PRODUCTION ENGINEERING & INDUSTRIAL MANAGEMENT

B. Tech.

Effective from A. Y. 2014-15

INDEX

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	BSC	Basic Science Course
2	PSC	Professional Science Course
3	PCC	Program Core Course
4	LC	Laboratory Course
5	HSSC	Humanities and Social Science Course
6	MLC	Mandatory Learning Course
8	LLC	Liberal Learning Course

Program Education Objectives (PEOs):

I. Advance professionally as a result of his/her ability to solve complex technical problems and to work in multidisciplinary teams on problems whose solutions lead to significant societal benefits.

II. Demonstrate professional engineering competence and compete successfully using principles of manufacturing and time and quality management in the design and manufacture of products and services.

III. Make scholarly contributions to knowledge as demonstrated by publishing papers and/or technical reports, applying for patents, delivering effective conference presentations, and/or contributing to innovative leadership articles.

IV. Demonstrate a commitment to the community and the profession through involvement with community and/or professional organizations and/or make contributions towards society's greater good and prosperity.

V. Demonstrate an understanding of the need for life-long learning via progress toward, or successful completion of an advanced degree, professional development and/or industrial training course(s), and/or engineering certification.

Program Outcomes (POs):

On successful completion Graduates will demonstrate:

a) An ability to apply knowledge of mathematics, science, and engineering.
b) An ability to apply knowledge of manufacturing, material science, design engineering to solve the real life problems and to increase the productivity.
c) An ability to design and conduct experiments, as well as to analyze and interpret the data and optimize the process.
d) An ability to design a system, component, or process to meet desired needs subject to technical, economical and environmental constraints.
e) An ability to function on multi-disciplinary teams and familiar with organizational behavior and management.
f) An ability to identify, formulate, and solve manufacturing engineering problems with advance tools and techniques leading to sustainable development of industry and society.
g) An understanding of professional and ethical responsibility.
h) An ability to think, listen and communicate effectively verbally and written.
i) An understanding of the impact of engineering solutions and industrial safety in a global and societal context.
j) Recognition of the need for, and ability to engage in healthy competition, life-long learning and knowledge of contemporary issues.
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CURRICULUM STRUCTURE OF FINAL B.TECH
(PRODUCTION S/W) Effective from 2014-15

VII-Semester

Sr. No	Course code	Subject Title	Contact hours L	T	P	Credits
01	**OEC**	OPEN ELECTIVE COURSE	3	-	-	3
02	**PCC/PE403**	Machine Tool Design	3	-	-	3
03	**PCC/PE405**	CAD / CAM / CIM	3	1	-	4
04	**PCC/PE407**	Mechatronics & Automation	3	-	-	3
05	**PCC/PE409**	Manufacturing Economics	2	-	-	2
06	**DEC/PE4XX**	Elective – I*	3	-	-	3
07	**DEC/PE4XX**	Elective – II**	3	-	-	3
08	**MLC/**	Intellectual Property Rights	*1*	-	-	*1*
09	**LC/PE495**	CAD / CAM / CIM Laboratory	-	-	*2*	*1*
10	**LC/PE497**	Mechatronics & Automation Laboratory	-	-	*2*	*1*
11	**LC/PE499**	Software Laboratory – II	-	*1*	*2*	*2*
		Total	**21**	**2**	**06**	**26**

*Elective-I & II (Any Two)

Sr. No	Course code	Subject Title
01	PE 451	Robotics
02	PE 453	Facility Planning & Design
03	PE 455	Tribology in Manufacturing
04	PE 457	MEMS
05	PE 461	Product Design
06	PE 463	Supply Chain & Logistic Management
07	PE 465	Reliability & Terotechnology
08	PE 467	Total Quality Management

VIII-Semester

Sr. No	Course code	Subject Title	Contact hours L	T	P	Credits
01	**Project Work/ PE402**	Industrial Inplant Training 6 Months (1 contact hrs. per student per week is allotted to teacher)	-	-	-	14
02	**PE404**	Seminar-II	-	-	-	2
03	**HSSC/ PE406**	Project and Production Management	-	-	-	3
		Total	**-**	**-**	**-**	**19**

$ The contact hours are provided for supervision of students under training and for giving guidance regarding the theory subject to be studied during training. Assessment will be based on mid-sem presentation and the other at the end of the Industrial In-plant training.

Prod Engg Dept OPEN ELECTIVE COURSE

Sr. No	Course code	Subject Title	Category of Course	Contact hours L	T	P	Credits
01	**PE 401**	Operations Research	OEC	3	-	-	3

SEMESTER VII

PE-401 OPERATIONS RESEARCH

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(08)**

Introduction:
Operations Research : Development, history, definitions, objectives, characteristics, limitations, phases, and applications. Optimization models and their classifications.

Linear Programming :
Formulation of LP problem. Graphical method. Simplex method (minimization / maximization cases). Degeneracy in LP. Duality in LP, Sensitivity analysis.

Unit 2 **(08)**

Transportation:
Introduction. Methods for finding initial solution. Test of optimality Maximization Transportation problem. Tran-shipment problem. Degeneracy.

Assignment Problem :
Introduction. Solution methods. Variations of the assignment problem. Traveling Salesman Problem.

Unit 3 **(08)**

Sequencing Models: Scheduling and sequencing. Processing “n” jobs on “m” machines. Processing of two jobs on “m” machines with each having different processing order.

Inventory Control System (Quantitative Approach) :
Functional classifications of Inventories. 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 4 **(05)**

Queuing Theory:
Queuing Systems : characteristics, operating characteristics and probability distributions. Classification of queuing models. Kendall’s notations. Models : {(M/M/1) : (α / FSFS)}. minimum cost service rate.

Simulation :
Monte -Carlo Method.

Unit 5 **(08)**

Replacement Models :
Replacement of capital equipment that deteriorates with time : value remains same during the period, and it changes with constant rate during the period, Replacement of an equipment that deteriorates with an alternate equipment, Replacement of items that fail without deteriorating.

Theory of Games:
Introduction, two–person zero-sum game. Minimax and Maximin principle. Saddle point. Methods for solving game problems with mixed strategies. Introduction to graphical, and iterative methods for solving game problems.

Unit 6 **(08)**

Network Models:
Introduction to PERT / CPM and its importance in project management. Concepts and construction of network diagrams. Critical path and project duration, floats, network crashing, optimum project duration and cost, PERT activity, time estimate, probability of completion of a project on before specified time, Resource allocation and load smoothening.

Text Books

- Gupta P. K. and Hira D. S. : Operations Research, S Chand & Company Ltd.
- Sharma S. D., Kedar Nath : Operations Research, Ram Nath & Co.

Reference Books

- Sharma J. K. : Mathematical Models in Operations Research, Tata McGraw – Hill Publishing Company Limited.
- Taha H. A. : Operations Research : An Introduction, Prentice Hall of India Pvt. Ltd.
- Wagner H. N. : Principles of Operations Research with applications to Managerial Decisions, Prentice Hall of India Pvt. Ltd.
- R. Panneerselvam : Operations Research, Prentice Hall of India Pvt. Ltd
- Wiest J. D. & Levy F. K.: Managerial Guide to PERT/CPM, Prentice Hall of India Pvt. Ltd.
- Srinath L.S "PERT & CPM principles & Applications" Affiliate East West Press (P) Ltd., New Delhi, 1975.

Outcomes:

- Formulate a certain class of decision problems as a linear program and solution.
- Use network planning procedures for solving logistics problems, scheduling problems.
- Formulate inventory and queuing problems and generate optimal solutions.
- Simulate various queuing situations.

PE-403 MACHINE TOOL DESIGN

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	100 marks: Continuous evaluation-Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(08)**

Introduction & Drives:
Recent Trends in designing machine tools: Classification of various machine tools General purpose, Special purpose, NC-CNC on the basis of kinematics. Considerations in designing drives, based on continuous on intermittent requirement of power. Type and selection of motor for the drive, regulation and range of speed based on preferred number series/

Geometric progression. Design of headstock gear box for spindle drive using ray diagram, structure diagram, nodal optimization while designing compact gearbox.

Unit 2 **(12)**

Stepless Regulation & Elements of Machine Tools:

Electromechanical regulation of speeds, Friction, pressure and ball variators, P.I.V. drive (Kopp. Variator) Epicyclic drive etc.

Design of beds, slideways, carriage, tables of lathes, milling machines based on force, frictional behavior and different types of lubrication system, used.

Design of Power Screws – sliding as well as rolling friction, spindle units, and bearing, Preloaded supports.

Unit 3 **(05)**

Static & Dynamic Rigidity of Machine tools, Sources of Vibration, Chatter, Stability, Dynamics of Cutting Process Vis-a-Vis machine tool, Stick-slip phenomenon and methods of combating.

Unit 4 **(04)**

Control System:

a) Electrical Control: Push button control, directional control relays, thermal relays, electrical brakes, Control for reversing traverse and automation in feed mechanism, selective/pre-selective control, and adaptive control.
b) Hydraulic Control of shaper, miller and other machine. Power pack for lubrication system in hydrostatic drive.

Unit 5 **(08)**

NC - CNC Machine : Introduction, Construction, Operation, Transducers of various type, CPU block diagram, CAD-CAM Systems interfacing, APT programming, Retrofitting & Design considerations for conversion. Open or closed loop for NC\CNC machine using stepper motor or DC motor, protective and safety devices.

Flexible manufacturing System: Definition, Types, classification, equipment application – Auto Tool Changer – types, functional details, Modular Concept of Design.

Unit 6 **(04)**

Acceptance tests for machine tools: Schlesinger's tests and Tobias's Stability Envelopes, Performance criteria of Machine Tools, Static & Dynamic tests, foundation of Machine tools etc.

Text Books

- D.K. Pal and S.K.Basu, Design of Machine Tools (6th Revised Ed), Oxford-IBH 2014.
- A. Bhattacharya and G.C. Sen, Principles of Machine Tools, New Central Book Agency, Calcutta

Reference Books

- Acherkan, N.S. et al Machine Tools Vol. I to Vol. IV, :, MIR Publications.
- Martin, S.J. NC Machine Tools,: ELBS
- Koenigsburger, A., Design Principles of MCMT Pergamon press, 1964.
- Mehta, N.K., Machine Tool Design, Tata McGraw Hill
- T Kundra, Rao, P.M., Tiwari, N.K. Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill

Outcomes:

- Knowledge about Design of various elements of machine tools and their structures.
- Knowledge of drives in machine tools.
- Learn the methods of acceptance tests for machine tools.
- Knowledge of NC-CNC machine & their controls.
- Information about recent trends in machine tools

PE-405 CAD / CAM / CIM

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(05)**

Introduction to CAD/CAM:-Trends in Modern Manufacturing, Product Cycle and CAD/CAM, Functional relationship, Elements of CAD Hardware.

Computer Graphics:- Transformation- Introduction, Formulation, Translation, Rotation, Scaling, Reflection, Homogenous Representation, Concatenated Transformation, Inverse Transformations.

Unit 2 **(15)**

Modelling

Curves:- Introduction, Analytic Curves, Parametric representation, Line, Circle, Parabolas, Hyperbolas, Ellipses, Conics. Geometric continuity (C0, C1, C2) and Visual continuity (G0, G1, G2), Synthetic Curves, Hermite Cubic Spline, Bezier Curve, B-Spline Curve and NURB

Surface:- Introduction, Surface Representation, Analytic Surface, Synthetic Surfaces, Hermite bicubic Surface, Bezier surfaces, B-spline Surfaces, Coons Surface, Reverse Engineering

Solids:- Introduction, Geometry & Topology, Solid Representation, Boundary Representation, Constructive Solid Geometry, Sweeps, Solid Manipulations, Feature Based Modelling**.**

Unit 3 **(08)**

Rapid Prototyping:- Importance and overview of Rapid Prototyping, Classification of Rapid Prototyping (RP) Process (FDM, LOM, SLA, SLS, Stereolithography etc.), Typical Process Chain for RP, Introduction to CAD and Data exchange format, data format details, conversion, validation, repairing, Part Slicing and Orientation and its importance, application and case studies**.**

Unit 4 **(06)**

NC 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 5 **(05)**

Computer Integrated Manufacturing (CIM): Computer application in manufacturing, computer aided inspection and quality control. Computer integrated production management system, inventory material requirement planning, manufacturing resource planning, enterprise resource planning.
Computer aided process planning (CAPP): Retrieval CAPP, generative CAPP and computer assisted shop floor control.

Unit 6 **(03)**

Group Technology: Part Families, Part classification and coding, production flow analysis, Rank Order Clustering Algorithm, machine cell design and Cellular manufacturing.

Text Books

- T. Kundra, Rao P.M., Tiwari N.K. : Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill
- Ibrahim Zeid: Mastering in CAD-CAM, Tata McGraw Hill Publication.

Reference Books

- Paul C. Bave: CAD Principles and Applications
- Mikell P. Groover: Automation, Production systems & Computer Integrated Manufacturing, Prentice Hall.
- Mikel P. Groover and Emory W. Zimmers: Computer Aided Design and Manufacturing, Prentice Hall.
- Nanua Singh: Systems Approach to Computer-Integrated Design and Manufacturing, John Wiley and Sons, Inc.
- P. Radhakrishnan and Subramaniam: CAD / CAM / CIM, Wiley Eastern Ltd.
- Venuvinod, PK., MA. W., Rapid Prortotyping – Laser Based and Other Technologies, Kluwer, 2004.

Outcomes:

- Understand the principles of Computer Aided Designing systems.
- Understanding the concepts of Transformation, Geometric modeling and Solid Representation Schemes.
- Describe the principles of Rapid Prototyping Process and Reverse Engineering and its integration
- Compare and distinguish the difference between the operation and programming of a CNC machine tool using manual programming and the operation and programming of CNC machine tool using CAM systems. Apply practices (manually) to develop the G-code program.
- Exposure of concepts of Computer Integrated Manufacturing, Group Technology and Computer Aided Process Planning

PE-407 MECHATRONICS & AUTOMATION

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

UNIT 1 **(08)**

Overview of Manufacturing:

Introduction to Production Systems, Automation in Production Systems, Overview of Manufacturing, Manufacturing Operations, Manufacturing Models and Metrics

Automation, Mechatronics and Control Technologies:
Introduction to Automation, Definition of Mechatronics, Mechatronics in Manufacturing, Products and Design, Review of Fundamentals of Electronics Industrial Control Systems, Hardware Components for Automation, Mechatronics and Process Control (Data Conversion Devices, Sensors, Micro-sensors, Transducers, Signal Processing Devices, Relays, Contactors and Timers), Data Acquisition, Actuators and Mechanisms

UNIT 2 **(08)**

Material Handling and Identification Technologies
Introduction to Material Handling, Principles of Material Handling, Material Transport Systems, Conventional and Automated Storage Systems, Engineering Analysis of Storage Systems, Automatic Identification and Data Capture

Manufacturing Systems
Introduction to Manufacturing Systems, Single Station Manufacturing Cells, Manual Assembly Lines: Single Model and Mixed Assembly Line Balancing, Automated Production Lines, Automated Assembly Systems

UNIT 3 **(06)**

Automation and Principle of Hydraulic and Pneumatic Circuit Design and Analysis
Hydraulic and Pneumatic Controls, Application in Machine Tools and other Mechanical Fields, Hydraulic and Pneumatic Circuit Design Considerations, Functional Diagram in Circuit Design, Pneumatic Circuit Analysis, Electrical Controls for Fluid Power Circuits, Fluid Logic Control Systems, Fluid Power Maintenance and Safety, Synthesis of circuits, circuit optimization techniques.

UNIT 4 **(06)**

Programmable Automation
(Processors)
Overview of Microcomputer systems, Microcontroller, 8051 Microcontroller Architecture, 8051 Instruction set and interfacing, applications and assembly language programming of microcontroller

UNIT 5 **(08)**

Control System and Controllers
Transfer function and block diagram, Block Diagram Reduction, Controller Principles, Process Characteristics, Control System Parameters, Controller Modes, Control Actions

Discrete Control
Programmable Logic Controllers, Basic Structure, Ladder Logic Programming, Types and Selection of PLC

UNIT 6 **(06)**

Mechatronic Systems – Control Architectures, Design Strategy and Case Studies
Introduction, Control Architecture, Traditional and Mechatronics Designs, Possible Mechatronic Design Solutions, Case Studies of Mechatronic Systems

Text Books:

- Mikell P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Third Edition, Prentice-Hall of India Private Limited.
- W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education Limited

Reference Books:

- N. P. Mahalik, Mechatronics: Principles, Concepts and Applications, Tata McGrawHill
- S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, Tata McGrawHill
- HMT Ltd. Mechatronics, Tata McGrawHill
- Joji P. Pneumatic Controls, Wiley India
- S. R. Majumdar, Pneumatic Systems: Principles and Maintenance, Tata McGrawHill

Course Outcomes:

- To have an overview of manufacturing, manufacturing operations and automation technologies
- To study the definition and elements of mechatronics and automation system
- To learn how to apply the principles of mechatronics and automation for the development of productive and efficient manufacturing systems.
- To study the hydraulic and pneumatic systems employed in manufacturing industry.
- To study material handling technologies for their identification in automated material control purposes.
- To learn the integration of automation technologies and material handling technologies into manufacturing systems.

PE-409 MANUFATURING ECONOMICS

Teaching Scheme	**Examination Scheme**
Lectures : 2 hrs/week	100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

UNIT 1 **(06)**

Introduction Engineering and Economics, Definition and scope of Engineering Economics,
Time value of money : Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time –value equivalences.
Present worth comparisons, Comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, Future worth comparison, payback period comparison

UNIT 2 **(06)**

Fund flow analysis, concepts, objectives, techniques of Fund flow statement.
Ratio analysis: Classification of ratios, structural group, standards for comparison limitations of Ratio analysis, returns on investment and integral ratio.
Cost volume profit analysis: mechanics of break even chart, profit planning and break-even analysis, margin of safety.

UNIT 3 **(09)**

Standard Costing:- Concept, Development and use of Standard Costing, Budget and Budgetary Control, Variance Analysis.
Marginal Costing:- Use of Marginal Costing in Decision Making.

Allocation of Resources:

Capital Budgeting: Control of Capital Expenditure, Evaluation Process – Payback approach, Accounting of Rate of Return, Present Value Method Vs Internal Rate of Return.

Cost of Capital:

Relevant Cost, Measurement of Cost of Capital, Cost of Debt, Preference Shares, Equity Shares, Internal Financing, Dividends, Cost of Retained Earnings Concept.

UNIT 4 **(07)**

Cost Control:

Introduction to Cost Control, Significance for Engineers, Limitations of Financial Accounting, Corporate Objectives, Profitability and other objectives, Product, Services and Market Mix.

Elements of Cost:- Material, Labour, Expenses, Overheads, Direct and Indirect Cost, Fixed and Variable Cost, other classifications.

Cost Allocation:- Cost Accumulation and Allocation, Allocation of cost of Service Departments – Reciprocal Method, Allotting cost from one department to other Depreciation, Various methods for calculation.

Text Books

- Prasad N. K., Cost Accounting Book Syndicate Pvt. Ltd.. Kolkata
- C. B.Gupta, Fundamentals of Business, Sultan Chand & Co

Reference Books .

- Henry M. Stenier, engineering economics Principles, Mc Grow hill Publication.
- P. A. Samualson, Economics, Mc Grow hill International.
- Colin Drury, management and Cost Accounting, English Language Book Society, Chapman & Hall Landon.
- Basu S.K., Sahu K.C and Rajiv B, Industrial Organization and Management –. PHI New Delhi, 2012

Outcomes:

- Be able to apply concepts of economic analysis to a manufacturing industries.
- Be able to understand Break Even Analysis, Standard Costing, Marginal Costing.
- Be able to apply probabilistic risk analysis methods.
- Be able to understand budgeting

PE-451 ROBOTICS

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(08)**

Basic Concepts in Robotics:

Automation and robotics, robot anatomy, basic structure of robots, resolution, accuracy and repeatability.

Classification and Structure of Robotics System:

Point to point and continuous path systems. Control loops of robotic system, manipulators, wrist motions and grippers.

Robot End Effectors / Grippers:

Grippers and tools, Types of end effectors-mechanical, magnetic and vaccum, gripper force analysis and gripper design considerations.

Unit 2 **(08)**

Drives and Control Systems:

Basic control systems, concepts and models, types of drive system- Hydraulic systems, pneumatic and electrical, DC servo motors, control system analysis, robot activation and feedback components, types of controllers- P, PI, PID controllers.

Sensors in Robotics
Sensors, internal-external sensors, contact and non-contact sensors, position and velocity sensors, Touch and slip sensors, Force and torque sensors, tactile sensors, Proximity and range sensors.
Vision Systems:
Vision equipment, Vidicon Camera with line and area scanner, C.C.D. Camera, image processing, and analysis, preprocessing, segmentation and feature recognition, smoothening of binary image

Unit 3 **(06)**
Robot Arm Kinematics and Dynamics:
Homogenous coordinates and homogenous transformations, Forward and Inverse kinematics in robot, Denavit Hartenberg convention and its applications Lagrange-Euler formation, Robot dynamics control

Unit 4 **(08)**
Interfacing & Robot Programming:
Interfacing robot with PC, RS232C serial interface
Robot Programming:
Methods of robot programming, lead through programming methods, a robot program for generating a path in space, motion interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and limitations of lead through methods.
Robot Language:
The textual robot languages, generations of robot programming languages, variables, motion commands, end effectors and sensor commands, computations and operations, Introduction to artificial intelligence

Unit 5 **(06)**
Trajectory Planning
Introduction, Joint Space Scheme,Cubic Polynomials with via points, Blending scheme

Unit 6 **(06)**
Robot Applications in Manufacturing:
Material transfer and machine loading/unloading, processing operations assembly and inspection. Concepts of safety in robotics, social factors in use of robots, economics of robots. Collaborative robots, Calibration of Robots.
Introduction to Telechirs & Futuristic Topics in Robotics:
Telechiric machines and its application - handling radioactive materials, work in space, mining & under sea operations, Telechiric surgery.

Text Books

- S. R. Deb.: Robotics Technology And Flexible Automation, Tata McGrawHill Publishing Co. Ltd.
- M. P. Grover, M. Weiss, R. N. Nagel, N. G. Odrey, : Industrial Robotics Technology, ISBN 0-07-100442-4.

Reference Books

- Richard D. Klafter, Thomas A. Chmielewski, Michael Negin : Robotic Engineering An Integrated Approch, Prentice Hall of India, 2002
- M. W. Thring, Robots and telechirs, Ellis Horwood Limited, ISBN 0-85312-274-1.
- Robert J. Schilling, Fundamentals of Robotics-Analysis and Control, Prentice Hall India, 2002
- John J. Craig, Introduction to Robotics, Pearson Education, 2005
- Yoren Koren: Robotics for Engineers, McGraw Hill Book Co., ISBN 0-07-035341-7.
- P.A. Janakiraman, Robotics and Image Processing, Tata Mcgraw Hill, 1995
- K. S. Fu, C. G. S. Lee, R. C. Gonzaler, Robotics Control, Sensing, Vision and Intelligence, Tata McGraw Hill, 1997

Outcomes:

- To enable students to know the basic concepts and principles in robotics.
- To classify the robot structures & drives. Analyzing the robot structure & gripper
- Study of kinematics, Dynamics & mathematical analysis.
- To enable students to know and analyse the trajectory planning of robot manipulator.
- To explain various application areas of the robotics & its programming.

PE-453 FACILITY PLANNING & DESIGN

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(08)**

Plant Location And Layout

Factors influencing plant location, Theories of plant location and location economies.

Plant Layout

Objectives of plant layout, Principles of plant layout, type: of plant layout, their merits and demerits.

Unit 2 **(08)**

Material Handling

Definition, principles, system design and selection of equipment, unit load concepts, basic layout types Immer, Nadler, Muther, Apple James and Reed's approaches to plant layout, Modular design concept, Production Line balancing.

Unit 3 **(05)**

Computer Aided Layout

CRAFT, COFAD, PLANET, CORELAP, ALDEP, Muther’s Classification, formation of cells of machines each operating using common Host Computer.

Unit 4 **(08)**

Space Determination And Area Allocation

Factors for consideration in space planning, receiving, storage, production, shipping, other auxiliary) service actions, Establishing total space requirement, area allocation factor to be considered, expansion, flexibility, aisles column and area allocation procedure. Design of layout using Travel chart, plot plan, block plan, Sequence demand straight-line method and non - directional method.

Construction of the Layout

Methods of constructing the layout, evaluation of layout, efficiency indices, presenting layout to management, implementing layout.

Unit 5 **(08)**

Quantitative Approaches to Facilities Planning

Deterministic models - single and multi facility location models, Location allocation problems - quadratic assignment problems, Warehouse layout models, plant location problems. Conveyor models. Storage models.

Unit 6 **(08)**

Probabilistic Models

Conveyor models, waiting line models and simulation models. Evaluation, selection, implementation and maintenance of the facilities plan.

Text Books

- Thompkins, J A and White, J**.** A Facilities Planning, John Wiley & Sons.
- Francies, R.L. and White, J**.** A. Facility layout and Location, John Wiley & Sons .

Reference Books

- James M Apple, Plant Layout and Material handling 2nd Edition., The Ronald Press Company John, Wiely and Sail
- Muther Richard, Practical plant layout, McGraw hill.
- Sunderesh Heragu, Facilities Design, PWS Publishing Company, ISBN- 0-534- 95183.
- James M Moore, Plant Layout Design, Mac Millon Co. 1962 LCCCN: 61 - 5204.

Outcomes:

- Learn formulations, models, and analytical procedures for the study of facilities layout planning.
- Learn fundamental principles of material handling.
- Be able to design a factory layout incorporating product, process, and personnel requirements.

PE-455 TRIBOLOGY IN MANUFACTURING

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

Assignments/ Quiz –I : 20,
Assignments/ Quiz –II : 20,
End-Sem Examination : 60.

UNIT 1 **(08)**

Tribology

Introduction, Importance of Tribology in Design, Tribology in Industry, Economic Considerations, effects of surface preparation on Tribology.

Friction
Introduction, Laws of friction, kinds of friction, causes of friction, area of contact, friction measurement, theories of friction.
Wear
Types of wear, various factors affecting wear, cutting tool wear & coating, measurement of wear, wear between solids and flowing liquids, theories of wear.

UNIT 2 **(08)**
Lubricants and Lubrication
Introduction, Lubricant properties- physical and chemical, basic modes of lubrication, types of lubricants, Seals-Static and dynamic.

UNIT 3 **(08)**
Hydrostatic and Aerostatic Lubrication
Basic concept, operations, advantages and limitations. Flow of viscous fluid through rectangular slot, Circular pad bearing and conical bearing, load carrying capacity and flow of lubricants. Bearing power, energy losses in bearing and film thickness, bearing temperature. Optimum design of step bearing, Introduction to Aerostatic Bearing and its application.

UNIT 4 **(10)**
Hydrodynamic Lubrication
Theory of hydrodynamic lubrication. Mechanism of pressure development in oil film. Two dimensional Reynolds equation, pressure distribution in journal bearings - long & short , Load Carrying capacity, Somerfield number, importance of radial clearance, eccentricity ratio minimum oil film thickness etc., Heat Balance equations.
Hydrodynamic Thrust Bearing
Introduction, flat plate thrust bearing, pressure distribution equation, load, centre of pressure. Tapered land thrust bearing, step-thrust bearing, and tilting pad thrust bearing. Friction in tilting pad thrust bearing, Heat Balance equations.

UNIT 5 **(06)**
Hydrostatic Squeeze Film
Introduction, parallel rectangular plate, Circular plate approaching each other and cylinder near plane; pressure distribution, squeeze load and time of approach.

UNIT 6 **(04)**
Lubrication in metal processing
Lubricants in Forging, wire drawings, drawing, extrusion, rolling etc. Lubricants used for wire ropes, pulley and chains.

Text Books

- Basu S.K., Sengupta S. N. and Ahuja B.B. “Fundamentals of Tribology” PHI Learning, Ltd. India.
- Majumdar B. C. "Introduction to Tribology and Bearings", S. Chand and Company Ltd., New Delhi.

Reference Books

- Bharat Bhushan, “Principles and Applications of Tribology”, John Wiley and Sons.
- Sahu P., “Engineering Tribology”, PHI Learning, Ltd. India
- Fuller D.D. "Theory and Practice of Lubrication for Engineers". John Wiley and Sons.
- Neale M. J. "Tribology hand Book", Butterworths. London.
- Orlov P., "Fundamentals of Machine Design", Vol. IV, MIR Publication.
- Cameron A. "Basic Lubrication Theory", Wiley Eastern Ltd.
- 'Hailing J., "Principles of Tribology", McMillan Press Ltd., 1975.

- Ghosh M.K., Majumdar B.C. and Sarangi M., “Theory of lubrication”, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Course Outcomes:

- The course will enable the students to understand the importance of Tribology in Industry.
- The course will enable the students to understand the basic concepts of Friction, Wear, Lubrications and their measurements.
- This course will help students to understand the performance of different types of bearings and analytical analysis thereof.
- This course will help students to learn and discuss different metal forming processes from tribological point of view.

PE-457 MICRO ELECTRO MECHANICAL SYSTEMS

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 Introduction

Overview of MEMS & Microsystems: Evolution of microsensors, MEMS & microfabrication – typical MEMS and Microsystems and miniaturization – applications of microsystems.
Materials demand for Extreme conditions of operation, material property mapping, Processing, strengthening methods, treatment and properties

Unit 2 MEMS materials: Overview of Smart Materials, Structures and Products Technologies Smart Materials (Physical Properties) Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials, Magnetorheological Fluids Electrorheological Fluids, Shape Memory Materials, Bio-Materials, metal matrix composites (MMC), their applications in aerospace and automobiles, Super-plastic materials

Unit 3 Design

Design consideration – process design – mechanical design

Unit 4 Micromanufacturing/Microfabrication

Preparation of the substrate, Physical Vapour Deposition, Chemical Vapour Deposition, Ion Implantation, Coatings for high temperature performance, Electrochemical and spark discharge and Plasma coating methods, electron beam and laser surface processing, Organic and Powder coatings, Thermal barrier coating, LIGA process

Unit 5 Microsensors/Microactuators etc

Smart Sensor, Actuator and Transducer Technologies, Smart Sensors: Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors; Microphones; Sensor Arrays Smart Actuators: Displacement Actuators; Force Actuators; Power Actuators; Vibration Dampers; Shakers; microFluidic Pumps; microMotors Smart Transducers: Ultrasonic Transducers; Sonic Transducers;

Unit 6 Packaging

Microsystem packaging: consideration, interfaces, technologies

Text Books:

- MEMS & Microsystem: Design & Manufacture by Tai ran Hsu, Tata McGraw Hill Publisher, 2002.
- M.V. Gandhi and B.S. Thompson, Smart Materials and Structures, Chapman & Hall, London;
  New York, 1992 (ISBN: 0412370107).
- B. Culshaw, Smart Structures and Materials, Artech House, Boston, 1996 (ISBN: 0890066817).

References:

- Westbrook J.H & Fleischer R.L., Intermetallic compounds VOL I & II, John Wiley, Chichester 1995.
- Microsensors, MEMS and smart Devices by Julian W. Gardner & Vijay K. Varadan, John Wiley & Sons, 2001.
- A.V. Srinivasan, Smart Structures: Analysis and Design, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).

PE-461 PRODUCT DESIGN

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(05)**

Introduction To Product Design

Asimow's Model: Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors c Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-consumption Cycle, The Morphology of Design (The sever phases), Primary Design Phases and flowcharting, Role of Allowance Process Capability, and. Tolerance in Detailed Design and Assembly.

Unit 2 **(08)**

Product Design Practice And Industry

Introduction,, Product Strategies Time to Market, Analysis of the Product, The Three S's, Standardization Renard Series (Preferred Numbers), Simplification, The Designer and E,, Role, The Designer: Myth and Reality, The Industrial Design Organization Basic Design Considerations, Problems faced by Industrial! Designer. Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, What the Designer contributes, Role of Aesthetics in Product Design, Functional Design Practice.

Review of Strength, Stiffness and Rigidity Considerations in Product Design

Principal Stress Trajectories (Force - Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression.

Unit 3 **(08)**

Design for Production - Metal Parts

Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, The Role of Process Engineer, Ease of Location and Clamping, Some Additional Aspects of Production Design, Die Casting and Special Castings, Design for Powder Metallurgical Parts, Expanded Metals and Wire Forms.

Designing with Plastics, Rubber, Ceramics and Wood

Approach to Design with Plastics, Plastic Bush Bearings, Gears in Plastic, Fasteners in Plastic,

Rubber Parts, Design Recommendations for Rubber Parts, Distortion in Rubber, Dimensional Effects, Tolerances, Ceramics and Glass Parts, Production Design Factors for Ceramic Parts, Special Considerations for Design of Glass Parts, Dimensional Factors and Tolerances, Wood. Design for assembly and disassembly.

Unit 4 **(08)**

Optimization in Design

Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Simplex search Method, Geometric Programming, Johnson's Method of Optimum Design.

Unit 5 **(08)**

Economic Factors Influencing Design

Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break- even Analysis, Economics of a New Product Design (Samuel Eilon Model).

Human Engineering Considerations in Product Design

Introduction, Human being as Applicator of Forces, Anthropometry: Man as Occupant of Space, The Design of Controls, The Design of Displays, Man/Machine Information Exchange.

Unit 6 **(08)**

Value Engineering and Product Design

Introduction, Historical& Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis, Job Plan, Creativity, Steps to Problem-solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Cheek-list, Cost Reduction through Value Engineering Case Study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering.

Modern Approaches to Product Design

Concurrent Design, Quality Function Deployment (QFD) for design.

Text Books

- A.C. Chitale and R.C. Gupta, Product Design and Manufacturing by PHI.
- Karl T. Ulrich & Steven D., Product Design & Development Eppinger Tata McGraw Hill, 3rd Edition, 2003

Reference Books

- Tim Jones, Butterworth Heinmann, New Product Development by Oxford, *TAC*- 1997.
- Roland Engene Y.,Inetoviez, New Product Development: Design & Analysis, John Wiley and Sons Inc., N.Y. 1990.
- Geofferry Boothroyd, Peter Dewhurst and Winston Knight. Product Design for Manufacture and Assembly, Amherst, 1983.
- Bill Hollins, Stwout Pugh, Butterworth, Successful Product Design by London 1990.
- Boothroyod & Dewburst P.,Design for Assembly, a Designer's Hand book, University of Massachusets, Amherst, 1983.
- Keyin otto and Kristini Wood, Product Design Pearson Education 2004.

Outcomes:

- Students learn basics of product design process and morphology of design.
- Students are exposed to Concept design, detail design, manufacturing, marketing, Introduction strategy of new product. Students learn about process of design for production of metal components.

- Understand producibility requirements in the Design of Machine Components.
- To understand optimization tools and ergonomic principles applied on typical product design as well as concept of value engineering in new product design.
- To prepare a brief presentation on design morphology of at least one product as well as assignments are given to students to evaluate manufacturability and design for production.
- At the end of course students should aware of different stages of product design.

PE-465 RELIABILITY & TEROTECHNOLOGY

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(05)**

Reliability

Definition -methods of improving reliability, derivation of Reliability function, configurations of reliability, series parallel & mixed configuration, simple problems

Unit 2 **(08)**

Reliability Calculations:

methods of improving reliability, redundancy element, unit stand-by redundancy, reliability models, constant hazard, simple problems, hazard models.

Unit 3 **(08)**

Maintenance Systems

Objective, of maintenance, maintainability and availability concepts, types of availability - mean time to failure-mean time between failures-mean time to repair-mean down time-Reliability allocation

Unit 4 **(08)**

Life Cycle Costing

Technoeconomic Life; Reliability effort function, simple cost models for Life cycle.

Unit 5 **(08)**

Maintenance Management

Principles types of maintenance breakdown, periodic, preventive and total productive maintenance, maintenance planning and control strategies, maintenance planning, maintenance policies, maintenance organization, maintenance standards-quality service standards-maintenance Strategy, influence of Terotechnology on maintenance management-maintenance performance indices, maintenance system documentation.
Failure Analysis: using causes & effects using Ishikawa diagram FMEA, FMECA.

Unit 6 **(08)**

Condition Monitoring

Definitions, advantages, limitations, through ferrography and particle analsyer, spectroscopic oil analysis programme (SOAP), contaminant analysis, vibration monitoring, use of monitoring, instruments and applications-magnetic chip detector. Role of computers in condition monitoring. Monitoring, systems- layers & monitors.

Text Books

- L. S. Srinath Reliability Engineering, -Affiliated East -West press, 2002.

Reference Books

- K. K. Ahuja, Industrial management and Organizational Behaviour, Khanna Publications. 1999
- H. P. Garg, Industrial Maintenance, S. Chand & company. Ltd, Third Edition 1990.
- Dr. Shankar, Industrial engineering Management Golgotia Publications Pvt. Ltd. 1997
- S.K. Basu & B.Bhadury, Terotechnology: Reliability Engg & maintenance Management, Asian book Private Ltd., Delhi, 1st Edition, 2003.
- A.K. Gupta, Reliability Engineering & Terotechnology

Outcomes:

- Student will be able to understand the importance and application of reliability.
- Student will be able to use the concepts of reliability in designing and maintenance of products.
- Student will be able to simulate techno economic life which is very important for industry application.

PE-463 SUPPLY CHAIN & LOGISTIC MANAGEMENT

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(06)**

Introduction to Supply chain management

Definition of Supply chain and supply chain management, Supply chain stages and decision phases, process view of a supply chain. Supply chain flows. Internal supply chains and External supply chains. Information systems and SCM, Inventory management across the SC. Drivers of supply chain performance. Competitive and supply chain strategies. Achieving strategic fit**.** Expanding strategic scope, Challenges facing SC managers

Unit 2 **(08)**

Supply Chain Network

Supply Chain Network (SCN) - Role, Factors, design options for distribution network. Models for Facility Location and Capacity Allocation and problem solving, Impact of uncertainty on SCN - Discounted Cash Flow Analysis

Unit 3 **(08)**

Planning & Managing Inventories in a Supply Chain

Role of forecasting in the SC, Time series forecasting methods, Review of inventory concepts. Trade promotions, Managing Cycle Inventory, Cycle time overview, Causes of long cycle times, Methods of reducing cycle time, Safety inventory determination.

Unit 4 **(08)**

Sourcing and Transportation in the supply chain

Role of Sourcing, Supplier - Scoring & Assessment, Selection & Contracts. Design Collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network,

Tailored transportation, Routing and scheduling in transportation. International transportation.

Unit 5 **(06)**

Coordination and Technology in the Supply Chain

Coordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT in Supply Chain, The Supply Chain IT Framework, CRM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in Practice. Case discussions.

Unit 6 **(04)**

Performance measurement and Cases in SCM

Performance metrics in SCM, Balanced scorecard approach.

Text Books

- Sunil Chopra & Peter Meindl; Supply Chain Management -Strategy, Planning & Operation; 11 Edition - 2003. Pearson Education Inc.
- Douglas Lanibert & James Stock: Strategic Logistics Management: Irwin McGraw Hill
- Robert B. Handfield, Ernest L. Nichols, Jr, Introduction to Supply chain management, Prentice Hall

Reference Books

- Robert B. Handfield, Ernest L. Nichols, Jr.; Supply Chain Redesign-Transforming Supply Chains into Integrated Value Systems 2002, Pearson Education Inc.,ISBN:81-297-0113-8.
- Jeremy F. Shapiro, Duxbury ; Modelling the Supply chain: 2002, Thomson Learning, ISBN: 0-534-37363-
- David Simchi Levi, Philip Kaniinsky & Edith Simchi Levi: Designing and Managing the Supply Chain: McGraw Hill
- B.S. Sahay, Supply Chain Management: Mc. Millen.

Outcomes:

- Understand, analyze the designing, planning and operational decisions of SCM.
- Identify, clarify managerial action to improve supply chain performance for the desired goals.
- Understanding of techniques used in the management of critical components of logistics and supply chains e.g., transportation, warehousing, inventory.
- Explain the likely future development of logistics and supply chain management

PE-467 TOTAL QUALITY MANAGEMENT

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-Assignments /Quiz- 40 Marks, End Sem Exam- 60 marks

Unit 1 **(05)**

Introduction to Quality Management

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

Unit 2 **(06)**

Principles and Philosophies of Quality Management

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.

Unit 3 **(09)**

Statistical Process Control and Process Capability

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed.

Process capability – meaning, significance and measurement – Six sigma concepts of process capability.

Sampling inspection, OC Curves and Sampling Plan, 100% Inspection and Selective Inspection, Statistics in Selective inspection.

Unit 4 **(09)**

Tools and Techniques for Quality Management

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.

Unit 5 **(06)**

Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terrotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

Unit 6 **(05)**

Quality Systems Organizing and Implementation

Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.

Text books

- Dale H. Besterfield et al, Total Quality Management, Third edition, Pearson Education (First Indian Reprints 2004).
- J Evans and W Linsay, the management and control of quality, 6th Edition, Thomson, 2005

Reference Books

- Roger C. Swanson, "The Quality Improvement Hand Book", Publisher Vanity Books International, New Delhi.
- Williarn. C. Johnson and Richard J. Chavia, "Encyclopaedia of Total Quality Management", New Delhi.
- Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.

Outcomes:

- Understanding of quality management philosophies and frameworks.
- In-depth knowledge on various tools and techniques of quality management.
- Learn the applications of quality tools and techniques in both manufacturing and service industry.

- Develop strategies for continuous process improvement.

PE-495 CAD / CAM / CIM LABORATORY

Teaching Scheme
Practical: -- 4 Hrs/Week

Examination Scheme
Term Work: -- 50 Marks
Oral: -- 50 Marks

List of Experiments:
The term work shall consists of record of assignments on following topics.

Assignments should be based on computer application of:
1. CAD Programming and Application
2. Programming on CNC machine
3. Programming on Robot Application
4. FMS
5. Manufacturing resource planning and Mathematical Transformation (Matrices)

Outcomes:
- Compare and distinguish the difference between the operation and programming of a CNC machine tool using manual programming and the operation and programming of CNC machine tool using CAM systems. Apply practices (manually) to develop the G-code program
- Make aware with Manufacturing Cell, and the Flexible Manufacturing System (FMS).
- Study of basic concepts of Group Technology and Computer Aided Process Planning.

PE-497 MECHATRONICS & AUTOMATION LABORATORY

Teaching Scheme
Practical: -- 2 Hrs/Week

Examination Scheme
Term Work: -- 50 Marks
Oral: -- 50 Marks

TERM WORK
The term work shall consist of record of any eight assignments on following topics:
1. Study & Design of basic hydraulic and pneumatic circuits: such as Standard ON-OFF and Pneumatic Latch.
2. Study & Design of Pneumatic or Hydraulic circuit for Two Push Button Control and Clamping of Work piece.
3. Study & Design of Pneumatic or Hydraulic circuit for material handling.
4. Study & Experiments in 8051 Microcontroller & its applications in Production Engineering.
5. Study & experiments in Programmable Logic Controllers (PLC).
6. Study of Displacement, Level, Pressure controls.
7. Measurements & Design of circuit for Speed & Temperature measurements.
8. Study & Design of Simple Hydraulic or Pneumatic and Electro-Hydraulic or Electro-Pneumatic Automatic Control Circuit Problem.
9. Study & Design of Electro-hydraulic or Electro-pneumatic Control Circuit Problem.
10. Study of Maintenance and Troubleshooting of Fluid Power Systems.

Note: Oral shall be based on above assignments.

Outcomes:

- To study the fluid power systems employed in manufacturing industry.
- To learn how to design and analyze the fluid power systems required in automated environment
- To understand how to measure and design the circuits for different operating parameters of an automated or mechatronic system

PE 499 SOFTWARE LABORATORY – I

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Term-work: 50 Marks
Tutorial : 1hr/week	Oral: 50 Marks

The laboratory work will be done in two parts:

Part I

1. Introduction to FEA, Advantages & Disadvantages of FEA & its Applications, What is FEA, Functional Approximation method, Finite Difference Method, Steps involved in FEA, Stiffness matrix & its properties, Derivation of Stiffness matrix, Types of Elements.
2. Introduction to ANSYS, ANSYS Interface & Environments, Problem solving methodology in ANSYS
3. Analysis of various problems in ANSYS software **(16hrs)**

PART II

1. Introduction to MS project. One assignment based on MS project.
2. Introduction to simulation software ProModel.
3. Factory simulation concepts and organization of layout.
4. Generating alternate layouts using ProModel
5. Evaluating different layouts using ProModel.

Term Work / Experiments

Term work will consists of 7 assignments based on ANSYS and ProModel software. **(16hrs)**

Outcomes:

- Students will understand the concept of FEA and its implementation.
- Students will be able to generate layouts.
- Students will be able to generate layout using optimum resources.

SEMESTER VIII

PE-402 INDUSTRIAL INPLANT TRAINING

Teaching Scheme	**Examination Scheme**
Contact Hours: 2 hrs/week/student	Term Work : 50 Marks
Duration of Training in Industry : 6 months	Oral Exam : 50 Marks

General guidelines to the institutions running production - Sandwich degree course and to the students opting for sandwich course. Students are expected to learn following things during the Industrial Inplant Training of 6 months:

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

1. Orientation / Rotational Training :

   Organizational Structure of the Company, scale and type of production, types of products, functional departments like Manufacturing, Process Planning & Control, Quality Assurance, Assembly, Testing, Maintenance, Stores, Purchase, Marketing, Human Resources Department, Design and Drawing Department, General Administration, Packing and Dispatching. Tool Engineering, Materials & Material Handling etc.

2. Industrial Design and Drawing Practice:

   Design and Drawing standards, study of Mechanical components and mechanical components and introduction to machine element design such as gears, gear boxes, chain and belt drives, electric motor selection, couplings, shafts, keys, bearings, brackets, bolted and welded connections. Sub - assembly and assembly design and drawings. Various ISO and BIS standards for design. Simple assignments based on the above items, selection of materials, material specification, beat treatment, and properties of materials.

3. Study of Manufacturing Processes:

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

4. Study of Various Manufacturing Machine Tools such as lathes, capstan and turret lathes, planer, shaper and milling. Mechanical and Hydraulic Presses, Gear hobbing, shaping and grinding machines.

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

6. Study of single point cutting tools and multipoint tools, form tools, jig and fixtures, special purpose machine tools and Press tools, Tool material and tool selection, study of cutting parameters.

7. Study of material handling methods and equipment.

8. Introduction to Quality and Quality Policy, need for Quality Control, National and

   International Standards on Quality and Reliability. Study of various inspection gauges, selection of gauges, comparators, calibration of gauges, Standards Room, etc. Product Performance Test Procedures.

9. Study of various Production Planning and Control functions. Process and Operation Planning, Yearly and Monthly Planning, Forecasting, Scheduling, Planning.

10. Study of various Industrial Engineering functions, Work Study, (Motion Study and Time analysis), Ergonomic considerations, Plant Layout, Safety aspects of working, Safety gadgets used on machines and Personal Safety Equipment.

The students shall be asked to do simple assignments in various departments where he is undergoing training.

Industries shall be requested to prepare training program before hand, covering as much as possible from above mentioned topics depending upon the type of industry.

Term Work :

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

Students should maintain training project diary and report to internal guide every week. For writing project report, students must follow the format given in the project diary.

Oral Examination
Oral examination will be based on In-plant Training Report (Term Work), which will be conducted jointly by internal examiner from within the institute and external examiner from the industry.

Outcomes:

- At the end of the programme, successful trainees will be able to understand different manufacturing methods and their applications.
- Assessments and application of different management options for optimal production.
- To acquire skills to deal with public policy issues at the interface of science, government, industry and civil society.
- Students will understand different management tools and their applications.

PE-404 SEMINAR - I

Teaching Scheme	**Examination Scheme**
Practical:- 2 hrs/week	Oral: -- 50 Marks
	Term Work: -- 50 Marks

Seminar shall be based on deep study of any topic related to production engineering; format of the report shall be as follows:

1. Title Page (Refer format given)
2. Certificate (Refer format given)
3. Acknowledgements:- There should not be any mistake in name and initials.
4. Abstract:- A page explaining the Seminar topic in maximum 150 words.
5. Content / Index (Refer format given in the Project Diary)
6. List of Tables/Figures or Nomenclature and Symbols:- List of Tables, Figures, Graphs etc. with respective page numbers.
7. Introduction:- 2-3 pages.
8. Seminar Report:- Description of topic about 12-15 pages.
9. Conclusion
10. References (Refer format given in the Project Diary)

Instructions regarding Seminar Report Printing:-

Page size	:-	A4.
Page Format	:-	Left-1.25", Right-1", Top & Bottom 1" – No Border / Frame.
Font	:-	Arial Regular.
Font Size and Colour	:-	12, Black.
Line Spacing	:-	1.5
Printing / Typing	:-	On one side of the paper only. (No blank sheet be left any where in the report.)
Paragraph	:-	Justified.
Paragraph Indent	:-	Nil.
Page numbers	:-	Right bottom, starting from 'Contents' page.
Printing	:-	Laser.
Binding	:-	Spiral with front and back cover of card paper neatly cut to size.

Number of Copies of the Seminar Report: - **Two.**

Instructions for figures and tables:-

i. Figures should be drawn on separate sheets or inserted on the page on which the text is typed. The figures are drawn in either permanent black ink or printed on paper. The figures should be numbered.

ii. Tables shall be typed in text. A separate sheet may be used, if necessary. The table shall be numbered.

iii. Mathematical portion of the text shall be preferably typed. If this is not possible, it should be written in permanent black ink. Lengthy Mathematical derivations shall not be included. Only the important steps and expressions shall be given.

iv. Discussions and conclusions shall form the last paragraph of the text.

Front page (on Binding and Title Page):-

COLLEGE OF ENGINEERING, PUNE

Title Line (Font size to extend across 5'' width)

Title should be in one line, if required use two lines.

_____

_____

Submitted by:-

Class:- _____ Roll No.:- _____

DEPARTMENT OF PRODUCTION ENGINEERING & INDUSTRIAL MANAGEMENT

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra)

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Certificate Page: -

DEPARTMENT OF PRODUCTION ENGINEERING & INDUSTRIAL MANAGEMENT

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra)

CERTIFICATE

This is to certify that Mr./Miss_____ has completed the Seminar entitled _____in partial fulfillment of the requirement of the VIII semester Production Engineering (Sandwich) Course at the Department of Production Engineering of COLLEGE OF ENGINEERING, PUNE – 411005, during the academic term 20 - 20 .

(Name of Guide)

Date:- dd/mm/yyyy Guide

(Name of HOD)

Place:- Pune-411005. Prof. & Head

Department of Production Engg. & Industrial Management ,

College of Engineering, Pune:- 411005.

(Examiner)

Term Work
Term Work shall comprise of Seminar report. Topic of seminar should be pre-approved by guide.

Oral Examination
Seminar Presentation / Oral examination will be assessed by guide and one internal examiner from within the institute.

Outcomes:

- Assessment of contemporary engineering developments
  Development of presentation & communication skills
- Interest towards research oriented fields with ability to search the literature and brief report preparation.
- Technical writing skill.

PE 406 PROJECT AND PRODUCTION MANAGEMENT

Teaching Scheme	**Examination Scheme**
Self Study	End-Sem Exam- 100 Marks.

Unit 1.
Project Management
Project Management Overview, Project selection, Project Identification and Screening, Project Appraisal, Project Selection

Unit II
Project Planning
Development of Project Network , Project Representation, Consistency and Redundancy in Project Networks, Project Scheduling ,Basic Scheduling with A-O-A Networks , Basic Scheduling with A-O-N Networks , Project Scheduling with Probabilistic Activity Times , Time/ Cost Tradeoffs in Projects Linear Time-Cost Tradeoffs in Projects: A Heuristic Approach, Resource Considerations in Projects, Resource Profiles and leveling ,Limited Resource Allocation

Unit III
Project Implementation & COMPLETION
Project Monitoring and Control with PERT / Cost, Team Building and Leadership in Projects , Project Completion, Review and Future Directions

Unit IV
Production Management
Introduction to Production Systems and a Generalized Model of Production, Life cycle of a Production System and Major managerial Decisions
Financial Evaluation of Production Related Decisions
Performance Measures of a Production System, Financial Evaluation of Capital Decisions, Decision Trees and evaluation of risk.
Designing Products & Services
Introducing New Products and Services, Product Mix Decisions

Unit V
Facility Location and Layout
Plant Location, Process Layouts, Product Layouts and Assembly Line Balancing, Cellular Layouts, Layouts for Advanced Manufacturing Systems.

Unit VI
Production Planning Over Medium Term Horizon
Demand Forecasting, Aggregate Production Planning
Operational Decisions Over The Short Term
Inventory related Decisions, Material Requirements Planning, Scheduling of Job Shops

Text Book:
- Prasanna Chandra, Projects Planning, Analysis, Selection, Financing, Implementation, and Review , Sevent Edition, Mc Graw Hill Education (India) Pvt. Ltd.

References:
- Arun Kanda, Project and Production Management (Video Course) From NPTEL , IITD, http://www.nptel.ac.in/video.php?subjectId=112102106
- Prasanna Chandra, Projects Planning, Analysis, Selection, Financing, Implementation, and Review , sevent Edition, Mc Graw Hill Education (India) Pvt. Ltd.
- Martand Telsang, Industrial Engineering and Production Management
- R. L. Francis, John A. White, Facility layout and location: an analytical approach, Prentice-Hall, 1974
- Stephen N Chapman, Fundamentals of Production Planning and Control, Pearson Education , 2006
- William Bolton, Production Planning and Control- Longman Scientific & Technical 1994

Course Outcomes:
- To enable students to learn the basic concepts of Project & Production Management
- To enable students to implement Project Planning in their Industrial In-Plant Training Project work
- To get capable of self-education and clearly understand the value of achieving perfection in Project implementation & completion.
- To study concept of Facility Location & Layout and implement in their Industrial In-Plant Training Project work
- To develop analytical mind for solving demand forecasting and Inventory decisions