determination, Seals-Mechanical and dynamic seals, Lubrication used for forging, wire drawings extrusion, rolling and wire ropes

Unit IV: Lubricants and Lubrication
Typical characteristics of the Lubricant to reduce the friction as well as vibration, Dry friction, Boundary friction, and Semi-Liquid and Liquid friction under lubrications, Modes of lubrication

Unit V: Hydrostatic and Hydrodynamic Bearings
Circular thrust bearing under Hydrostatic condition, Energy losses and optimization, Radial journal bearing under hydrodynamic condition including Reynolds's equation, Finite bearing (Raimondi and Boyd method), Introduction to Elasto-hydrodynamic (modified Reynolds equation). Bearing power, film thickness, bearing temperature and radial clearance.

Unit VI: Squeeze Film
Circular, rectangular plates squeeze film Lubrication, Tribology in: Tyre – Road, Rail – wheel, Metal working cases; Application of squeeze film lubrication

Term Work:
Term work shall be based on any six assignments based on the above syllabus

Text Books:
1. Mazumdar B.C., Tribology of Bearings -, Wheeler Book Co

**Reference Books**
411089: FINITE ELEMENT ANALYSIS (ELECTIVE III - IV)

Teaching Scheme                                             Examination Scheme
Lectures: 4 hrs/Week                                         Theory: 100 Marks
Practicals: 2 hrs/Week                                       Term work: 50 Marks
Duration: 3 Hours

Unit I: Introduction (8)
Introduction, One Dimensional Problem, Finite Element modeling, Coordinate and Shape
function, Derivation of stiffness matrix and Load Vector using Potential Energy approach,
Properties of Stiffness Matrix, Assembly of Global Stiffness Matrix and Load Vector,
Elimination and penalty approach, shape function, Quadratic Shape Function.

Unit II: Trusses (8)
Introduction, Plane trusses, Assembly of global Stiffness Matrix for Banded Skyline solutions.

Unit III: Two-Dimensional Problem Using Constant Strain Triangles (8)
Introduction, finite element formulation, load considerations and boundary conditions, problem
modeling, member end forces, plane frame.

Unit IV: Axi-symmetric solids subjected to axi-symmetric loading (8)
Introduction, axi-symmetric formulation, finite element modeling of triangular element
Two dimensional iso-parametric elements
Introduction, four node quadrilateral, introduction to higher order elements.

Unit V: Finite element analysis of heat transfer (8)
Introduction, steady state heat transfer - 1D and 2D heat conduction and convection, governing
differential equation, boundary conditions, formulation of element.

Unit VI Software based FEA (8)
Mesh generation, meshing techniques, meshing in critical areas, type and size of element,
mapped elements, quality checks-[aspect ratio, warp angle, skew, Jacobian, distortion,
stretch, included angle, taper], boundary conditions, interpretation of results and design
modification

Term Work:
The term work shall consist of record of any three from 1 to 4 (C/MATLAB programs) and any
three from 5 to 8 assignments of the problems based on following topics:

1. Computer program for axial bar subjected to axial forces.
2. Computer program for truss subjected to plane forces.
3. Computer program for beams subjected to transverse forces and moments.
4. Computer program for frames subjected to transverse forces and moments.
5. Stress and deflection analysis of two dimensional truss using FEA software.
6. Stress and deflection analysis of any machine component consisting of 2-D elements
   using FEA software.
7. Stress and deflection analysis of any machine component consisting of 3-D elements
   using FEA software.
Text Books:

Reference Books:
411090 WORLD CLASS MANUFACTURING (ELECTIVE IV - I)

Teaching Scheme                                Examination Scheme
Lectures: 4 hrs/week                           Theory: 100 Marks
Duration: 3 Hours

Unit I: Historical Perspective               (8)
World class Excellent organizations – Models for manufacturing excellence: Schonberger, Halls,
Gunn and Maskell models, Business Excellence.

Unit II: Benchmark, Bottlenecks and Best Practices (8)
Concepts of benchmarking, Bottleneck and best practices, Best performers – Gaining
competitive edge through world class manufacturing – Value added manufacturing – Value
Stream mapping - Eliminating waste –Toyota Production System –Example.

UNIT-III: System and Tools for World Class Manufacturing (8)
Improving Product & Process Design – Lean Production – SQC, FMS, Rapid Prototyping, Poka Yoke,
5-S ,3 M, JIT, Product Mix , Optimizing , Procurement & stores practices , Total Productive
maintenance, Visual Control.

Unit IV: Human Resource Management in WCM           (8)
Adding value to the organization– Organizational learning – techniques of removing Root cause
of problems – People as problem solvers – New organizational structures . Associates –
Facilitators – Teamsmanship – Motivation and reward in the age of continuous improvement.

Unit V: Typical Characteristics of WCM Companies   (8)
Performance indicators like POP, TOPP and AMBITE systems– what is world class
Performance –Six Sigma philosophy

Unit VI: Indian Scenario                              (8)
Case studies on leading Indian companies towards world class manufacturing –Task Ahead.
Green Manufacturing, Clean manufacturing, Agile manufacturing

Text Books
1. Sahay B.S., Saxena KBC. and Ashish Kumar, “World Class Manufacturing - Strategic
   Prentice Hall, 2000

References:
   learning pvt. Ltd., New Delhi.
   excellence”, Butter worth Heinmann
411090: INTELLIGENT MANUFACTURING SYSTEMS (ELECTIVE IV - III)

Teaching Scheme:
Lectures: 4 hrs/Week

Examination Scheme
Theory: 100 Marks
Duration: 3 Hours

Unit I: Review on Computer Integrated Manufacturing
Computer Integrated Manufacturing Systems – Structure and functional areas of CIM system - CAD, CAM, CAPP CAQC, ASRS. Advantages of CIM. Factories of future

Unit II: Concepts of Artificial Intelligence
Origin of Artificial Intelligence, Human and machine Intelligence, Branches of artificial intelligence, Programming in AI environment, Emergence of expert systems, Applications in Engineering and Manufacturing

Unit III: Knowledge Based Systems/Expert Systems
Expert systems: Expert system process, characteristics and components of expert systems,
Knowledge Acquisition: Knowledge acquisition phases, Methods of extracting knowledge from experts, Knowledge acquisition meetings, Group knowledge acquisition,
Knowledge Representation: Characteristics of knowledge, Knowledge representation models, Concepts of knowledge sets and Reasoning models.
Expert system justification and future directions for expert systems

Unit IV: Machine Learning
Machine Learning – Concept, Artificial Neural Networks, Biological and Artificial Neuron,
Types of Neural Networks, Applications in manufacturing
Use of probability and fuzzy logic for machine thinking

Unit V: Knowledge Based Group Technology
Group Technology: Models and Algorithms – Visual method, Coding method, Cluster analysis method
Knowledge based group technology – Group technology in automated manufacturing system, Structure of knowledge based system for group technology (KBSGT) – Database, Knowledge base, Clustering algorithm

Unit VI: Industrial Applications of AI
Intelligent system for design, equipment selection, scheduling, material selection, maintenance, facility planning and process control

Text Books

Reference Books:
Unit I: Introduction (8)

Unit II: Principles of Total Quality Management (8)

Unit III: TQM Tools (8)

Unit IV: Reliability (8)
Concept and Components – Types of failure – Reliability of system – Success and Failure models in series and parallel – Methods of achieving higher reliability – Concept of maintainability and availability — Weibull Distribution (Bath Tub curve), Comparison with reliability ,MTBF, MTTF and FMEA

Unit V: Managing and organization for Quality (8)

Unit VI: Quality Management Standards: (Introductory aspects only) (8)

c. ISO 27001:2005 Information Security Management System

d. ISO / TS16949:2002 for Automobile Industry

e. CMMI Fundamentals and Concepts

**Reference Books**

1. Dale H Bester, “Quality Control”, Pearson Education,
4. Smith, “Quality Problem Solving”, Quality Press, Wisconsin Avenue, USA
411091: MANUFACTURING COSTING AND ANALYSIS

Teaching Scheme
Practical: 2 hrs/Week
Examination Scheme
Term work: 50 Marks

Financial Management & Ratio Analysis


Classification of Costs


Overheads, Standard Costing & Marginal Costing

Classification, collection of overheads, Primary and Secondary apportionment of overheads, absorption of overheads - Machine hour and labour hour rate. Under and over absorption of overheads.

Standard costing - Concept, development and use of standard costing, variance analysis.

Marginal Costing - Use of Marginal Costing in decision-making.

Capital Budgeting

Control of Capital Expenditure, Evaluation Process-Payback approach, IRR, present value method. Replacement cost and other models: Introduction, models including discounted cash flow.

Budgetary control and variance Analysis:


Import and Import Substitution

Factors affecting National and International markets, Import procedure and documents (Bill of lading, letter of credit etc.), current EXIM policies, import Substitution, E-procurement.

Pricing and Decision Process:

Opportunity cost relevance and contribution approach; incremental cost; ROI; strategic pricing of new products, Full cost pricing-advantages and disadvantages.
Term Work:

The term work shall consist of record of any eight assignments based on the above syllabus.

Text Books: