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

Subject Code	Subject	Teaching Scheme (Hrs)		Examination Scheme				
		Lecture	Pr/Dw	Th	Tw	Or	Pr	Total
411081	Machine Tool Design	4	2	100	25	50	-	175
411082	Manufacturing Automation	4	2	100	25	-	50	175
411083	Operations Research	4	2	100	50		-	150
411084	Elective I	4	2	100	50	-	-	100
411085	Elective II	4	-	100	-	-	-	100
411086	Project Work**	-	2	-	-	-	-	-
	Total	**20**	**10**	**500**	**150**	**50**	**50**	**750**

**** It is mandatory to submit preliminary project report for the grant of the term I**

Semester II

Subject Code	Subject	Teaching Scheme (Hrs)		Examination Scheme				
		Lecture	Pr/Dw	Th	Tw	Or	Pr	Total
411086	Project Work	-	6	-	100	50	-	150
411087	Computer Integrated Design and Manufacturing	4	2	100	-	-	50	150
411088	Process Planning and Tool Selection	4	2	100	-	50	-	150
411089	Elective III	4	2	100	50	-	-	150
411090	Elective IV	4	-	100	-	-	-	100
411091	Manufacturing Costing & Analysis		2	-	50	-	-	50
	Total	**16**	**14**	**400**	**200**	**100**	**50**	**750**

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

Elective I

1. Plastic Engineering
2. Industrial Robotics
3. Powder Metallurgy
4. Microprocessor Applications

Elective II

1. Ergonomics and Human Factors in Engineering

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

Elective IV

1. World Class Manufacturing
2 ***
3. Intelligent Manufacturing Systems
4. Total Quality Management

*** 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	Examination Scheme
Lectures: 4 hrs/week	Theory: 100 Marks
Practical: 2 hrs/week	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)

Design of spindle and spindle support using deflection and rigidity analysis, analysis of anti-friction bearings, preloading of antifriction bearing.
Design of power screws: Distribution of load and rigidity analysis.

Unit V: Dynamics of machine tools (8)

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

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:

1. Mehta N.K., "*Machine Tool Design*", Tata McGraw Hill, ISBN 0-07-451775-9.
2. Bhattacharya A. and Sen S.G., "*Principles of Machine Tool*", New central book agency Calcutta, ISBN 81-7381-1555.
3. Pal D.K., Basu S.K., "*Design of Machine Tool*", 4th Edition. Oxford IBH 2005, ISBN 81-204-0968.
4. Date P. P., "*Introduction to Manufacturing Technology, Principles and Practices*", , Jayco Publishers, Mumbai

Reference Books:

1. Acherkan N.S., "*Machine Tool*", Vol. I, II, III and IV, MIR publications.
2.Koenigsberger F., "*Design Principles of Metal Cutting Machine Tools*", The Macmillan Company,
New York 1964.

411082: MANUFACTURING AUTOMATION

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

1. Kuo B.C., "*Automatic control systems*", Prentice Hall India Pvt. Ltd., New Delhi
2. Peter Rohner, "*Industrial hydraulic control*", Wiley Edition, 1995
3. Mikell P Groover, "*Automation, Production System and Computer Integrated Manufacturing*", Prentice Hall Publications, ISBN 81-203-0618-X.
4. Mujumdar S.R., "*Pneumatic System*", Tata McGraw Hill 2002 Edition.
5. Gopal, "*Control Systems Engineering*", Willey Eastern Ltd., ISBN 0-85226-605-7.

Reference Books:

1. Doebelin E.O, "*Measurement System, Application and Design*", Tata McGraw Hill Publications Ltd., New Delhi, ISBN 0-07—17338-9.
2. Bolton W., "*Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering*", Pearson Education (Singapore) Pvt Ltd., ISBN 81-7808-339-6.
3. Rangan C.S., Sharma G.R., Mani V.S., "*Instrumentation - Devices and Systems*", Tata McGraw Hill Publications Ltd., New Delhi, ISBN 0-07-463350-3.
4. Histand B.H., Alciatore D.G., "*Introduction to Mechatronics and Measurement Systems*", ISBN 0-07-052910-8.
5. Johnson C.D., "*Process Control Instrumentation Technology*", Prentice Hall of India Pvt. Ltd., New Delhi, ISBN 81-203-0987-1.
6. HMT *Mechatronics*, HMT, ISBN 0-07-462147-5..
7. Vickers manual on hydraulics
8. G. Boothroyd , C. Poli, L. Murch, "*Automatic Assembly*", Marcel Dekker Inc. 1982.
9. Werner Deport and Kurt Stool, "*Mechanization by pneumatic control*", Vol. I and II.
10. Date P. P., "*Introduction to Manufacturing Technology, Principles and Practices*", , Jayco Publishers, Mumbai

411083: OPERATIONS RESEARCH

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

Unit I: Linear programming (LP) (6)

Definition of Operations Research: objectives, Simplex methods for maximization and minimization problems, degeneracy in L.P., duality in L. P., Sensitivity analysis, Revised simplex method

Unit II: Transportation and Assignment problem (8)

Structure, industrial and business application, Transportation problems- use of various methods for solving transportation problem, degeneracy and its solution, transshipment problem. Assignment problem- solutions of various types of problems, travelling salesman problem.

Unit III: Introduction to Integer, Dynamic and Non-linear programming (7)

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. (3)

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

Unit IV: Replacement models (8)

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: (4)

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

Inventory Theory: **(4)**

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 (8)

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

1. Sharma S.D., "*Operations Research*", Kedarnath Ramnath and company publications.
2. Gupta P.K., Hira D.S., "*Operations Research*", S Chand and Co. Ltd., New Delhi
3. Taha H.A., "*Operations Research - An introduction"*, Prentice Hall Pvt. Ltd.,

Reference Books

1. Hillier F.S., Lieberman G.J., "*Introduction to Operations Research*", Tata McGraw-Hill,
2. Wagner H.M., "*Principles of Operations Research*", Prentice-Hall India,
3. Ravindran A., "*Operations Research*", Tata McGraw-Hill. New Delhi
4. Basu S.K., Pal D.K., and Bagchi H., "*Operations Research for Engineers*", Oxford and IBH Publishing Co. Pvt. Ltd.,
5. Panneerselvam R., "*Operations Research*", Prentice Hall of India Ltd., New Delhi

411084 PLASTIC ENGINEERING (ELECTIVE I – I)

Teaching Scheme:
Theory: 4 hrs. / week.
Practical: 2 hrs / week

Examination scheme:
Paper: 100 marks.
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:

1. William J. Patton, "*Plastic Technology*, Tarapurwala and Sons.
2. Akira Kobayashi, "*Machining of Plastics"*, Robert A Krieger Publication, 1981.
3. Batra, "*Design of Blow Moulds",* CBS Publishers & Distributors, 2007
4. Throne J.L., *"Technology of Thermoforming",* Hanser Gardner Publications, 1996
5. Brent Strong, "*Plastics: Materials Processing",* 3rd Ed., Prentice Hall, 2005

References:

1. 1.Allen W.S., and Baker P/N., "*Handbook of Plastic Technology",* Vol I &II, CBS Publishers.
2. 2.Athlye A.S., "*Plastic Processing Handbook"*, Multitech Publication.
3. 3.Christopher Lefteri, "*Plastics Handbook*", RotoVision Publication, 2008
4. Date P. P., "*Introduction to Manufacturing Technology, Principles and Practices*", , Jayco Publishers, Mumbai

411084: INDUSTRIAL ROBOTICS (ELECTIVE – I - II)

Teaching Scheme	Examination Scheme
Lectures: 4 hrs/Week	Theory: 100 Marks
Practical: 2 hrs./Week	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. Dennavit - 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)

Sensors - functioning, types, analysis and fields of applications. Tactile sensors, temperature sensors, Variable Pressure Light Converting Sensor, High Resolution Pneumatic tactile Sensor, Slip type Sensors, Piezo electric Contact Sensors. Remote Sensor Compliance, Range & Proximity Sensors, Electro- optical Sensors.
Vision system: Median filtering, thresholding, discretisation, Smoothening of binary image. Recognition Procedure. CCD Camera.

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)

Pick and place Robot, Arc Welding Robots, Assembly and mega-assembly Robots, Walking Robots, Climbing Robots, Machine mounted Robots. Interfacing Robots with computers.
Obstacle Avoidance: Lee's Algorithm; Counter Path Defining using 'via' point, blending technique.

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:

1. Deb S.R., "*Robotics",* Tata McGraw Hill Publications, New Delhi.
2. Yoram Koren, "*Robotics for Engineers*", McGraw Hill Book Co.
3. Groover M.P., Weiss M., Nagel R.N., Odrey N.G., "*Industrial Robotics Technology* - Programming *and Applications*", McGraw Hill Book Co.
4. Fu K.S., Gonzalex R.C., Lee C.S.G., "*Robotics Control Sensing, Vision and intelligence*", McGraw Hill Book Co.

Reference Books

1. Hartenberg and Denavit, "*Kinematics and Synthesis of Linkages*", McGraw Hill Book Co.
2. Hall A.S., "*Kinematics and Linkage Design*", Prentice Hall.
3. Hirchhorn J., "*Kinematics and Dynamics of Machinery*", McGraw Hill Book Co.
4. Todd D.J., "*Fundamentals of Robot Technology*", Wiley Publications
5. Paul R., "*Robots - Manipulators, Mathematics, Programming and Control"*, MIT Press.
6. Janakiraman P.A., "*Robotics and Image Processing"*, Tata McGraw Hill 1995.

411084: POWDER METALLURGY (ELECTIVE I - III)

Teaching Scheme	Examination Scheme
Lectures: 4 hrs/week	Theory: 100 Marks
Practicals: 2 hrs./Week	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.
Production methodology and quality control. Preparation of powder: grading, sizing, handling and storage. Testing of powders. Powder sampling Particle size & particle size distribution, flow rate, surface conditions, purity, flow properties, porosity, true and apparent density, Green compact strength. Powder Treatment, Powder mixing & blending

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)

Economics, Quality, Manufacturing Competitiveness due to conservation of energy, Materials, Operations, Durability, rigidity, near net – shape, surface finish and machining.
Heat treatment of Powder Metallurgy parts, advantages and limitations, typical applications.
Quality control and quality assurance. Newer materials, production of nano-composites

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:

1. Sinha A.K., "*A textbook of power Metallurgy*", D.P. Tai.
2. Thumler, "*Powder Metallurgy Science"*
3. Upadhyaya G.S., *Powder Metallurgy*, University Press, 2011.
4. Sands C.R. and Shakespere R.L., "*Powder Metallurgy*", Gorge Newnes Publications, 1966.

Reference Books:

1. ASM HandBook Vol. II.
2. Hari Singh Nalwa (Editor), "*Handbook of Nano-structured Materials and Nano-Technology*" Vol 1-5,
Springer Verlang

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, I^2C.

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

Text Books:

1. Muhammas Mazidi, Jancie Mazidi, Rollin McKinay : '*The 8051 Microcontroller and Embedded Systems using Assembly & C*, Pearson edition
2. Kenneth J. Ayala, "*The 8051 Microcontroller*" Cengage Learning
3. Myke Predko" *Programming and Customizing the 8051 Microcontroller*" Tata Mc-GrawHill
4. Gaonkar R.S., "*Microprocessor Architecture, Programming and Applications with 8085*", Penram International.

Reference Books

1. Intel Manuals.
2. Ayala K.J., "*The 8051 Micro controller: Architecture, programming and Applications*", Penram International Published, India.
3. Boyer S.Y., "*SCADA*", ISA Publications.
4. John Webb, "PLC", Otter.
5. Noltingk B.E., "*Instrumentations Reference Book*", Butterworth International Edition.
6. Malvino A.P. Leach, D.P., "*Digital Principles and Applications*", Tata McGraw– Hill, 1990.
7. Goankar R.S., "*Microprocessors Architecture. Programming and Applications*", Wiley Eastern, 1992.
8. Ajit Pal., "*Microprocessors*", Tata McGraw-Hill, Revised Edition 1995.
9. Douglas, Hall, "*Microprocessors and Interfacing*", Tata McGraw–Hill, Revised Edition 1990.
10. Mathur A.P., "*Introduction to Microprocessors*", Tata McGraw–Hill, Revised Edition 1995.

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.
Atmospheric conditions: Measurement of thermal variables, wet-bulb globe temperature, Botsball, heat stress index, heat index, wind chill index, physiological effect of heat & cold on performance.
Noise: Physiological effect of noise on performance, noise exposure limits, noise controls.

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

1. Sanders M. S. and McCormick E. J., "*Human Factors in Engineering and Design*", McGraw-Hill International Editions,
2. Bridger R. S., "*Introduction to Ergonomics*", McGraw-Hill International Editions

References

1. Gavriel Salvendy (Ed.)., *'Handbook of human factors and ergonomics"*, 3rd Edition, John-Wiley and Sons

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

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

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:

1. Dobler and Lee, "*Purchasing and Material Management*", Tata McGraw Hill, New Delhi
2. Jhamb, L.C., "*Inventory Management*", Everest Publications,
3. Menon, K.S., "*Purchasing and Inventory Control*", Wheeler Publication, New Delhi
4. Chopra Sunil and Peter Meindl., "Supply Chain Management: Strategy, Planning and Operation",3rd Edition, Prentice Hall, 2006.

Reference Books:

1. Miles L.D., "*Techniques of Value Analysis and Engineering*", McGraw Hill Book Company.
2. Simchi-Levi, Kaminsky, "*Designing and Managing the Supply Chain, Concepts Strategies and Case studies*", 2nd Edition, Tata McGraw Hill, New Delhi
3. James R. Stock and Diouglas M. Lambert, "*Strategic Logistics Management*" 4th Edition, McGraw Hill International Edition.
4. Bowersox D.J., Closs, D.J., "*Logistical Management*", McGraw Hill Book Company, Singapore

411085: SIMULATION AND MODELING (ELECTIVE II - III)

Teaching Scheme:	Examination Scheme
Lectures: 4 hrs/Week	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:

1. Averill M Law, "*Simulation Modeling and Analysis",* Fourth Edition, Tata McGraw Hill Education Private Ltd, New Delhi, 2010.
2. Banks, J., J. S. Carson II, and B. L. Nelson. "*Discrete-Event System Simulation",* Second Edition, Prentice Hall, Upper Saddle River, New Jersey, 1996.
3. Bratley, P., B. L. Fox, and L. E. Schrage "*A Guide to Simulation",* 2nd ed., Springer-Verlag, New York, 1987.
4. Fishman, G.S., "*Monte Carlo: Concepts, Algorithms and Applications",* Chapman & Hall, New York, 1996.

References:

1. Jerry Banks (Ed.), "*Handbook of Simulation – Principles, Methodology, Advances, Applications and Practice"*, Wiley – Interscience Publication, 1998
2. Gordon G., "*System Simulation",* 2nd Edition, Prentice Hall,1978
3. Nelson, B. L., "*Stochastic Modeling: Analysis and Simulation",* McGraw-Hill, New York, 1995.

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

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

Unit I: Organisation of Plant Engineering (8)

Principles of plant management functions. Classification of maintenance work-Routine maintenance, emergency work, service work, preventive maintenance. Project work, Corrective work, Assessment of maintenance work. Performance and productivity measurement; problem solving techniques. Statistical processes. Parato chart. Manpower planning and training for maintenance and safety staff.

Unit II: Plant Facilities and Layout Planning (8)

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 (8)

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 (8)

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 (8)

Plant safety-fire protection and prevention, safety against mechanical hazards, chemical hazards, accident prevention practices and codes. Pollution control-Waste disposal, existing limiting norms. Recycling of waste. Energy conservation, management and audit. Material handling equipments.

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, Tero-technology 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:

1. Bhadury B. and Basu S.K., "*Terotechnology: Reliability Engineering and Maintenance Management",* Asian Books, New Delhi 2002.
2. Gupta A.K., "*Terotechnology & Reliability Engineering"*, McMillan Publications
3. Collacatt R.A., "*Mechanical fault Diagnosis and Condition Monitoring"*, Chapman and Hall Ltd.
4. Sushikumar Srivastava, "*Industrial Maintenance Management"*, S. Chand and Co. Ltd., New Delhi.
5. Garg H.P., "*Industrial Maintenance"*, S. Chand and Co., New Delhi.

Reference Books:

1. Jardine A.K.S., "*Maintenance, Replacement and Reliability"*, HMSO, London
2. Rosaler R., "*Handbook of Plant Engineering"*, 3rd Edition, McGraw Hill, 2002.
3. Higgins L.R., et al, "*Handbook of Maintenance Engineering"*, McGraw Hill, 2001
4. Rudenko N., "*Material, Handling equipment",* MIR Publications, Moscow.
5. Jacob Fruchlboum, "*Bulk Material Handling Handbook"*, 1st Edition, Springer, 1988.

411086 PROJECT WORK

Teaching Scheme:	Examination Scheme - II Term
Practicals: 2 hrs/week (Semester I)	Term Work: 100 Marks
Practicals: 6 hrs/week (Semester II)	Oral: 50 Marks

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
6. Energy Audit of an organization, Industrial evaluation of machine devices.
7. Design of a test rig for performance evaluation of machine devices.
8. Product design and development.
9. Analysis, evaluation and experimental verification of any engineering problem encountered.
10. Quality systems and management. Total Quality Management.
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
3. Completion Certificate form Industry, if sponsored.
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

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

Unit I: Computer Aided Design (CAD) (8)

Trends in Modern Manufacturing, Product Cycle and CAD/CAM, Functional relationship, Transformation- Introduction, Formulation, Translation, Rotation, Scaling, Reflection, Homogenous Representation, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations, Introduction to Solid, Geometry & Topology, Solid Representation Techniques, Introduction to synthetic curves and surfaces.

Unit II: Computer Applications in Engineering Analysis (8)

One dimensional problems: Finite elements modeling, Co-ordinates and shape functions, Potential Energy Approach, Galerkin Approach, Assembly of Global Stiffness Matrix and Load Vector, Finite Element equations. Truss problems: Plane trusses, Three-dimensional trusses, Two dimensional problems: Finite element modeling, constant strain triangle, Problem modeling and Boundary conditions, Axi-symmetric Solids subjected to axi-symmetric loading, Two dimensional iso-parametric elements, Beams and Frames,

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)

Introduction, ESPRIT – CIM OSA Model, The NIST – AMRF Hierarchical Model, The Siemens Model of CIM, The CIM model of Digital Equipment Corporation, IBM concept of CIM, Present Scenario, Rapid Product Development and Manufacture, Extended Enterprises.
Methods of rapid prototyping: steriolithography, 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

Term Work:

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

1. Construction of parametric solid model of any machine elements using software package.
2. Programming on CNC Lathe/Milling.
3. Programming on Robot application.
4. Flexible Manufacturing Systems.
5. Manufacturing Resource Planning.
6. Simulation of a simple mechanical system.

Text Books

1. Kundra T.K., Rao P.N., Tiwari N.K., "*Numerical control and Computer aided manufacturing*", Tata McGraw Hill 1992.
2. Ibraim Zeid, "*Mastering CAD/CAM*", Tata McGraw Hill Publishing Co. 2000.
3. Nanua Singh, "*System Approach to Computer Integrated Design and Manufacturing*", John Wiley 1996.
4. Radhakrishanan P, Subramanium S., and Raju V., "*CAD /CAM / CIM*", New Age International Pvt. Ltd. New Delhi.
5. Mikel P.Groover, Emory W. Zimmers, "*Computer aided design and manufacturing*", Prentice Hall
India Ltd. 2000.

Reference Books

1. Mikell P. Groover, *"Automation, Production systems and Computer Integrated Manufacturing*", Prentice Hall of India Pvt. Ltd. 1999.
2. Rogers D.F.,, "*Procedural Elements for Computer Graphics*", TMH Book Co. New Delhi 2004.
3. Harrrington Steven, "*Computer Graphics- A Programming Approach*', McGraw Hills Inc. 2003.
4. Chandrupatla T.R., Belegundu A.D., "*Introduction to Finite Elements in Engineering*", Prentice Hall of India 2003.
5. Segerund L.J., "*Applied Finite Elements Analyses*", John Wiley and Sons.
6. Bathe K.J., "*Finite Element Procedures*", Prentice Hall of India 2001.
7. Ramamurti V., "*Computer Aided Mechanical Design and Analysis*", Tata McGraw Hill Pub. Co. New Delhi 1987.

411088: PROCESS PLANNING AND TOOL SELECTION

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

Unit I: Product Engineering (8)

Concept of a product – Its elements, units, subassemblies and assemblies, scope of product engineering function, Flow charts of assemblies, Product analysis and planning: Design for Manufacturing and assembly (DFMA). Product selection and criteria of Product acceptability based on market research.

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 (8)
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 (8)
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:

1. D. F. Eary, G. E Johnson, "*Process Engineering for Manufacturing*", Prentice Hall of India Pvt. Ltd.
2. P.W. Wang, J.K Li, "*Computer-Aided Process Planning*", Elsevier, Amsterdam.

3. Nanua Singh, "*Systems Approach to Computer Integrated Design and Manufacturing*", John Wiley & Sons, 1995.
4. Scallan Peter, "*Process Planning- Design, Manufacture Interface",* 1st Edition, Butterworth – Heinemann Publications, 2003.
5. Radhakrishanan P., Subramanyan S., Raju V., "*CAD/CAM/CIM*", New Age International (P) Limited.
6. Narayana K.L., Kannaiah P., Venkata Reddy K., "*Production Drawing*", New age International Publishers

Reference Books:

1. K. Hitomi , "*Manufacturing System Engineering*", Taylor and Francis 1996,
2. Groover, Mikell P., "Fundamentals of Modern Manufacturing- Materials, Processes, and Systems"**, S**econd Edition, Wiley, 2002.
3. Date P. P., "*Introduction to Manufacturing Technology, Principles and Practices*", , Jayco Publishers, Mumbai

411089: AUTOMOBILE ENGINEERING (ELECTIVE III - I)

Teaching Scheme	Examination Scheme
Lectures: 4 hrs/Week	Theory: 100 Marks
Practical: 2 hrs/Week	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.
3. Study of ignition 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, trouble shooting for clutch, steering, brake, suspension and gear box systems in an automobile.

Text Books

1. Ganesan V., "*Internal Combustion Engines*", Tata McGraw Hill Publishing Company Ltd, Ninth Edition, New Delhi, 1995.
2. Mathur M.L., and Sharma R. P., "*A course in I.C. Engine*", Dhanpat Rai Publication, Seventh Edition, New Delhi, 1999.
3. Singh Kirpal, "*Automobile Engineering – Vol II*", New Chand Jain", Seventh Edition, Delhi, 1996.
4. Narang G. B. *S.,* "*Automobile Engineering*", S. Chand and Company Ltd, Fifth Edition, Delhi, 1995.
5. Ballancy P. L., "*Internal Combustion Engines*", Khanna Publishers, Third Edition, New Delhi, 1991.

Reference Books

1. Newton, Steeds and Garrett., "*Motor Vehicle*", The English Language Book Society, Ninth Edition, 1972.
2. Crouse W. H., "*Automotive Mechanics*", Tata McGraw Hill Publishing Company Ltd, New Delhi, Ninth Edition, Delhi, 1993.
3. Joseph Heitner, "*Automotive Mechanics*" CBS Publishers and Distribution, Second Edition, Delhi, 1987.
4. Gill P. W., Smith J. H., et.al, "*Fundamental of I.C. Engines*", Oxford and IBH Publishing Co. Pvt. Ltd., Fourth Edition, Delhi, 1959.
5. Arkhangelsky V. et.al., "*Motor Vehicle Engines*", MIR Publishers, Mascow,1976.

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 (8)

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 (8)

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 (8)

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 (8)

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 (8)

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 (8)

Basic Measurement Concepts, Interpreting Errors in Measurements, Transducer Measurements, Thermal Transducers, Displacement Transducers, Pressure Transducers, Flow Transducers, Vibration Transducers (Any two)

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

Text Books:

1. Brayan L.A., Brayan E.A., "*Programmable Controllers Theory and Implementation",* Industrial Text Company Publication
2. Keith Clements, Jeffcoat J.W., *"The PLC workbook: programmable logic controllers made easy*", Prentice Hall, 1996.
3. Peter Rohner, "*Automation with Programmable Logic Controllers*", UNSW Press, 1996.
4. Bolton W., "*Programmable Logic Controllers*", 5th Edition, Newnes Publications, 2009.

Reference Books:

1. Clarence T. Jones, "*Programmable Logic Controllers: The Complete Guide to the Technology*", Brilliant-Training Publications, 1996.
2. Andrew Parr E., "*Programmable Controllers: An Engineer's Guide*", 3rd Edition, Elsevier Publications, 2003.
3. James Rehg A., Glenn Sartori J., *Programmable Logic Controllers*"; Prentice Hall, 2007.

411089: METAL WORKING TRIBOLOGY (ELECTIVE III – III)

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

Unit I: System Analysis and its Applications in Tribo Environments (8)

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 (8)

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

Unit III: Wear (8)

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 (8)

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 (8)

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 (8)

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
2. Basu S.K., Sengupta S. N. and Ahuja B.B. "Fundamentals of Tribology" PHI Ltd., 2006.
3. Date P. P., "*Introduction to Manufacturing Technology, Principles and Practices*", , Jayco Publishers, Mumbai

4. Cameron B., *Elastohydrodynarnic Lubrication*, Wiley and Sons.

Reference Books

1. Kragelsky I, Alisin V. "*Friction, Wear Lubrication: Tribology Handbook*", Pergmon press, 1982
2. Czichos H., *Tribology - A Systems Approach,* Elsevier Scientific Pub. Co., Amsterdam.
3. Rabinowics E., *Friction and Wear of Materials*, Wiley, N.Y.
4. Halling J., *Principles of Tribology,* Scholium Intl. publications, 1978

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, Jacobean, 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.
8. Modal analysis of any machine components.

Text Books:

1. Chandrupatla T.R. and Belegunda A.D., *Introduction to Finite Elements in Engineering*, Prentice Hallof India.
2. Reddy J.N, "*Introduction to Finite Element Methods*" Mc Graw Hill Publications,

Reference Books:

1. Daryl Logan, *First Course in the Finite Element Method*, Cengage Learning India Pvt Ltd.
2. David V. Hutton, *Fundamentals of Finite Element Analysis*, Tata McGraw-Hill Education Pvt. Ltd.
3. Zienkiewicz. C., Taylor, R. I., *The Finite Element Method*, Butterworth-Heinemann, 5th Edition, 2000.
4. Akin J.E., *Finite Element Analysis with Error Estimators*, Elsevier, 2005.
5. Cook R. D., *Finite Element Modeling for Stress Analysis*, John Wiley & Sons Inc, 1995.
6. Liu G.R. and Quek S.S., *The Finite Element Method – A Practical Course,* Butterworth-Heinemann, 2003.
7. Kwon Y. W., and Bang H., *Finite Element Method using MATLAB*, CRC Press, 1997.
8. Asghar Bhatti, *Fundamental Finite Element Analysis and Applications*, John Wiley & Sons Inc, 2005

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 Perspective*, Mac Milan Publications, New Delhi.
2. Korgaonkar M.G., "*Just In Time Manufacturing*", MacMilan Publications
3. Narayanan V.K., "*Managing Technology and Innovation for Competitive Advantage"*, Prentice Hall, 2000

References:

1. Adam and Ebert, "*Production and Operational Management",* 5th Edition, Prentice Hall learning pvt. Ltd., New Delhi.
2. Ron Moore, "*Making Common Sense Common Practice – Models for manufacturing excellence"*, Butter worth Heinmann
3. Jeffrey K.Liker, "*The Toyota Way – 14 Management Principles",* Mc-Graw Hill, 2003.
4. Chase Richard B., Jacob Robert., *Operations Management for Competitive Advantage",* 11th Edition, McGraw Hill Publications, 2005.
5. Moore Ron, "*Making Common Sense Common Practice*", Butterworth-Heinemann, 2002.

6. Womack J.P., Jones D.T., *"Machine That Changed The World: The Story of Lean Production"*, Harper Perennial, 1991.

411090: INTELLIGENT MANUFACTURING SYSTEMS (ELECTIVE IV - III)

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

Unit I: Review on Computer Integrated Manufacturing (8)
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 (8)
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
Intelligent Manufacturing Systems – System components, System Architecture and Data Flow and System Operation

Unit III: Knowledge Based Systems/Expert Systems (8)
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 (8)
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 (8)
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 (8)
Intelligent system for design, equipment selection, scheduling, material selection, maintenance, facility planning and process control

Text Books

1. Badiru A.B., "*Expert Systems Applications in Engineering and Manufacturing"*, Prentice-Hall, New Jersey, 1992.
2. Andrew Kussiak,, *"Intelligent Manufacturing Systems",* Prentice Hall , 1990

Reference Books:

1. Groover M.P., "*Automation, Production Systems and CIM*", Prentice-Hall, New Delhi, 2009.
2. Robert Levine et al., "*A Comprehensive guide to AI and Expert Systems*", McGraw Hill Inc, 1986.

415090: TOTAL QUALITY MANAGEMENT (ELECTIVE IV - IV)

Teaching scheme	Examination scheme
Lectures: 4 Hrs/week	Theory: 100 Marks
	Duration: 3 Hours

Unit I: Introduction **(8)**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Quality in Manufacturing and Service Systems, Leadership Concepts, The Balridge view of Leadership, Role of Senior Management, Economic Issues - Quality and Price - Quality and Market Share – Quality and Cost, Quality Council, Quality Statements, Barriers to TQM Implementation.

Unit II: Principles of Total Quality Management **(8)**

Elements of Total Quality Management– A Customer Focus – Fact-Based Management – Continuous Improvement –Teamwork and Participation. Customer Perception of Quality , Customer Complaints, Service Quality, Customer Retention, Employee Involvement ,Malcolm Baldrige National Quality Award ,Award Criteria. Benefits of Total Quality Management. The Deming Management Philosophy – Profound Knowledge – The Impact of Profound Knowledge – Deming's 14 Points for Management- PDCA Cycle, The Juran Philosophy – The Juran Quality Trilogy. The Crosby Philosophy. The Taguchi Loss Function, 5S, Kaizen, Performance Measures

Unit III: TQM Tools **(8)**

Ishikawa 's Seven Quality Tools, Ishikawa Fish bone diagram –Nominal Group Technique – Quality Circles – Flow Charts – Pareto Analysis– Poka Yoke (Mistake Proofing), Benchmarking, Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD), House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) Concept, Improvement Needs, FMEA, Stages of FMEA, cybernetic Analysis

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)**

Quality Policy – Quality Objectives– Leadership for Quality – Quality and organization culture – Change Management – Team Building. Partnerships - Cross-Functional Teams –Supplier/Customer Partnerships, Control Charts for variables and attributes, Process capability, Concept of six sigma, Auditing Techniques - Planning for an audit - Developing a Check-list -Conducting an Audit - Writing an Audit Report - Auditor Ethics - Value -addition process during Internal Audit - Mock Audits.

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

a. The ISO 9001:2000 Quality Management System Standard

b. The ISO 14001:2004 Environmental Management System Standard
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,
2. Sundarrajan, "*Total Quality Management",* Pearson Education
3. Jain, "*Quality Control and Total Quality Management"*, Khanna Publications, New Delhi
4. Smith, "*Quality Problem Solving"*, Quality Press, Wisconsin Avenue, USA
5. James R.Evans and William M.Lidsay, "*The Management and Control of Quality"*, 5th Ed., South-Western (Thomson Learning), 2002.
6. Feigenbaum.A.V., "*Total Quality Management"*, McGraw-Hill, 1991.
7. Oakland.J.S., "*Total Quality Management"*, Butterworth Hcinemann Ltd., Oxford. 1989.
8. Narayana V. and Sreenivasan, N.S., "*Quality Management - Concepts and Tasks"*, New Age International 1996.
9. Zeiri, "*Total Quality Management for Engineers"*, Wood Head Publishers, 1991

411091: MANUFACTURING COSTING AND ANALYSIS

Teaching Scheme
Practical: 2 hrs/Week

Examination Scheme
Term work: 50 Marks

Financial Management & Ratio Analysis

Financial Function, Scope, goals and tools. Sources of finance. Ratio Analysis – important ratios, their utility and limitations. Turnover Ratios, Profitability Ratios.

Classification of Costs

Methods of costing and elements of cost. Prime Cost, Cost of production, Overheads; Material Cost, Labour Cost, Expenses.
Different methods of pricing of issue of materials.
Wages and incentive plans. Principles of good remunerating system, labour turnover.
Depreciation - concept, importance and different methods of depreciation
Estimating of material, machining, labour and overheads 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:
Material, Labour, Overhead, Sales. Profit, Product-mix and Yield Variance.
Capital cost control-the nature of control, elements of cost control programme, project planning and scheduling, cost reporting and corrective action. Capital cost control-repetitive operating cost, standard costs, cost reporting and corrective action.

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:

1. Henry M. Steiner, "*Engineering Economics Principles*", McGraw Hill Publication.
2. N. K. Prasad, "*Principles and Practice of Cost Accounting*", Book Syndicate Pvt. Ltd., Calcutta 700009.
3. Jawahar Lal, "*Cost Accounting*", 3rd Edition, Tata Mc-Graw Hill Publications, New Delhi.