Syllabus

Savitribai Phule Pune University

Faculty of Engineering

Fourth Year Production Engineering

(Course 2015)

(with effect from June 2018)

Savitribai Phule Pune University, Pune
Syllabus for Fourth Year Production Engineering
(2015 Course)
(With effect from Academic Year 2018-19)

Semester- I

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
		Theory	Practical	Tutorial	Paper		TW	OR	PR	Total	TH/TW/ TUT	PR/OR
					In-Sem	End-Sem						
411081	Machine Tool Design	3			30	70				100	3	
411082	Automation & Control Engineering	3			30	70				100	3	
411083	Operations Research	4			30	70				100	4	
411084	Elective I	3			30	70				100	3	
411085	Elective II	3			30	70				100	3	
411086	Machine Tool Design Lab		2					50		50		1
411087	Automation & Control Engineering Lab		2						50	50		1
411088	Operations Research Lab		2				50			50	1	
411089	Elective I Lab		2				50			50	1	
411090	Project Phase-I		2				50			50	1	1
											19	**3**
	Total	**16**	**10**	**0**	**150**	**350**	**150**	**50**	**50**	**750**	**22**	

Elective I
(a) Product Design & Development
(b) Financial Management and Costing
(c) Data Analytics
(d) Advanced Thermal Engineering
(e) Mechatronics

Elective II
(a) Nano Manufacturing
(b) Simulation & Modeling
(c) Additive Manufacturing
(d) Reliability Engineering
(e) Advanced Materials

Abbreviations:

TW: Term Work, TH: Theory, OR: Oral, TUT: Tutorial, PR: Practical

Savitribai Phule Pune University, Pune
Syllabus for Fourth Year Production Engineering
(2015 Course)
(With effect from Academic Year 2018-19)

Semester- II

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
		Theory	Practical	Tutorial	Paper		TW	OR	PR	Total	TH/TW/ TUT	PR/OR
					In-Sem	End-Sem						
411091	Computer Integrated Design & Manufacturing	3			30	70				100	3	
411092	Industrial Robotics	3			30	70				100	3	
411093	Elective III	3			30	70				100	3	
411094	Elective IV	3			30	70				100	3	
411095	Computer Integrated Design & Manufacturing Lab		2						50	50		1
411096	Industrial Robotics Lab		2					50		50		1
411097	Elective III Lab		2				50			50	1	
411098	Elective IV Lab		2				50			50	1	
411099	Project Work			6			50	100		50	1	5
											15	**7**
	Total	**12**	**8**	**6**	**120**	**280**	**150**	**150**	**50**	**750**	**22**	

Elective III
(a) Sustainability Engineering
(b) Supply Chain Management
(c) Automobile Engineering
(d) Entrepreneurship
(e) Human Resource & Management

Elective IV
(a) Intelligent Manufacturing System
(b) Energy Management
(c) World Class Manufacturing
(d) Finite Element Analysis
(e) Environmental Engineering

Abbreviations:
TW: Term Work, TH: Theory, OR: Oral, TUT: Tutorial, PR: Practical

411081: Machine Tool Design

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Machine Tool Operations, Mechanics of Materials and Design of Machine Elements, Kinematics of Manufacturing Machines.

Course objectives:

1. An ability to apply knowledge of Machine tool Design.
2. An ability to identify & solve engineering problems.
3. An ability to identify, conduct experiment as well as analyze the data.
4. An ability to design a system, component to meet the desired needs of subject to constraints.
5. Proficiency in process, assembly and product engineering:-Understand the design of machine tool design.
6. Proficiency in manufacturing. Competitiveness:-understanding the creation of competitive advantage through manufacturing planning, strategy & control of Machine tool design.
7. Proficiency in machine tool design: understanding the analysis of machine tool engineering.

Outcomes:

After learning this subject, the student will be able do:

1. Design multi-stage gear box for machine tool applications
2. Design machine tool structures and element so machine tools such as bearings, powers crews, guideways etc.
3. Perform the analysis of vibration and dynamic characteristics of machine tools
4. Design special purpose machine tools

Unit I: Gear Box Design [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 [7]

Analysis of forces on machine tool structure, static and dynamic stiffness. Design of beds, columns, housings, bases and tables. Design of spindle and spindle support using deflection and rigidity analysis, analysis of Antifriction bearings, preloading of antifriction bearing.

Unit III: Design of Guide ways and Power Screw [7]

Functions and types of guide ways, design criteria and calculation for slide ways, design of Hydrodynamic, hydrostatic and aerostatic slide ways, Stick-Slip motion in slide ways. Design of power screws: Distribution of load and rigidity analysis.

Unit IV: Controls and Stability of machine tools [7]

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 V: Special Features of Machine Tools [7]

Design considerations of Stepless drives, electromechanical system of regulation, friction, and ball variators, PIV drive, Epicyclic drive, principle of self locking, Machine tool monitoring and safety.

Unit VI: Recent Trends of Machine Tool Design [7]

Recent trends in machine tools, Design considerations for SPM, NC/CNC, Micro/Nano machining, Retrofitting, Autonomous machine tool, Installation, Calibration and Machine tool testing.

References:

1. Mehta N.K., "Machine Tool Design and Numerical Control", Tata McGraw Hill,2002, ISBN 0-07-451775-9.
2. Bhattacharya A. and Sen S.G., "Principles of Machine Tool", New central book agency Calcutta, 2009,ISBN 81-7381-1555.
3. Pal D.K., Basu S.K., "Design of Machine Tool", 4th Edition. Oxford IBH 2005,ISBN:81204-0968.
   Date P. P., "Introduction to Manufacturing Technology, Principles and Practices", , Jayco Publishers, Mumbai,2010, ISBN8179929973, 9788179929971
4. Koenigsberger F., "Design Principles of Metal Cutting Machine Tools", The MacmillanCompany, New York ,1964.
5. CMTI Banglore, "Machine tool design handbook" Tata McGraw-Hill, New Delhi, 1982

411082: Automation & Control Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Basic Electronics Engineering, Basic electrical engineering, Heat and fluid engineering

Course objectives:

1. To learn Basic principles of Industrial hydraulics.
2. To study design of hydraulic circuits & selection of various components.
3. To study pneumatic systems & circuit.
4. To understand concept of programmable automation viz microprocessor & control.
5. To study various control system & learn of programmable logic control.
6. To get well verse with the factory automation methods & system.

Outcomes: After learning this subject, the student will be able to:

1. Understand basic concepts of industrial hydraulics and pneumatics
2. Design the hydraulic and pneumatic circuits for given application
3. Use microprocessor and programmable logic controller for soft automation.
4. Apply electric, electronics and computer control systems used in automation.
5. Apply various innovative methods for factory automation.

Unit I: Introduction to Hydraulic Systems [7]

Introduction of fluid power system, Properties of fluids, Fluids for hydraulic systems, governing laws. Standards in circuit diagram representation, hydraulic symbols, Working Principle, design and analysis of reservoir, pumps, filters, valves, actuators, accumulators, intensifiers.

Unit II: Design and Analysis of Hydraulic Circuits [7]

Design considerations for hydraulic circuit, Detail analysis speed control, flow control, pressure control circuits, Industrial applications of hydraulic circuit design using proportional valves and servo valves.

Unit III: Pneumatic Systems [7]

Operational principles, Functions of different pneumatic components and selection, Valves for logic functions; Time delay valve; Examples of typical circuits using Displacement – Time and Travel-Step diagrams, cascade circuits, Construction of pneumatic controls and circuit diagrams for conveying, feeding, clamping, indexing, cutting and non-cutting operations.

Unit IV: Programmable Automation [7]

Microprocessor - Basic architecture and its Busses, programming model, internal data operation and registers, controls and status signals, instruction sets, addressing modes.

Microcontroller: Microcontroller based manufacturing systems.

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.

Case studies on electrohydraulic and electro-pneumatic circuits.

Unit VI: Advance Automated Systems [7]

Large scale control systems: Supervisory control and data Acquisition (SCADA), Human machine interface (HMI), Remote Terminal Unit (RTU), Digital Communication Unit (DCU).

Robotic systems: Manipulator kinematics, trajectory planning,

Artificial Intelligence in automation: Artificial Neural Networks, Fuzzy Logic, Image Processing

Text Books:

1. Kuo B.C., “Automatic control systems”, Prentice Hall India Pvt. Ltd., New Delhi, ISBN: 1305-5070-1
2. Peter Rohner, “Industrial hydraulic control”, Wiley Edition, 1995, ISBN: 0471334987
3. Mikell P Groover, “Automation, Production System and Computer Integrated Manufacturing”, Prentice Hall Publications, ISBN 9789332549814
4. Mujumdar S.R., “Pneumatic System”, Tata McGraw Hill, 2002 Edition. ISBN: 9780074602317
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 HillPublications 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

411083: Operations Research

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 04 hours / week	Theroy: 04	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Engineering Mathematics-III, Industrial Engineering, & Management, Production Management

Course objectives:

1. To introduce the students how to use variables for formulating complex mathematical models in business management, industrial engineering and transportation engineering.
2. To provide the students with opportunity of using various software package for solving linear programming and integer programming models
3. To introduce the students to the use of basic methodology for the solution of linear programs and integer programs.
4. To introduce the students to the basic concepts of polyhedral theory and valid inequalities and how to integrate the theory to the solution methods for integer programming.
5. To introduce the students to the advanced methods for large-scale transportation and assignment problems.
6. To familiarize students with the basic concepts, models and statements of the operations research theory.

Outcomes:

After learning this subject, the student will:

1. Know principles of construction of mathematical models of conflicting situations and methods of operations research
2. Be able to choose rational options in practical decision-making problems using standard mathematical models of operations research
3. Have skills in analysis of operations research objectives, mathematical methods and computer systems.
4. Use mathematical software to solve the proposed models.
5. Solve network models like the shortest path, minimum spanning tree, and maximum flow problems
6. Be able to take decisions with a quantitative basis and improves quality of decisions.

Unit I: Linear programming (LP) [8]

Definition of Operations Research: Objectives, Simplex methods for maximization and minimization problems: Formulation, Degeneracy in L.P., Duality in L. P.

Unit II: Transportation and Assignment problem [8]

Transportation problems- Use of various methods for solving transportation problem, Degeneracy and its solution, Transshipment problem.

Assignment problem- Solutions of various types of problems: Hungerian Method, Branch & Bound Technique, travelling salesman problem.

Unit III: Introduction to Integer, Dynamic and Non-linear programming [8]

Integer programming, Branch & Bound method, Cutting Plane method, Dynamic programming introduction, application, capital budgeting, different problems solved by dynamic programming,

Geometric and goal programming, Definition, Introduction, Application of geometric and goal programming

Unit IV: Replacement models [8]

Replacement of capital equipment that deteriorates with time, Time value of money: Cases in which time value of money remains same and changes with constant rates during period. Group and individual replacement.

Unit V: Decision Theory and Games Theory [8]

Decision Theory: steps in decision theory, Decision making under conditions of certainty, uncertainty and risk, maximum likelihood criterion, Expected value criterion

Games Theory: Introduction, Terms and definitions, Solution methods

Unit VI: Queuing theory and Simulation [8]

Operating characteristics, Poisson single and multi channel queuing system (M/M/1): (∞/∞/FCFS), (M/M/1): (∞/∞/SIRO),(M/M/1): (N/∞/FCFS), (M/M/c): (N/∞/FCFS)

Monte Carlo simulation of Production quantity, Demand, Inventory, Queuing systems, Investment decision etc.

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 ISBN: 8121902819
3. Taha H.A., “Operations Research - An introduction”, Prentice Hall Pvt. Ltd.
4. P. Shankaralyer, “Operations Research” Sigma Series, Tata McGraw-Hill. ISBN: 1283922487
5. Rao, S. S. “ Engineering Optimization: Theory and Practice”, John Wiley & Sons. ISBN: 0470183527

Reference Books

1. Hillier F.S., Lieberman G.J., “Introduction to Operations Research”, Tata McGraw-Hill, ISBN: 0071333460
2. Wagner H.M., “Principles of Operations Research”, Prentice-Hall India, ISBN: 0137095929
3. Ravindran A., “Operations Research”, Tata McGraw-Hill. New Delhi. ISBN:1420091875
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. ISBN: 8120319230

411084(A): Elective I: Product Design and Development

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Prerequisites: Production Management

Course Objectives:

- To carry out the engineering design process for new product.
- To understand the generic product development process.
- Use of various analysis tools for product design & development.
- To understand the structure of PLM in organization

Course Outcomes:

After Successful completion of this course students will be able to

- Carry out the basic engineering design process and also various techniques used for a product.
- Construct the product development process and customer requirements, QFD.
- Evaluate the performance measure of design and DFM of a product.
- Perform the case study of product life cycle management of a product

Unit I: Engineering Product Design [7]

Introduction to engineering design process, Industrial design, Importance of the engineering Design process, Types of designs, Engineering design process, A simplified iteration model, Design method versus scientific method, A problem-solving methodology, Considerations of a good design, Total life cycle, Regulatory and social issues, Description of design process, Conceptual design ,Embodiment design, Detail design, Planning for manufacture, Planning for distribution, Planning for use, Planning for retirement of the product.

Unit II: Embodiment Design [7]

Product architecture, Modular product architecture, Implication of Architecture, Establishing the Architecture, Product configuration and concurrent engineering, Parametric design: steps, Failure Mode and Effect Analysis.

Unit III: Product Development Process [7]

Product life cycle, Generic product design process, Stage gate system of product development, Product Development process flow, Types of products, Product planning, Product planning process, Markets and marketing, Functions of marketing department, Element of marketing plan, Product development Economics.

Unit IV: Identifying Customer Needs [7]

Identifying customer needs, Voice of customers, preliminary research on customers' needs, Gathering information from customers, Customer requirements, Differing views of customer requirements, Classifying customer requirements, Kano model, Establishing the engineering characteristics, Benchmarking in general, Competitive performance benchmarking, Reverse engineering or product dissection, Determining engineering characteristics, Quality function deployment, The house of quality, Steps for building a house of quality

Unit V: Analysis Tool [7]

Design for Manufacture (DFM) and Design for Assembly (DFA): DFM guidelines, Specific design rules, Overview of DFM process, Design of castings**:** Guidelines for the design of castings, Producing quality Castings ,Design of forgings: DFM guidelines for closed-die forging, Design for sheet-metal forming: sheet metal stamping, Sheet bending, Deep drawing, Design of machining, Design for Plastic processing: Injection Molding, Estimation of manufacturing cost,

Minimize the system complexity.

Unit VI: Product Life Cycle Management (PLM) [7]

Introduction to PLM, Opportunity & benefits of PLM, Components of PLM, PLM vision, Structure for PLM vision, PLM strategy, Product Data Management, Case studies in PLM (Auto Industry & Home appliances)

Text Books

1. Karl T. Ulrich & Steven D. Eppinger., Product Design & Development, McGraw Hill, 3rd Edition, 2003.
2. Dieter and Schmidt , Engineering Design, McGraw – Hill Higher education, ISBN: 978–0– 07–283703–2
3. John Stark, Product Life Cycle Management, 21st Century Paradigm for Product Realization, Springer

Reference Books

1. Tim Jones, Butterworth Heinmann, New Product Development by Oxford, TAC- 1997.
2. Roland Engene Y.,Inetoviez, New Product Development: Design & Analysis, John Wiley and Sons Inc., N.Y. 1990.
3. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight. Product Design for Manufacture and Assembly, Amherst, 1983.
4. Bill Hollins, Stwout Pugh, Butterworth, Successful Product Design by London 1990.
5. Boothroyd & DewburstP.,Design for Assembly, a Designer's Hand book, University of Massachusets, Amherst, 1983.
6. Keyinotto and Kristini Wood, Product Design Pearson Education 2004.
7. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub. 1986
8. ISO Standard: 9001:2008: Clauses 7.1, 7.2, 7.3

411084(B): Elective I: Financial Management and Costing

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Industrial Engineering & Management, Production Management

Course objectives:

- To provide thorough grounding of financial management concepts and preparation of Financial Statements with their analysis.
- To gain expert knowledge of principles and concepts used in finance
- To learn to manage short-term resources of a business firm
- To be able to find out the best course of action among several financial options
- To help understand costing and management accounting techniques that could be utilized for decision making and control.

Outcomes:

After learning this subject, the student will be able to:

1. Use Financial Statements to evaluate performance of a firm
2. Calculate time value of money and Cost of Capital.
3. Demonstrate how materials, labor and overhead costs are added to a product at each stage of the production cycle.
4. Apply cost accounting techniques and evaluate their limitations;
5. Use and evaluate appropriate costing and decision making techniques to make short term decisions;
6. Use standard costing systems to undertake a performance review and interpret the results

Unit I: Financial Management [7]

Financial function, Scope, goals and tools. Sources of finance, corporate planning and financial management. Financial Statements: Balance sheet, profit and loss account. Ratio Analysis: Classification, Ratio Analysis and its limitations. Operating and Financial Leverage.

Unit II: Capital Budgeting [7]

Control of Capital Expenditure, Evaluation Process-Payback approach, Accounting of Rate of

Return, Present Value Method Vs Internal Rate of Return. Replacement cost and discounted cash flow.

Unit III: Working Capital Management [7]

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

Unit IV: Costing [7]

Methods of costing and elements of cost. Material Cost: Different methods of pricing of issue of materials. Material losses - Wastage and its consideration. Labour Cost: Different methods wages and incentive plans. Principles of good remunerating system, labour turnover and its methods.

Depreciation: Concept, importance and different methods of depreciation. Estimation of material, machining and labour cost machining. Overheads: 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. Estimation of overheads**.**

Unit V: Standard Costing and Variance Analysis: [7]

Concept, development & use of standard costing. Material, Labour, Overhead, Sales. Profit, Product-mix and Yield Variance. Cost control: 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.

Unit VI: Types of Costing Methods [7]

Marginal Costing: Concept, Use of Marginal Costing in decision-making Activity based costing: Concept, cost drives, applications. Process costing: Concept, transfer cost, concept of by products, joint costing, scrap, waste, losses, cost of quality.

Text Books:

1. N. K. Prasad, “Principles and Practice of Cost Accounting”, Syndicate Pvt. Ltd., Calcutta
2. M. Pandy, “Financial Management”, New Delhi Vikas Publication House Pvt. Ltd.,ISBN 81-259-0638-X
3. M. Y. Khan, P. K. Jain, “Financial Management”, Tata McGraw Hill Publishing Ltd. ISBN: 933921305X
4. B. K. Bhar, “Cost Accounting Methods and Problems”, Academic Publishers, Calcutta, ISBN: 9380599617

Reference Books:

1. Henry M. Steiner, “Engineering Economics Principles”, McGraw Hill Publication.
2. C.B. Gupta, “Fundamentals of Business”, Sultan Chand & Co.,
3. P. A. Samualson, “Economics”, McGraw Hill International.
4. K. K. Dewett, “Modem Economic Theory”, Sultan Chand & Co., ISBN 81-219-0331-1
5. Colin Drury, “Management and Cost Accounting”, English Language Book Society, Chapman & Hall London.

411084(C): Elective I: Data Analytics

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Engineering Mathematics III, Numerical Techniques and Optimization Methods

Course objectives:

The objective is to provide a basic understanding of data analysis using statistics and to use of computational tools on problems of applied nature.

Outcomes:

After learning this subject, the student will be able to:

1. Effectively visualize and interpret the data
2. Apply predictive and prescriptive techniques for production engineering applications
3. Use data analysis for engineering applications through the powerful tools of data application

Unit 1: Introduction to data analytics [7]

Significance & applications of data analytics, Data collection, data processing, data transformation, data integration, data visualization, basic statistics, inferential statistics

Unit 2: Descriptive analytics [7]

Uni-variate/multi-variate statistics, bi-variate associations, correlations, covariance, analysis of variance (ANOVA)

Unit 3: Predictive analytics [7]

Multiple regression, conjoint analysis, neural networks, data clustering, Data mining

Unit 4: Classification techniques [7]

Linear classifiers, Quadratic classifiers, Support vector machines, Random forests.

Unit 5: Prescriptive analytics [7]

Decision tree analysis, Expert system, principal component analysis, genetic algorithms

Unit 6: Reinforcement learning [7]

Markov chain analysis, Monte Carlo simulation, Q learning, State action reward state action (SARSA) learning

Books:

1. Acharya Seema and Chellappan, Big Data and Analytics, Willey India Pvt. Ltd. (2015), ISBN: 9788126554782
2. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services, Willey India Pvt. Ltd. (2016), ISBN: 978-1-118-87622-0
3. Michael Minelli, Michale Chambers, Ambiga Dhiraj, Big Data Analytics: Emerging Business Intelligence and analytics trends for today's business, Willey India Pvt. Ltd. (2015)

411084(D): Elective I: Advanced Thermal Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Basic Mechanical Engineering, Basic of Physics, Heat and Fluid Engineering

Course objectives:

1. To understand Basics concepts of thermodynamic
2. To develop an ability to apply knowledge of mathematics, science, and engineering.
3. To Learning the fundamental principles and different methods of refrigeration
4. To develop an ability to apply the knowledge of Heat transfer in Manufacturing System
5. To understand the concept power generation System in various forms

Outcomes:

After learning this subject, the student will:

1. Apply laws of thermodynamics to devices viz. engines, refrigerators etc.
2. Analyze and compare air standard cycles, steam power cycles
3. Understand the principle of power generation system and devices used in steam power plant.
4. Understand and analyze basic modes of heat transfer
5. Explain the design, performance analysis and practical applications of heat exchangers.

Unit I: Introduction to thermodynamic [7]

Heat and work, reversible process, irreversible processes, Ideal Gas Equation Ideal gas Processes, Enthalpy, entropy Steady flow energy equation (SFEE) and its application (boiler, turbine, compressor, Nozzle), Air standards Cycles

Unit II: Introduction to Power Plant Engineering [7]

Steam power plant, working of Steam power plant, Carnot vapour power cycle, Rankine cycle, comparison between Carnot and Rankine cycle, irreversibility and losses in vapour power cycle, effect of operating variables on Rankine cycle, reheating of steam

Gas turbine Power Cycles (Brayton cycle analysis) , Open, Closed & Semi Closed cycles Gas Turbine Plant , combined cycle plant

Unit III: Non-Conventional Power Plants [7]

Wind Power plant : Introduction, wind availability measurement, types of wind machines, site selection, and wind power generation.

Solar Power Plant : Introduction, components ,Types of Collectors & Solar Ponds, Low & High Temperature Solar Power Plant. Photovoltaic Power System, Heliostat Tidal, OTEC, geothermal, magneto hydrodynamics, fuel cell, hybrid power plants, Challenges in commercialization of Non-Conventional Power Plants.

Unit IV: Introduction to Refrigeration [7]

Definition of Refrigeration, Refrigerators and Heat Pumps, Refrigeration terminology, types of refrigeration systems, gas refrigeration Systems, Brayton refrigeration cycle, Bell Coleman cycle, ideal vapour compression refrigeration cycle (Numerical treatment with p-h chart), vapour absorption refrigeration cycle, refrigerants, classification of Refrigerant, Ozone Potential depletion, kyoto protocol, Montreal Protocol.

Energy V: Introduction to heat transfer **[7]**

Introduction To Heat Transfer: Introduction, modes of heat transfer, steady state heat transfer, thermal conductivity and coefficient of heat transfer, Convective Heat Transfer: Introduction to natural and forced convection, empirical relation, significance of different non dimensional numbers in convective heat transfer, Radiation Heat Transfer: Introduction, definitions, laws of radiation, surface resistance, Radiations shields, Electrical analogy for steady radiation problems.

Unit VI: Heat Exchangers: **[7]**

Classification, concept of overall heat transfer coefficient, LMTD relations, effectiveness, and effectiveness by NTU method, Simple Numerical Case studies of Heat Transfer in Manufacturing Sector (Casting, Welding etc.)

Textbooks:

1. P. K. Nag, Engineering Thermodynamics: Tata Mc-Graw Hill publication
2. Yunus A. Cengel, Michael A. Boles, Thermodynamics-An Engineering approach: Mc-Graw Hill publication
3. - P. K. Nag, Tata Power Plant Engineering Mc- Graw Hill Publications, Third Edition
4. S. Domkundwar Power Plant Engineering -, Dhanpatrai & sons
5. R. K. Rajput, A Textbook of Refrigeration and Air-Conditioning, S.K.Kataria& Sons
6. C.P. Arora, Refrigeration and Air-conditioning, TMH Pub.
7. Incropera & Dewitt J. Introduction to Heat Transfer, Wiley, John Wiley & Sons
8. Heat Transfer: S. P. Sukhatme, Universities Press

Reference Books:

1. P.L. Balaney, Thermal Engineering: Khanna Publisher.
2. Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics: Mc-Graw Hill publication
3. M. M. Wakil, Power Plant Engineering, Mc-Graw Hill.
4. Black and Veatch, Power Plant Engineering, CBS Publisher and Distributors
5. Jordon & Priestar, Refrigeration & Air-conditioning,PHI Publication.
6. Yunus A Cengel, Heat Transfer, Mc Graw Hill
7. J P Holman, Heat Transfer, Mc Graw Hill
8. D. S. Kumar , Heat Transfer, S K Kataria & Sons
9. C P Kothandaraman, Fundamentals of Heat & Mass Transfer, New Age Techno Press

411084(E): Elective I: Mechatronics

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Engineering Mathematics III**,** Basic Electrical Engineering, Basic electronics Engineering

Course objectives:

1. To provide knowledge about types of system, sensor, transducers.
2. To provide knowledge about filters and amplifiers used in electrical circuits.
3. To make aware students about applications of Mechatronics system to automate manufacturing processes .

Outcomes:

After learning this subject, the student will:

1. Understand the control system basics and the types of control systems
2. Apply knowledge of response specifications of control system.
3. Use controller principles for composite modes of control
4. Be Able to do PLC programming, programming with counters and timers, real time PLC programming examples.
5. Apply the Mechatronics system, actuators, sensors and transducers used digital signal processing in real life problems

UNIT I: Sensors and Transducers [7]

Introduction to Mechatronics, Open and Closed loop control system, Block Diagram Algebra With respect to Types, Range, and Applications and limitations, Thermocouples, Thermistors and Resistance Temperature Detectors With respect to Construction, Working and Applications, Linear Variable Differential Transducer. With respect to Principle, Types, and Applications, Strain Gauges, Gauge Factor and Measurement of Strain With respect to construction, working and specifications Electromagnetic Flow meter. With respect to specifications and applications, Capacitive and Inductive Proximity sensors Angular Velocity measurement, Tacho generators, Rotary Encoders

UNITII: Analog Signal Conditioning [7]

Passive Circuits, Voltage dividers, Wheatstone's bridge, Low pass, high pass and bandpass filters. Op-Amps, Characteristics and Specifications, Voltage Follower, Inverting Amplifier, Non Inverting Amplifier, Summing Amplifier,

Instrumentation Amplifier, Integrator, Differentiator. Current To Voltage Converter, Current to Voltage Converter Numerical Examples based on Wheatstone's Bridge and Op-Amps

UNIT III: Interfacing [7]

Logical Gates, Boolean Algebra, Binary, Octal and Hexadecimal Number Systems and their significance. Analog to Digital Conversion SAR & R-2R Digital to Analog Conversion Sample and Hold Circuits, Sampling Theorem, Samplifing Frequency, Quantization. Numerical Examples based on ADC, DAC and Sampling

UNIT IV: Modelling and Analysis [7]

Process Control Basics, Control System Parameters Process Dynamics Laplace Transform Basics, Dead Time Responses in Laplace Form Lag Responses in Laplace Form, Types of Second-Order Responses

UNIT V: Control System [7]

Controller Actions, Proportional Controllers (P Mode), Integral Controllers (I Mode) with examples of plotting controller action vs time for respective error time plot Proportional-Integral Controllers (PI Mode) with examples Derivative Controllers (D Mode) Proportional-Derivative Controllers (PD Mode) with examples Proportional-Integral-Derivative Controllers (PID Mode) with examples

UNIT VI: PLC Programming [7]

Introduction to PLC Programming, Types of PLC Languages, Ladder Diagram Format, Ladder Relay Instructions, Ladder Relay Programming, Timer Instructions with example Counter Instructions with example

Text Book

1. C D Johson, Process Control Instrumentation Technology, 7th Edition, Prentice Hall of India Pvt Ltd. 2005.
2. L. A. Bryan, E. A. Bryan, Programmable Controllers : Theory and Applications, Industrial Text Company Publications, 2/e

Reference Book

1. Alciatore & Histand, Introduction to Mechatronics and Measurement system, 4th Edition, Mc-Graw Hill publication, 2011.
2. Bishop (Editor), Mechatronics – An Introduction, CRC Press, 2006

411085(A): Elective II: Nano Manufacturing

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Machine Tool Engineering Material, Material Forming, Metrology & Quality assurance

Course objectives:

1. To give awareness of different techniques used in nano manufacturing
2. To give in-depth idea of the conventional techniques used in nano manufacturing
3. To introduce Non-conventional nano manufacturing and finishing approaches
4. To introduce Nanofabrication Techniques
5. To know different techniques used in metrology tools in micro and nano manufacturing.

Outcomes:

After learning this subject, the student will able to:

1. Distinguish between micro and nano manufacturing and identify the various finishing approaches.
2. Identify the applications of conventional and non-conventional manufacturing processes.
3. Distinguish various nano finishing processes.
4. Measure the micro and nano scales.

Unit -I: Precision Engineering [7]

Introduction to conventional micro machining, Non-conventional micro-nano manufacturing and finishing approaches, Introduction to Nanotechnology

Unit -II: Precision Machining Processes [7]

Process principle, description and applications of conventional micro-nano machining processes such as: turning, drilling, milling and grinding Process principle, description and applications of non-conventional micro-nano machining processes such as: Micro EDM, Micro WEDM, Micro EBM, Micro ECM, Micro LBM, Photo Chemical Machining.

Unit -III: Precision Forming Processes [7]

Micro extrusion- process and applications, Nano- Plastic forming and Roller Imprinting, micro bending with Laser

Unit -IV: Nano Finishing Processes [7]

Magnetorheological Finishing (MRF) processes, Magnetorheological abrasive flow finishing processes (MRAFF) – process principle and applications

Force analysis of MRAFF process, Elastic Emission Machining (EEM) – machine description, applications, Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications

Unit -V: Nanofabrication Techniques [7]

Nanofabrication using soft lithography – principle, applications – Examples (Field Effect Transistor, Elastic Stamp), Manipulative techniques – process principle, applications, Introduction to Carbon nano materials, Carbon nano tubes – properties and applications, Laser Micro welding – description and applications, Defects, Electron Beam Micro-welding – description and applications

Unit -VI: Micro and nano Measurements [7]

Introduction to On-Machine Metrology, Defining themicro and nano scale, uncertainty, Scanning Electron Microscopy – description, principle, Scanning White-light Interferometry – Principle and application, Optical Microscopy – description, application, Confocal Microscopy - description, application

References:

1. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
2. Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.
3. N P Mahalik, Micro-manufacturing and Nanotechnology, 2006.
4. V. K. Jain, Micro-manufacturing Processes, CRC Press, 2012.

411085(B): Elective II: Simulation and Modeling

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Numerical Techniques and optimization, Production Management

Course objectives:

1. Introduce students to the simulation and modeling techniques
2. Provide students with opportunities to develop basic simulation and modeling skills with respect to carrying out research projects using any simulation method on the computer.

Outcomes:

After learning this subject, the student will able to:

1. Solve the problems based on simulation principal
2. Differentiate the simulation systems.
3. Collect data and generate the random numbers.
4. Distinguish simulations with regard to output analysis
5. Apply simulation to manufacturing system.
6. Handle software packages – ARENA/SimFactory/Promodel/ Witness

Unit I: Principles of Simulation and Modeling [7]

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 [7]

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 [7]

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 [7]

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 **[7]**

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 **[7]**

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.
3. Banks, J., J. S. Carson II, and B. L. Nelson. "Discrete-Event System Simulation", Second Edition, Prentice Hall, 1996.
4. Bratley, P., B. L. Fox, and L. E. Schrage "A Guide to Simulation", 2nd ed., Springer-Verlag, 1987.
5. 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(C): Elective II: Additive Manufacturing

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Material Science, Computer Aided Design

Course objectives:

1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

Outcomes:

After learning this subject, the student will:

1. Identify the materials for used in additive manufacturing.
2. Identify the software for additive manufacturing and digitization techniques.
3. Identify industrial applications of liquid based additive manufacturing technology.
4. Identify industrial applications of solid based additive manufacturing technology .
5. Identify the industrial applications of powder based additive manufacturing.
6. Find applications of Bio-Additive Manufacturing- Computer Aided Tissue Engineering

UNIT I: Introduction **[7]**

Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling – Applications,3D modeling ,Data Conversion, Checking and Preparing, Building, Post processing

UNIT II: CAD & Reverse Engineering **[7]**

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS

UNIT III: Liquid Based Additive Manufacturing Systems **[7]**

Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications , Cubital's Solid Ground Curing (SGC), D-MEC's Solid Creation System (SCS), Meiko's Rapid Prototyping System for the Jewelry Industry, Rapid Freeze Prototyping, Microfabrication

UNIT IV: Solid Based Additive Manufacturing Systems **[7]**

Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Cubic Technologies' Laminated Object Manufacturing (LOM), Kira's Paper Lamination Technology (PLT), 3D Systems' Multi-Jet Modeling System (MJM), Beijing Yinhua's Slicing Solid Manufacturing (SSM), Melted Extrusion Modeling (MEM) and Multi-Functional RPM Systems (M-RPM)

UNIT V: Powder Based Additive Manufacturing Systems **[7]**

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT VI: Medical and Bio-Additive Manufacturing [7]

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies, Biomedical applications of AM-Operation Planning for Cancerous Brain Tumor Surgery, Planning Reconstructive Surgery with RP Technology, Craniofacial Reconstructive Surgery Planning, Biopsy Needle Housing, Knee Implants, Scaffolds for Tissue Engineering, Customized Tracheobronchial Stents, Inter-Vertebral Spacers, Cranium Implant

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCES:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.

411085(D): Elective II: Reliability Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Metrology and Quality Control

Course objectives:

1. To focus on static and dynamic reliability of complex systems.
2. To study graphical techniques and empirical distributions.
3. To utilize common physical models for reliability analysis.
4. To study how to perform reliability analysis of complete data.
5. To study root cause, correct, and document system failures.
6. To study the failure Mode and its interactions.

Outcomes:

After learning this subject, the student will able to:

1. Identify and analyze the static and dynamic reliability of complex systems.
2. Identify commonly used reliability techniques using graphical techniques and empirical distributions.
3. Utilize common physical models for reliability analysis.
4. Perform reliability analysis of complete data.
5. Acquire ability to root cause, correct, and document system failures.
6. Implement accelerated and highly accelerated life testing analyses.

Unit I: Fundamentals of Reliability Engineering [7]

Reliability definition, reliability concept, quality, failure, patterns of failure, causes of failure, Time to failure Distributions–experimental, Weibull, gamma, normal, log normal, extreme value, model selection for components failure, failure analysis. failure density, failure rate, hazard rate, MTTF, MTBF,MTTR, MDT, unreliability, factor of safety and reliability, areas of reliability, life characteristic phases, bath-tub curve, Elements of Probability theory: Set theory, total probability theorem, Bayes rule.

Unit II: System reliability and modeling: [7]

Series, parallel, mixed configuration, k- out of n structure, complex systems- enumeration method, conditional probability method, matrix method, cut-set and tie-set method, Redundancy, element redundancy, unit redundancy, standby redundancy- types of standby redundancy, parallel components single redundancy, multiple redundancy. Markov analysis.

Unit III: Maintainability and Availability [7]

Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system down time, Availability - Inherent, Achieved and Operational availability, reliability and maintainability trade-off.

Unit IV: System reliability Analysis [7]

Reliability allocation or apportionment, Reliability apportionment techniques – equal apportionment, AGREE, ARINC, feasibility of objectives apportionment, dynamic programming apportionment, Evaluation of overall system reliability, Reliability block diagrams and models, Reliability predictions from predicted unreliability, minimum effort method.

Unit V: Failure Mode, Effects and Criticality Analysis [7]

Failure mode effects analysis, severity/criticality analysis, FMECA examples, RPN, Ishikawa diagram for failure representation, fault tree construction, basic symbols development of functional reliability block diagram, fault tree analysis, fault tree evaluation techniques, minimal cut set method, Delphi methods, Monte carlo evaluation.

Unit VI: Reliability testing and Failure Interactions and Terro-technology [7]

Reliability growth models, grouped and ungrouped data, censored data, accelerated life testing, Markov analysis of two independent components, reliability with standby system, multi component systems, DTMC and CTMS models. Terro-technology, application of terro technology.

Text Books:

1. L.S. Srinath, Concepts of Reliability Engg., Affiliated East-West Press (P) Ltd., 1985.
2. E. Balagurusmy, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1984.
3. Bhadury B., Basu S. K., Terotechnology-Reliability Engineering and maintenance‖, Asian Books Private Limited, ISBN 81-86299-40-6.

Reference Books

1. A.K. Govil, Reliability Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1983.
2. B.S. Dhillion, C. Singh, Engineering Reliability‖, John Wiley & Sons, 1980.
3. M.L. Shooman, Probabilistic Reliability‖, McGraw-Hill Book Co., 1968.
4. P.D.T. Conor, Practical Reliability Engg‖, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, Reliability in Engineering Design‖, John Wiley & Sons, 1977.
6. A.Birolini , Reliability Engineering, Theory and Practice‖, Third Edition, Springer, 1999
7. Rao S. S., Reliability Engineering‖, McGraw Hill.

411085(E): Elective II: Advanced Materials

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Material Science and Engineering Metallurgy

Course objectives:

1. To develop futuristic insight into materials
2. To acquaint students with basic concepts, properties and applications of different materials
3. To acquire the skills and techniques necessary for modern materials engineering practice

Outcomes:

After learning this subject, the student will:

1. Understand and possess the knowledge of working on materials.
2. Gain the knowledge of properties and applications of different materials
3. Select the appropriate material and prevent failure.

Unit I: Electrical and Magnetic Materials [7]

Electrical conducting materials, Electric contact materials, Applications of semiconductor materials, Dielectric Materials and Insulation: Polarization, Polarization Mechanisms, Dielectric Constant, Dielectric Loss, Piezoelectric, Ferro Electric and Pyroelectric Materials, Permanent Magnet materials, Feebly magnetic materials

Unit II: Nanomaterials [7]

Introduction, Unique properties of nanomaterials, Applications of nanomaterials- Nano electronics, Micro-and-Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Structure and Engineering, Automotive Industry, Nano-medical applications, Tools to characterize Nanomaterials- XRD, SEM, TEM, AFM, STM, FIM, 3DAP, Nanoindentation

Unit III : Polymers [7]

Introduction, Formation of polymers, Classification of polymers, Polymerization mechanisms, Degree of polymerization and it's numericals, Crystallization of polymers, Cross-linking, Deformation of polymers, Factors affecting the properties of a polymer, Applications of polymers

Unit IV: Elastomers [7]

Introduction, Characteristics of rubber, Uses of rubber, forms of rubber, Plasticization, Compounding, Calendering, Vulcanisation, Extruding, Moulding, Reclaimed rubber, Properties of elastomers

Unit V: Ceramic Materials [7]

Introduction, Classification of ceramics, Advantages, Applications and Properties of ceramic materials, Advanced structural ceramics, WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN and diamond - properties, processing and applications, Properties and applications of Glass, Properties and applications of Refractories

Unit VI: Composite Materials [7]

Reinforced fibers, Particle strengthened and laminar composites-- production techniques of each type, Production of fibers, properties mechanics of composites, manufacturing of metal matrix,Ceramic matrix composite, Carbon-Carbon composite- properties and testing of composite material, areas of application.

Text Books

1. O.P.Khanna, "A Text Book of Material Science and Metallurgy", Dhanpat Rai Publications(P) Ltd., 2013, ISBN- 978-81-89928-31-5
2. V.D.Kodgire, S.V. Kodgire,"Material Science and Metallurgy for Engineers", Everest Publishing House, 24th Edition, 2008, ISBN 81 86314 00 8.
3. B.S. Murty, P.Shankar, Baldev Raj, B.B.Rath, James Murday, "Textbook of Nanoscience and Nanotechnology, Universities Press (India) Pvt. Ltd., 2013, ISBN : 978 81 7371 7383
4. R.K.Rajput, "A Textbook of Material Science and Engineering",S.K.Kataria and Sons, 3rd Edition, 2011, ISBN 81-85749-92-2

References:

1. W.D.Callister,Jr., "Callister's Materials Science and Engineering", 7th edition, Wiley India Pvt. Ltd., 2010,ISBN-978-81-265-2143-2
2. ASM Hand Book, Vol.11, "Failure Analysis and Prevention ".
3. W.F.Smith, "Principles of Materials Science and Engineering",3rd edition, McGraw Hill, ISBN: 0070592411

411086: Machine Tool Design Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Oral: 50 Marks

Practical/Design Assignments:

1. Design and working drawing of speed gear box
2. Design and working drawing of feed gear box
3. Study of step-less drives.
4. Design of machine tool structure.
5. Design for spindle and power screw.
6. Design for guide ways and slide ways.
7. Practical Case study on Machine tool – testing , safety and calibration .

411087: Automation & Control Engineering Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Practical: 50 Marks

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

Practical Work: (Any six from 1 to 7, 8th and 9th are compulsory)

1. Experiment on measurement of hydraulic pump efficiency.
2. Experiment on design of speed control hydraulic circuits.
3. Experiment on design of regenerative circuits
4. Experiment on design of electro-hydraulic sequencing circuits
5. Experiment on pneumatic circuits by demonstrating logic gates.
6. Experiment on electro-pneumatic circuits
7. Experiment on programmable logic controllers: Ladder logic programming
8. Microprocessor programming for basic operations.
9. *Industrial visit report on automation in any Industry.

* Industrial visit is compulsory.

Note: Use simulation software (freeware- fludsim, fluid demo etc) for doing experiments 1 to 7

411088: Operations Research Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term Work:

One exercise on each unit. At least one Computer Software Package such as Lindo/Lingo, MATLAB, MS-Excel/MS-Projects, Tora, AMPL etc. should be used. For each exercise along with manual solution of problems, any computer software package should be used to obtain the solution.

411089(A): Elective I: Product Design & Development Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work will be based on any six assignments from following;

1. Morphological analysis of product design
2. Quality Function Deployment (QFD) and House of Quality
3. Case study based on product design approach
4. Case study of FMEA
5. Product Tear Down approach in product design
6. Design for “X”
7. Case study in Product Life cycle Management (PLM)
8. Case study on identification of customer needs for specific product

411089(B): Elective I: Financial Management and Costing Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Numerical Based Assignments using MS-Excel/MS Project/Talley etc.

1. Preparation of Financial Statements and Ratio Analysis for any industry,
2. Assignment on Payback approach, Accounting of Rate of Return, Present Value Method and Internal Rate of Return.
3. Assignment on Working Capital Management
4. Assignment on Material Cost, Labor Cost, Depreciation and Overheads
5. Assignment on Standard Costing and Variance Analysis
6. Assignment on Marginal Costing, Activity based costing and Process costing

411089(C): Elective I: Data Analytics Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work shall consist of Programming/Assignment/Case studies on Data analysis based on each unit.

411089(D): Elective I: Advanced Thermal Engineering Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

The term work shall be based on the following assignments (any seven)

1. To determine thermal conductivity of composite wall.
2. To determine thermal conductivity of insulating powder.
3. To determine heat transfer coefficient in natural convection.
4. To determine heat transfer coefficient in forced convection
5. To determine Stefan Boltzman constant.
6. To determine the effectiveness of a concentric tube heat exchanger
7. To study construction and working of various solar photovoltaic (PV) systems
8. To study construction and working of various solar collectors
9. To study construction and working of various renewable energy systems
10. To determine the C.O.P. of vapour compression refrigeration test rig using P-H Chart
11. Report on visit to a cold storage/refrigeration plant/ Thermal power plant/hydroelectric power Plant.

411089(E): Elective I: Mechatronics Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Lab Work (any 6)

1. Measurement of Temperature
2. Measurement of Force using Strain Gauges
3. Measurement of Angular Velocity using proximity pickup/ encoders
4. Measurement of Displacement using LVDT
5. Demonstration of Op-Amps for Summing and Inverting Amplifier
6. PLC program for any real time example e.g. elevator, conveyor, bottle filling plant
7. Transient Response analysis of spring-mass balance system using MATLAB

411090: Project Phase-I

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 02(TW-1 & Oral-1)	Termwork: 50 Marks

Pre-requisite:

1. Students are required to undergo 3 to 4 weeks industrial training / implant training /in-house project based learning/project related skill development course/ industrial survey report before commencement of first semester of Final year .
2. Submit detailed report of 10-15 pages of the same.
3. Project registration will be based on completion of above activities.

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. **Students shall submit the project phase –II plan.** Above work shall be taken up individually or in groups. *The group shall not be more than 4 students,* ***(If project work is more then group members may be increased by permission of guide)***

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:

i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation
ii. Improvement of existing machine / equipment / process.
iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose Equipment, inspection gauges, measuring instruments for machine tool,
iv. Computer aided design, analysis *of* components such as stress analysis.
v. Problems related to Productivity improvements/Value Engineering/Material Handling Systems
vi. Energy Audit of an organization, Industrial evaluation of machine devices.
vii. Design of a test rig for performance evaluation of machine devices.
viii. Product design and development.
ix. Analysis, evaluation and experimental verification of any engineering problem
x. Quality systems and management. Total Quality Management.
xi. Quality improvements, In-process Inspection, Online gauging.
xii. Low cost automation, Computer Aided Automation in Manufacturing.
xiii. Time and Motion study, Job evaluation and Merit rating
xiv. Ergonomics and safety aspects under industrial environment
xv. Management Information System.
xvi. 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 and submit their Project Phase-I report to the internal and external examiner from college/Industry.**

411091: Computer Integrated Design & Manufacturing

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites:
Engineering drawing, Machine drawing, Dimensioning and tolerances, various geometrical features. Design of Machine Elements

Course objectives: The students completing this course are expected to:
1. Understand the role of computer in design, modeling and manufacturing industry.
2. Understand basic concepts of CIM system.
3. Understand the various automated manufacturing activities
4 Apply computer Technology in the Manufacturing activities
5. Learn the smooth transition from conventional manufacturing to automated production and computer integrated manufacturing

Outcomes: After learning this subject, the student will be able to:
1. Apply geometric modeling principles to design a component
2. Use different transformation methods to solve problems in CAD
3 Appreciate the role of computers in manufacturing process and apply it in operation.
4. Combine different concepts to describe computer integrated manufacturing
5. Group similar parts and design FMS process

Unit I: Computer Graphics [7]

CAD cycle for product design, CAD workstations - data communications - input/output devices, display technology, CAD software. Transformation- Introduction, Formulation, Translation, Rotation, Scaling, Reflection, Homogenous Representation, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations.

Unit II: Geometric Modelling [7]

Requirements of geometric modeling, geometric models, Wireframe modeling, Surface modeling, geometric construction methods, constraint based modeling, Representation of curves and surfaces. Analytic curves- Lines, circles, circular arcs, ellipse, parabola, hyperbola etc. Synthetic curves - cubic splines, bezier curves, B-spline curve etc., Surface modeling –Representation of surfaces, analytical and synthetic surfaces. Solid modeling – Solid entities, methods of solid modeling

Unit III: Computer Integrated Manufacturing (CIM) and Rapid Prototyping [7]

Computer application in manufacturing automation, Computer aided inspection and quality control. Computer integrated production management system, inventory, material requirement planning, manufacturing resource planning, enterprise resource planning. 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, Thermo jet Process, Ballistic Particle Manufacturing. Application of rapid tooling methods to press tool manufacture

Unit IV: Computer Aided Manufacturing (CAM) [7]

Concepts and features of NC, CNC & DNC - feed back devices ,Interpolators., Point-to-point and contouring systems – Interchangeable tooling system – preset & qualified tools – ISO specification – Machining center – Turning center ,
CNC Programming:- Machine Tool Co-ordinate System, Machine zero, Job zero, Cutter Programming, Tool Offsets, Manual part programming – steps involved – G-codes and M-codes, sample program in lathe & milling. CAM package – canned cycles - Programming.

Unit V: Computer Applications in Engineering Analysis [7]

Introduction, steps in FEA, Boundary conditions 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, One Dimensional Problem and Two dimensional Problems and Boundary conditions.

Unit VI: Flexible Manufacturing System [7]

Part families – visual – parts classification and coding – case studies in coding – Production flow analysis – benefits of G.T. – Application of G.T. Cellular Manufacturing –Machine cell design – Key machine concept - quantitative analysis in cellular manufacturing – Rank order clustering technique – Arranging machines in G.T. Cell

FMS – Types of FMS – FMS components – Workstations, Material Handling and storage system – FMS Layout type, computer control system, Human resource – FMS application and benefits – FMS planning and implementation issues. Quantitative analysis of FMS – CANQ, deterministic models.

Text Books:

1. Radhakrishnan.P, Subramanyan.S and Raju.V, "CAD/CAM/CIM", New Age International Publishers, 2000,ISBN:81-224-1248-3
2. Groover and Zimmers, "CAD / CAM: Computer Aided Design and Manufacturing", Prentice Hall of India, New Delhi (1994), ISBN:81-203-0402-0.
3. Zeid Ibrahim, "CAD - CAM Theory and Practice", Tata McGraw Hill Publishing Co. LtdNew Delhi.(2000)ISBN:0-07-463991-4.
4. Kundra T.K., Rao P.N., Tiwari N.K., "Numerical control and Computer aided manufacturing", Tata McGraw Hill 1992New Delhi, ISBN:9780074517406.
5. Rao P.N,"CAD - CAM Principles and Practice", Tata McGraw Hill Publishing Co. Ltd New Delhi.(2000)ISBN:0-07-044530-3.

Reference Books:

1. James A.Retrg and Henry W. Kraebher, "Computer Integrated Manufacturing", Pearson Education, Asia, 2001
2. Viswamathan.N and Narahari.Y, "Performance Modelling of Automated Manufacturing System", Prentice Hall of India Private Limited, ISBN:978-81-203-0870-1,Reprint2009
3. Chandrupatla T.R., Belegundu A.D., "Introduction to Finite Elements in Engineering",Prentice Hall of India 2003.ISBN:13:9780130615916.

411092: Industrial Robotics

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites:

Basic knowledge of Engineering drawing, Theory of Machines, Mechanics of Materials, Design of Machine Elements, Kinematics of Manufacturing Machines

Course objectives:

- To introduce basic concepts of Robotic arm, body and wrist motions.
- To learn the concept of Direct Kinematics and Inverse kinematics.
- To understand various ways to design mechanical grippers.
- To study sensors and use of machine vision system of robotics.
- To understand control units and drives, Artificial intelligence.
- To study the advancement in robotics area.

Outcomes:

After learning this subject, the student will:

- Understand the motions of robotic arm and body which generates robot configuration.
- Apply the techniques like Homogeneous transformation to understand direct and inverse kinematics.
- Use design procedure for mechanical grippers depending upon their types and mechanism.
- Understand different types of sensors and will be able to convert blank and white image from the given gray scale pattern.
- Use different programming languages used to operate robot.
- Identify application of robots in different areas where they will work in future.

Unit 1: Fundamentals of robotics [7]

Automation and robotics, robot anatomy, historical development of industrial Robots and manipulators, basic structure of robots, resolution, accuracy and repeatability. Classification, Configuration of robots, arm and body motions, wrist motions. Robot Drives, Basic Control systems. End effectors – Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers – Two fingered and three fingered grippers – Internal grippers and external grippers – Selection and design considerations.

Unit II: Robot Arm Kinematics [7]

Robot kinematics-Types- 2D, 3D Transformation, D-H Representation & Displacement Matrices for Standard Configurations, Forward kinematics and Inverse kinematics analysis of manipulators with two and three degrees of freedom (planar).

Unit III: Robot Arm Dynamics [7]

Robot dynamics – Rigid body dynamics, Newton-Euler formation, Lagrange-Euler, formation, generalized D'Alembert equations of motion.

Unit IV: Sensors and Machine vision systems in Robotics [7]

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, Piezoelectric Contact Sensors. Remote Sensor Compliance, Range &Proximity Sensors, Electro-optical Sensors.

Vision system: Median filtering, thresholding, discretization, smoothening of binary image. Edge detection algorithm, region growing algorithm.

Unit V: Robot Programming and Robot Interfacing [7]

Robot Programming: Methods of Programming the robot, Methods of defining positions in space, Motion interpolation, branching, Textual robot programming languages. Interfacing Robots with computers. Obstacle Avoidance: Lee's Algorithm; Counter Path Defining using 'via' point, blending Technique

Unit VI: Advanced Applications of Robots [7]

Pick and place Robot, Welding Robots, Assembly and mega-assembly Robots, Walking Robots, Climbing Robots, Machine mounted Robots. Artificial Intelligence: Concept of A.I., Role of A.I. in robotics.

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.

411093(A): Elective III: Sustainability Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Prerequisites:
Knowledge of Machine tool engineering, Welding and Foundry.

Course objectives:
1. Explain the design concepts, methods, tools, the key technologies and the operation of sustainable manufacturing.
2. Apply the principles, techniques and methods to customize the learned generic concepts to meet the needs of a particular industry/enterprise
3. Identify the strategies for the purpose of satisfying a set of given sustainable manufacturing requirements
4. Design the rules and processes to meet the market need and the Sustainable manufacturing requirements by selecting and evaluating suitable technical, managerial / project management and supply chain management schemes

Unit I: **Sustainability** **[7]**
Concepts related to Sustainability, Ecosystems, Biodiversity, Air and water pollution, Energy consumption, Land degradation, Global warming, Sustainable Development, the global sustainability Agenda, Green Expectations, confronting climatic change, Wake-up Conferences, The Voice of Society, Answering the call- The Green Movement

Unit II: Types and sources of solid and hazardous wastes **[7]**

Nature and hazard of pollutants: waste processing /segregation Need for waste management, Waste processing, Green processing and engineering operations, incineration, Energy recovery, a life-cycle approach, which considers the costs and benefits associated with material acquisition, transportation, production, product use, and recovery for recycling, reuse or remanufacture. Inventory management and improved operations.

UNIT III: Environment friendly Choices in Manufacturing, Operations and Logistics **[7]**

Materials for Sustainability, Materials and processes selection, Materials for the future, Materials for Recycling, Control on non-renewable material usage Component toxicity and health impact, Integrating sustainability principles.

Unit IV Techniques of Sustainability **[7]**
Conversion technologies, Innovations for reuse, bio processing technology Energy audits, Sustainable loading on ecosystems, The concept of "eco-efficiency," a measurable characteristic of products and processes, Product Life Cycle Assessment: Environmental analysis from raw materials to disposal, Matrices for sustainable design, industrial case studies.

Unit V Rules and regulations **[7]**
Overview of the cultural, political, and economic changes that are transforming the role of environmental management in the business world. Environmental Standards e.g. ISO- 14000 Environmental Legislations: Carbon Foot Print, Implications of public policy, Anti-pollution Boards Guarding Against Environmental Impact, Alternative product and process changes, manufacturing practices, Global warming and Kyoto protocol, environmental preservations. Environment and human health, Access to potable water

UNIT VI: Multi-objective Decision Making **[7]**
Considering environmental issues in operating strategy, Creating a sustainable manufacturing company Effective Hazards Mitigation Management, Role of IT, Communication Networking, Continuous sustainability awareness

programmers; Encouraging innovations in energy generation and usage economy, Sustainability Rating Schemes, Eco-labeling Programs Case Studies, human values and professional ethics

References:

1. M. K. Ghosh Roy; Sustainable Development by Ane Books Pvt. Ltd.
2. M. Karpagam, Geetha Jaikumar, Green Management, Anne Books Pvt. Ltd
3. S. P. Misra, S.N. Pandey, Essential Environmental Studies, Sheth Publishers
4. , Joseph Fiksel, Design for Environment: A Guide to Sustainable Product DevelopmentThe McGraw-Hill Companies

411093(B): Elective III: Supply Chain Management

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Course Objective

To help understand the importance of and major decisions in supply chain management for gaining competitive advantage.

Course Outcomes

After Successful completion of this course students will able to:

- Build and manage a competitive supply chain using strategies, models, techniques and information technology.
- Optimize supply chain network
- Plan the demand, inventory and supply

UNIT I: Introduction [7]

Supply Chain – Fundamentals –Evolution- Role in Economy - Importance - Decision Phases - Supplier-Manufacturer-Customer chain. - Enablers/ Drivers of Supply Chain Performance. Supply chain strategy - Supply Chain Performance Measures.

UNIT II: Strategic Sourcing [7]

Outsourcing – Make Vs buy - Identifying core processes - Market Vs Hierarchy - Make Vs buy continuum -Sourcing strategy - Supplier Selection and Contract Negotiation. Creating a world class supply base- Supplier Development - World Wide Sourcing.

UNIT III: Warehouse Management [7]

Stores management-stores systems and procedures-incoming materials control-stores accounting and stock verification Obsolete, surplus and scrap-value analysis-material handling-transportation and traffic management -operational efficiency-productivity-cost effectiveness-performance measurement

UNIT IV: Supply Chain Network [7]

Distribution Network Design – Role - Factors Influencing Options, Value Addition – Distribution Strategies - Models for Facility Location and Capacity allocation. Distribution Center Location Models. Supply Chain Network optimization models. Impact of uncertainty on Network Design - Network Design decisions using Decision trees.

UNIT V: Planning Demand, Inventory and Supply [7]

Managing supply chain cycle inventory. Uncertainty in the supply chain –- Analyzing impact of supply chain redesign on the inventory - Risk Pooling - Managing inventory for short life - cycle products -multiple item -multiple location inventory management. Pricing and Revenue Management

UNIT VI: Current Trends [7]

Supply Chain Integration - Building partnership and trust in SC Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain. . SC Restructuring - SC Mapping - SC process restructuring, Postpone the point of differentiation – IT in Supply Chain - Agile Supply Chains -Reverse Supply chain. Agro Supply Chains.

TEXT BOOKS

1. Janat Shah, Supply Chain Management – Text and Cases, Pearson Education, 2009.
2. Sunil Chopra and Peter Meindl, Supply Chain Management-Strategy Planning and Operation, PHI Learning / Pearson Education, 2007.

REFERENCES

1. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 5 th Edition, 2007.
2. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies, and Cases, Tata McGraw-Hill, 2005.
3. Altekar Rahul V, Supply Chain Management-Concept and Cases, PHI, 2005.
4. Shapiro Jeremy F, Modeling the Supply Chain, Thomson Learning, Second Reprint , 2002.
5. Joel D. Wisner, G. Keong Leong, Keah-Choon Tan, Principles of Supply Chain Management- A Balanced Approach, South-Western, Cengage Learning 2008.

411093(C): Elective III: Automobile Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 04 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Basic Mechanical Engineering, Theory of Machine, Basic Electrical & Electronics, Design Machine Elements.

Course Objectives:

1. Vehicle specifications, Chassis and safety.
2. Fuel Supply System & Cooling System.
3. Lubrication System and Ignition System.
4. Drive Train and Vehicle Performance.
5. Suspension and Steering System.
6. Breaking Systems and Automobile Maintenance techniques.

Outcomes:

Upon successful completion of this subject student should be able to….

1. Understand Vehicle specifications, Chassis and safety.
2. Study of Fuel Supply System & Cooling System.
3. Understand Lubrication System and Ignition System.
4. Study of Clutches and Gear Boxes.
5. Understand Suspension and Steering System.
6. Understand Breaking Systems and Automobile Maintenance techniques.

Unit-I: Introduction to Automobile Engineering & safety [7]

Automobile -history and development, classification, vehicle layout-engine location and drive arrangement, types of vehicle bodies, chassis types, constructional details, frames, sub frames, frameless vehicles, vehicle dimensions.
Vehicle safety-active, passive safety, air bags, seat belt, types of collisions-front, rear, side, vehicle interior and ergonomics safety regulations of vehicles.

Unit II: Ignition systems and Fuel supply system. [7]

Ignition System –battery, magneto and electronic ignition system, comparison, different starting system used in automobiles
Fuel supply system-S.I. Engine, carburation, Air-fuel requirements, simple carburetor & classification, Modern Carburetors (Solex & S.I carburetor). Fuel injection in S.I. engine M.P.F.I &G.D.I , C.I. engine – classification of fuel supply system-solid injection system fuel injection pump Bosch Pump and injector

Unit III: Lubrication and Cooling system [7]

Lubrication system-objective of lubrication, types of lubricants, properties and additives, types of lubrication systems-dry sum, wet sum and mist sum lubrication, crank case ventilation (Globe eye), SAE viscosity index.
Cooling system –necessity of cooling, under cooling, overcooling, types of cooling system components, working of pressurized force & thermostatic , coolant additives

Unit IV: Drive train and vehicle performance [7]

Drive train-Types of clutches, single plate, multiplate centrifugal clutches, clutch operating systems, Wet clutches, fluid coupling, clutch plate material Functions of gear box, selection of gear ratio sliding mesh, constant mesh and epicyclic gear boxes, Synchromesh devices, automatic gear boxes, torque converters, overdrive,Electro-magnetic transmission,

Automatic overdrive, Hydraulic control system for automatic transmission. Troubleshooting and diagnosis for Clutch & Gear Box Troubleshooting, latest trends in drive train of automobile

Vehicle performance- Vehicle performance parameters, various resistances to motion, rolling, air and radiant resistance, total resistance and tractive effort, variation of tractive effort with speed power required for acceleration and gradiability

Unit V: Steering system and Braking system [7]

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, types of wheels cross ply and radial tires, tubeless tires power steering

Braking systems - Types of brake systems - drum, disc, operation-mechanical, hydraulic, air brakes, servo and power braking, hand brake, ABS.

Preventive maintenance and diagnosis for Brake and Steering system.

Unit VI: Electrical Systems and Suspension System [7]

Electrical System –

Batteries: Principles and construction of lead-acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on battery condition, charging methods.

Lighting System & Accessories: Insulated & earth return systems, positive & negative earth systems, electrical fuel pump, speedometer, fuel, oil & temperature gauges, horn, wiper system, trafficator, sensors and actuators, electronic control unit, traction control devices.

Suspension Systems-Objects of suspension, principles of suspension design spring and unspring mass, types of springs, torsion bars, rubber springs, shock absorbers, independent suspension air suspension, interconnected suspension, hydro pneumatic suspension, self leveling suspension, Troubleshooting and diagnosis for Suspension system.

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 Heywood: Internal combustion Engine Fundamentals, Tata McGraw-Hill
2 Domkundwar & Domkundwar : Internal combustion Engine, Dhanpat rai
3 Automobile Electrical Equipment, P. S. Kohali, Tata McGraw Hill Publishing House.
4 Narang G. B. S, “Automobile Engineering”, S. Chand and Company Ltd.
5 Crouse W.H.Anglin.,Automotive Transmission and Power Trains Construction, McGraw- Hill, 1976.

411093(D): Elective III: Entrepreneurship

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Production Management, Industrial Engineering and Quality Assurance

COURSE OBJECTIVES:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

COURSE OUTCOMES:

After Successful completion of this course students will able to:

1. Appreciate the importance of embarking on self-employment and has developed the confidence and personal skills for the same.
2. Start a small business enterprise by liaising with different stake holders
3. Effectively manage small business enterprise.

UNIT I: Entrepreneurship [7]

Definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.

UNIT II: Motivation [7]

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III: Project identification [7]

Assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

UNIT IV: Accountancy [7]

Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT V: Project Planning and control [7]

The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows, control and communication.

UNIT VI: Laws **[7]**

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

Text Books:

1) Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd.,Ram Nagar, New Delhi, 2013.
2) Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

Reference Books

1) Forbat, John, "Entrepreneurship" New Age International.
2) Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International
3) Joseph, L. Massod, "Essential of Management", Prentice Hall of India.

411093(E): Elective III: Human Resource Management

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Industrial organization and Management

Course objectives:

1. Understand the importance of human resources and their effective management in organizations
2. Analyze the key issues related to administering the human elements such as motivation, compensation, appraisal, career planning, diversity, ethics, and training
3. Analyze the role of recruitment and selection in relation to the organization's business with demonstration of the appropriate use of job descriptions
4. Develop, analyze and apply advanced training strategies and specifications for the delivery of training programs. Describe appropriate implementation, monitoring and assessment procedures of training

Outcomes:

After learning this subject, the student will:

1. Discuss strategic plan for the human resources needed to meet organizational goals and objectives
2. Define the process of job analysis and discuss its importance as a foundation for human resource management practice
3. Compare and contrast methods used for selection and placement of human resources.
4. Describe the steps required to develop and evaluate an employee training program
5. Identify and explain the issues involved in establishing wage and compensation systems.
6. Summarize the activities involved in evaluating and managing employee performance
7. Explain how legislation impacts human resource management practice.

Unit I **[7]**

Human Resource Management: Basic Concepts, Scope, Objective, Functions, managerial Skill and Roles
Evolution And Environment: Evolution of H.R.M., Influence of Scientific Management on HRM, Influence of Labour Movement on HRM, Influence of Govt. Regulations on HRM.
Theories OF H.R.M.: Theories of Work, Fish Bone Diagram Approach to H.R.M., System Concept of H.R.M.

Unit II **[7]**

Human Resources Planning: Introduction, Strategic Considerations, Nature and Scope Of H. R. Plans, Human Resources Inventory, Human Resources Forecast, Job Analysis, Job Description, Job Specification, Job Evaluation, Employment Stability
Recruitment: Introduction, Recruitment Policy, Sources Of Recruitment, Recruitment Methods, Effectiveness Of Recruitment Programme
Selection: Scientific Selection, Selection Policy, Selection Process, Selection Tests, Interview, Work History, References, Provisional Selection, Medical/Physical Examination, Final Selection, Employment.
Placement, Induction And Socialization: Placement, Induction, Socialization, Strategies of Socialization.
Performance Appraisal And Merit Rating: Basic Concepts, Performance Standard, Appraisal Methods, Appraisal Errors, Methods of Improving Performance Appraisal, Merit Rating.

Unit III **[7]**

T**raining and Development:** Basic Concepts, Theories of Learning, Principles Of Learning, Training Policy.

Employees Training: Training Process, Identification of Training Needs, Planning Of Training Programme, Preparation Of Trainees, Implementation Of Training Performance Evaluation Of Training, Follow-Up Training

Management/Executive Development: Introduction, Objectives, Executive Development Process, T & D Techniques and Methods, Evaluation, Supervisors, Supervisory Training.

Career Development: Basic Concepts, Stages Of Career Development, Career Development Programme.

Promotion, Transfers and Separations: Promotions, Promotion Policy, Promotion Plans, Promotion Programme, Problems in Promotion, Transfers, Demotion, Separations.

Unit IV **[7]**

Wages and Salaries Administration: Basic Concepts, Theory Of Wages, Process Of Wages Payment, Job Evaluation, Wage(Pay) Structure, Wage Fixation, Wage Payment, Wages Incentive Plans, Executive Compensation Plan

Discipline and Grievances: Employees Discipline, Code Of Discipline, Role And Responsibility Of Personnel Department, Grievances.

Industrial and Labour Relations*:* Industrial Relations, International Labour Organization (I.L.O), Labour Legislation, Industrial Relations In India, Industrial Disputes/Conflicts, Workers Participation In Management (WPM), W.P.M. International Scene, Experts Committee Reports On W. P.M., W.P.M. Case Study At BHEL- Hardwar

Trade Unionism: Introduction, Theories Of Trade Unionism, Classification Of Trade Unions, Union Management Relation, Evolution Of Trade Unionism, Trade Union As An Organization, Problems Of Trade Unions, National Commission Labour

Collective Bargaining: The Concept, The Evolution, Collective Bargaining And Strike, Collective Bargaining And Union-Management Relations, Collective Bargaining And Environment, Nature And Scope, Types Of Collective Bargaining, The Process Of Collective Bargaining, Policies Of Collective Bargaining, Laws Of Collective Bargaining, Case Studies-Collectives Bargaining, Collective Bargaining- Public Sectors And Private Sectors, Committee Reports On Collective Bargaining.

Rewards and Labour Welfare: Rewards, Non-Financial Rewards, Labor Welfare In India, Benefits(Extra-Mural), Service (Intra-Mural), Case Studies

Unit V **[7]**

Theories of Human Relations and Motivation: Human Relations, Theories of Motivation, Integration of Motivation Theories

Vocational Guidance, Job Satisfaction and Morale: Vocational Guidance, Job Satisfaction, Morale.

Steps to Promote Intrinsic Motivation: The Concept, Worker Participation In Management (WPM), Management By Objectives (MBO), Organization Behavior Modification, Job Redesign, Alternative Work Schedules.

Organization Design, Structure And Development: Organization Theory, Design Consideration of Organization, Factors Influencing Contingency Organization Design, Mintzberg's Design Configuration, Organization Design-Future Trends, Organization Structure, Dynamism Of Organization, Organization Change, Organization Development.

Empowerment: Basic Concepts, Power and Behavior, Organization Politics, Organizational Climate and Culture, Innovation and Creativity, Empowering Leaderships, Holistic View Of Human Behavior, Human Capital, Empowerment, Corporate Vitality, Future of HRM

Unit VI **[7]**

Industrial Health and Safety: Industrial Health, Occupational Hazards, Occupational Diseases, Alcoholism And Drug Abuses, Absenteeism And Turn Over, Accidents, Safety Organization, cost of safety, Statutory Provisions On Safety, industrial safety products, Work Stress, Executive Stress, Personnel Research On Industrial Health. Occupational Safety and Health Administration[OSHA], Effect of environmental conditions and work design on Energy Expenditure.

The Factories Act, 1948: Introduction, Definition In The Act, Requirements Under The Act, Licensing And Registration, Health Provisions, Safety Provisions, Welfare Provisions, Working Hours , Employment Of Young Persons, Annual Leave, Accidents And Diseases, Penalties, Miscellaneous Provisions

Reference Books:

1. Nair and Nair,Personal Management and Industrial Relations, S. Chand and Company Ltd. New Delhi,ISBN81-219-1808-1
2. Garry Dessler, Human Resource Management, Pearson; 13 edition, ISBN: 0132668211
3. C. B. Mamoria, S V. Gankar, Personnel Management, Himalaya Publishing, , ISBN: 8184888082
4. Mirza Saiyadin, Human Resources Management - McGraw Hill Education; 4 edition, ISBN: 0070263639

411094(A): Elective IV: Intelligent Manufacturing System

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Numerical techniques and optimization methods, Process Planning and Tool Selection, Industrial Engineering and Management, Production Management

Course objectives:

1. To learn statistical methods, evolutionary optimization techniques, soft computing methods, machine learning and knowledge based system.
2. Effective applications of these methods to intelligent manufacturing systems.

Course Outcomes:

After learning this subject, the student will be able to:
Implement statistical methods, evolutionary optimization techniques, soft computing methods, machine learning and knowledge based system for manufacturing system applications such as:

1. Equipment selection and layout
2. Process planning and parametric optimization
3. Cellular manufacturing
4. Robotics systems

Unit I: Introduction to artificial intelligent techniques [7]

Goals of AI in manufacturing, tools for AI such as Search algorithm, Mathematical optimization, Evolutionary computation, fuzzy logic, Probabilistic methods for uncertain reasoning such as Bayesian network, Hidden Markov model, Kalman filter, Decision theory and Utility theory, statistical learning methods, support vector machines, neural networks, expert systems

Unit II: Industrial planning and decision making using intelligent systems [7]

Production planning using fuzzy cognitive maps, computer aided process planning, Methods for inventory space allocation and storage processes analysis, Optimization of production costs and methods finding of the best process plan, Methods for production equipment selection and layout, Heuristic scheduling of multiple resources, Fuzzy multiple attribute decision making methods.

Unit III: Intelligent techniques for manufacturing process optimization [7]

Application of neural networks and fuzzy sets to machining and metal forming, Artificial neural network modeling of surface quality characteristics in machining processes, parametric optimization of machining processes using evolutionary optimization methods.

Unit IV: Knowledge Based Group Technology [7]

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 algorithms

Unit V: Intelligent robotic systems [7]

Applications of intelligent systems for mobile Robot Motion Planning, Path Planning Robot Control in Dynamic Environments, Task Based Hybrid Closure Grasping Optimization for Autonomous Robot Hand. Accurate Motion Control of Fast Mobile Robots, obstacle avoidance.

Unit VI: Use of Intelligent techniques in flexible manufacturing systems (FMS) [7]

Applications of various intelligent systems for FMS functional segmentation schemes including control, real time scheduling, tool management, process planning, route optimization for AS/RS systems.

References:

1. Andrew Kussiak, “Intelligent Manufacturing Systems”, Prentice Hall , 1990
2. Badiru A.B., “Expert Systems Applications in Engineering and Manufacturing”, Prentice-Hall, New Jersey, 1992.
3. Liu, Dikai, Wang, Lingfeng, Tan, Kay Chen (Eds.) Design and Control of Intelligent Robotic Systems, Springer-Verlag, London. ISBN 978-3-540-89932-7
4. Rao R. V. “Advanced Modeling and Optimization of Manufacturing Processes”, Springer-verlag, London. ISBN 978-0-85729-014-4

411094(B): Elective IV: Energy Management

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Basic Mechanical Engineering, Heat and Fluid Engineering

OBJECTIVES:

At the end of the course, the student is expected to

1. understand and analyze the energy data of industries
2. carryout energy accounting and balancing
3. conduct energy audit and suggest methodologies for energy savings and
4. utilize the available resources in optimal ways

Course Outcomes:

After successful completion of this course students will:

1. Identify areas of energy conservation in industries.
2. Identify role and responsibilities of an energy manager and energy auditor.
3. Analyze working of the energy utilizing and generating machines.
4. Practice and utilize the instruments in energy audit process.
5. Implement proper energy saving techniques in boiler, furnaces, compressors and heavy machineries.

Unit I: Energy Scenario [7]

Energy Scenario: Basic of energy and its various Forms, Global primary energy reserves and consumption pattern, Indian energy scenario, sector wise energy consumption(domestic, industrial and other sectors), energy needs of growing economy, energy pricing in India, Energy Security: Chemical and Nuclear, energy and its impact on environmental climatic change , importance of energy conservation and introduction of energy conservation act 2001,

Future Energy Options: Sustainable Development, Energy Crisis: Transition from carbon rich and nuclear to carbon free technologies, parameters of transition, Need for use of new and renewable energy sources.

Unit II: Energy Economics and Audit [7]

Energy economics: Simple payback period, time value of money, return on investment, net present value and internal rate of return.

Energy Audit: Role of Energy auditor and Manager, Methodology, analysis and reporting, portable and online instruments required for energy audit, Energy audit case studies (Milk Industry, Central Library of Institute, Workshop, department sankey diagram and specific energy consumption.

Unit III: Energy Efficiency and Energy Performance in Thermal utilities [7]

Boiler efficiency calculations by direct and indirect method, various losses, steam distribution and steam traps, energy conservation opportunities in boiler. Efficiency calculation of oil fired furnace, heat losses and energy conservation opportunities in furnace. Thermal insulation, types of insulation, economic thickness of insulation.

Unit IV: Electrical System [7]

Demand control, billing structure, power factor improvement, benefits and ways of improving PF, load scheduling, electric motors, losses and efficiency, energy efficient motor, speed control methods of motor, Soft starters with energy saver, Lighting: illumination level, fixtures, timers, energy efficient illumination.

Unit V: Compressed air System and HVAC system [7]

Energy conservation in: Compressed air systems, refrigeration and air conditioning systems, pumps, fans, Diesel Generator (D.G.) set, Introduction to cooling tower and its type ,Energy conservation in opportunities in Cooling tower cooling tower, Energy conservation in boiler feed water pump, pumping systems for municipal drinking water, and sewerage, agriculture pump sets

Unit VI: Cogeneration, Trigeneration and waste heat recovery [7]

Cogeneration: Concept, technical options, classification of cogeneration system i.e. topping and bottoming cycle, selection criteria, applications. Concept of Trigeneration (CCHP), Waste Heat Recovery: Introduction, classification and applications, benefits, waste heat recovery equipments i. e. recuperator, regenerator, economizer, heat wheel, heat pipe, thermo-compressor, heat pump.

Reference Books:

1. Guide books 1, 2 and 3, Bureau of Energy Efficiency.
2. Practical Energy Audit Manual, Indo –German Energy Efficient Project, Tata EnergyResearch Institute (TERI).
3. Albert Thumann, Plant Engineers and Managers Guide to Energy Conservation, CRCPress.
4. I. G. C. Dryden , The Efficient Use of Energy, IPC Science and Technology Press.
5. S. C. Tripathy, Electric Energy Utilisation and Conservation, Tata McGraw-HillPublishing Company Ltd.
6. P. H. Henderson: India- The Energy sector, Oxford University Press.
7. W. C. Turner, editor: The efficient use of energy (Butterworths)
8. Frank Keith, Yogi Goswami, “Enegy Management and End use Efficiency Handbook” Taylor and Francis.
9. Donald A. Wulfinghoff, Energy Efficiency Manual, Energy Institute Press.
10. Energy Management Principles, C.B. Smith, Pergamon Press
11. Energy Management, Trivedi. P.R., Jolka K.R., Common wealth Publication.

411094(C): Elective IV: World Class Manufacturing

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Prerequisites: Production Management, Industrial Engineering and Quality Assurance.

Course Objectives: To enable manufacturing enterprises to be competitive by dynamically reconfiguring software, equipment and organization structures in this era of globalization.

Course Outcomes

After successful completion of course student will able to,

- Understanding recent trends in manufacturing
- Customization of product for manufacturing
- Implementation of new technology

Unit I: Historical Perspective [7]

World class Excellent organizations – Models for manufacturing excellence: Schonberger, Halls, Gunn and Maskell models, Business Excellence.

Unit II: Benchmark, Bottlenecks and Best Practices [7]

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 [7]

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 [7]

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 [7]

Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy

Unit VI: Indian Scenario [7]

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 manufacturingexcellence”, 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 ofLeanProduction”, Harper Perennial, 1991.

411094(D): Elective IV: Finite Element Analysis

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Prerequisites: Fundamentals of Programming Language, Engineering Mechanics, Strength of Material, Kinematics of Manufacturing Machines, Design of Machine Elements, Heat and Fluid Engineering

Course Objective:

1) To provide the knowledge about Finite element method.
2) To aware the students about programming of force analysis of mechanical components and structures.
3) To provide knowledge about the heat transfer analysis of component.
4) To aware the students about recent software's used in simulation and analysis.

Course Outcomes

After successful completion of course student will able to,

1) Model and Analyze 1-D problem.
2) Model and Analyze Truss subjected to loading
3) Model and Analyze two-Dimensional Problem Using Constant Strain Triangles
4) Perform finite element modeling of triangular element and 2-D iso-parametric elements
5) Analyze steady state heat transfer - 1D and 2D heat conduction and convection
6) Identify meshing techniques quality aspects of meshing

Unit I: Introduction [7]

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 [7]

Introduction to different approaches used in FEA such as direct approach, Variational approach, weighted residual, energy approach, Galerkin and Raleigh Ritz approach, Introduction to Plane trusses, Assembly of global Stiffness Matrix for Banded Skyline solutions.

Unit III: Two-Dimensional Problem Using Constant Strain Triangles [7]

Introduction, finite element formulation, load considerations and boundary conditions, problem modeling, member end forces, plane frame.

Formulation of elemental stiffness matrix and load vector for Plane stress/strain such as Linear Strain Rectangle (LSR), Constant Strain Triangles (CST), Pascal's triangle , primary and secondary variables, properties of shape functions.

Unit IV: Axi-symmetric solids subjected to axi-symmetric loading [7]

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 [7]

Introduction, steady state heat transfer - 1D and 2D heat conduction and convection, governing differential equation, boundary conditions, formulation of element.

Unit VI: Dynamic analysis **[7]**

Types of dynamic analysis, General dynamic equation of motion, point and distributed mass, lumped and Consistent mass, Mass matrices formulation of bar and beam element. Undamped-free vibration- Eigenvalue problem, Evaluation of eigenvalues and eigenvectors (natural frequencies and mode shapes).

Text Books

1. A First Course in the Finite Element Method, Daryl L. Logan
2. Concepts and Applications of Finite Element Analysis, R. D. Cook, et al. Wiley, India

Reference Books

1. Chandrupatla T. R. and Belegunda A. D., ―Introduction to Finite Elements in Engineering‖, Prentice Hall India.
2. Seshu P., Text book of Finite Element Analysis‖, PHI Learning Private Ltd. New Delhi, 2010.
3. Bathe K. J., Finite Element Procedures‖, Prentice-Hall of India (P) Ltd., New Delhi.
4. Fagan M. J.,Finite Element Analysis, Theory and Practice‖, Pearson Education Limited
5. Kwon Y. W., Bang H., ―Finite Element Method using MATLAB‖, CRC Press, 1997
6. S. Moaveni, Finite element analysis, theory and application with Ansys‖,
7. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill 8.

411094(E): Elective IV: Environmental Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Basic knowledge of Chemistry and Physics, Basic knowledge of environment and its composition

OBJECTIVES:

To impart knowledge of environment and different types of pollution
To impart knowledge about causes and preventive measures against air pollution
To impart knowledge about causes and preventive measures against water pollution
To impart knowledge about causes and preventive measures against noise pollution

Course Outcomes:

After successful completion of this course students will be able to,

1. Understand importance of environment and different types of pollution
2. Explain causes and preventive measures against air pollution.
3. Describe causes and preventive measures against water pollution.
4. Explain causes and preventive measures against noise pollution.

Unit I: Introduction to Air Pollution [7]

Man and Environment: Overview (socio-economic structure & occupational exposures) – Scope of Environmental Engineering – pollution problems due to urbanization & industrialization

Air Pollution: Causes of air pollution – types & sources of air pollutants- Climatic & Meteorological effect on air pollution concentration- formation of smog and fumigation

Analysis of Air Pollutants: Collection of Gaseous Air Pollutants- Collection of Particulate Pollutants – Analysis of Air Pollutants like: Sulphur dioxide – Nitrogen oxide – Carbon monoxide – Oxidants &Ozone – Hydrocarbons – Particulate Matter

Unit II: Methods &Approach of Air Pollution Control [7]

Air Pollution Control Measures & Equipment, Controlling smoke nuisance – Develop air quality criteria and practical emission standards – Creating zones suitable for industry based on micrometeorology of air area – Introducing artificial methods of removal of particulate and matters of waste before discharging to open atmosphere

Unit III: Water and Environment [7]

Water Sources Origin of waste water – Types of water pollutants and their effects

Different Sources of Water Pollution: Biological Pollution (point & non-point sources) – Chemical Pollutants: Toxic Organic & Inorganic Chemicals – Oxygen demanding substances – Physical Pollutants: Thermal Waste – Radioactive waste – Physiological Pollutants: Taste affecting substances – other forming substances

Unit IV: Water Pollution & Its Control [7]

Adverse effects on: Human Health & Environment, Aquatic life, Animal life, Plant life — Water Pollution Measurement Techniques – Water Pollution Control Equipment& Instruments – Indian Standards for Water Pollution Control

Unit V: Soil and Environment [7]

Liquid & Solid Wastes – Domestic & Industrial Wastes – Pesticides – Toxic: Inorganic & Organic Pollutants – Soil Deterioration – Poor Fertility, Septicity, Ground Water Pollution, Concentration of Infecting Agents in Soil

Solid Waste Disposal: Dumping domestic & Industrial Solid Wastes: Advantages & Disadvantages – Incineration: Advantages & Disadvantages – Sanitary Land Field: Advantages & Disadvantages – Management of Careful & Sanitary Disposal of Solid Wastes

Unit VI: Noise and Environmental Management System [7]

Noise Pollution & Control: Noise Pollution: Intensity, Duration – Types of Industrial Noise – Ill effects of Noise – Noise Measuring & Control – Permissible Noise Limits

Environmental Legislations, Authorities & Systems: Air & Water Pollution Control Acts & Rules (Salient Features only) – Functions of State / Central Pollution Control Boards – Environmental Management System: ISO 14 000 (Salient Features only

Reference Books:

1. Culp, G., George, W., Williams, R. and Mark, Hughes, V.Jr. "Wastewater Reuse and Recycling Technology-Pollution Technology" Review-72, Noyes Data Corporation, New Jersey
2. Pandey, G.N. and Corney, G.C. "Environmental Engineering", Tata Mc-Graw Hill.
3. Shen, T.T. "Industrial Pollution Prevention Handbook", Springer-Verlag.
4. D.lal, A.K.Upadhyay , "Water Supply and Waste Water Engineering", KATSON Books
5. Nancy, J.S. "Industrial Pollution Control: Issues and Techniques", Van Nostrand Reinhold.
6. Sivakumar, R. "Introduction to Environmental Science & Engineering'', Mc-Graw Hill.
7. Arya, S.P. "Air Pollution Meteorology and Dispersion", Oxford University Press
8. Rao, M. & Rao, H.V.N. "Air Pollution'', Mc-Graw Hill.
9. Davis, M. &Masten, S. "Principles of Environmental Engineering and Science'', McGraw Hill.

411095: Computer Integrated Design & Manufacturing Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Practical: 50 Marks

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 (student must perform one job in group of 5 students)
3. Stress–strain analysis of any machine component consisting of 1-D, 2-D elements using FEA software.
4. Simulation of a simple mechanical system

411096: Industrial Robotics Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Oral: 50 Marks

Term Work

The term work shall be based on the following Practical Sessions (Any 6 from 1 to 7, 8 is compulsory)

1 Experiment on Robot configuration.
2 Experiment on Robot forward kinematic analysis
3 Experiment on Robot inverse kinematic analysis
4 Programming the robot for pick and place operation using any robot
5 Robot Programming for Color identification/shape identification/path tracking
6 Selection of gripper & sensors for any one application
7 Detail report on any one standard configuration viz. PUMA, SCARA, Stanford etc.
8 Industrial visit and its report on industrial applications of robots

411097(A): Elective III: Sustainability Engineering Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

The term work shall be based on the following Practical Sessions

1. Assignment on overview of sustainable manufacturing.
2. Assignment on waste management
3. Assignment on environment friendly materials for sustainable product
4. Assignment on Product Life Cycle Assessment of any product of choice: Environmental analysis from raw materials to disposal (separate for each student)
5. Assignment on Environmental Standards e.g. ISO- 14000 Environmental Legislations
6. Industrial visit report of in any Industry.

411097(B): Elective III: Supply Chain Management Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work will be based on one assignment on each unit and any two case studies are to be prepared separately by every project group.

1. Case study on Supplier selection.
2. Case study on Logistics management.
3. Case study on Supply Chain Management

411097(C): Elective III: Automobile Engineering Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

The term work shall be based on of the following assignments (Any Seven)

1. Study of fuel injection systems for SI and CI engines.
2. Study and demonstration of cooling systems in an automobile.
3. Study of ignition systems in an automobile.
4. Study and Demonstration of different types of clutches.
5. Study and demonstration of transmission system in an automobile.
6. Study and Demonstration of different types braking system.
7. Study and Demonstration of suspension system.
8. Study of preventive maintenance, trouble shooting for clutch, steering, brake, suspension and gear box systems in an automobile
9. Visit to Service Station to study computerized wheel alignment.
10. To study and prepare report on the constructional details, working principles and operation of the Electric Vehicle
11. To study of Automotive Emission / Pollution control systems.

411097(D): Elective III: Entrepreneurship Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

1. Term work will be based on one assignment on each unit.
2. A small scale business plan is to be prepared using the topics covered.

411097(E): Elective III: Human Resource and Management Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work shall consist of Assignment And/Or Case studies based on each unit

411098(A): Elective IV: Intelligent Manufacturing System Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work will be based on following assignments:

1. Study of Artificial Intelligent techniques with application examples
2. Case studies on industrial decision making using fuzzy multiple attribute decision making
3. Applications of artificial neural networks to manufacturing engineering
4. Study of various clustering algorithms for group technology
5. Study of algorithms for robot path planning/obstacle avoidance
6. Case study on route optimization of AS/RS systems.

411098(B): Elective IV: Energy Management Lab

Teaching Scheme	**Credit Scheme**	**Examination Scheme**
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work will be based on following assignments (any Six)

1. To study of global primary and Indian energy reserves and consumption pattern
2. To Study of future energy options
3. To study of investment analysis tools relevant to energy management projects
4. Case study of energy audit on Milk Industry/Central Library of Institute/ Workshop/ any other firm
5. Case study on energy conservation opportunities in boiler/furnace.
6. To study of conservation opportunity in HVAC System
7. To study of lightening system for energy conservation
8. To study of Cogeneration, Trigeneration (CCHP) System
9. To Study of waste heat recovery equipments

411098(C): Elective IV: World Class Manufacturing Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term Work shall consist of Assignment/Case studies based on each unit.

411098(D): Elective IV: Finite Element Analysis Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work shall consist of following Practical's

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.
9 Computer program for 1-D temperature analysis
10 Thermal analysis of member subjected to loading
11 Shear force and Bending Moment Calculations of Shaft using FEA software
12 Analysis of component subjected to self weight
13 Thermal analysis of composite wall

411098(E): Elective IV: Environmental Engineering Lab

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Termwork: 50 Marks

Term work shall consist of following Practical's (any Seven)

1. Ambient air quality monitoring for PM10/PM2.5,SO_2 & NO_x
2. pH and Alkalinity of raw water, soft drinks & tea.
3. Total hardness and components of raw water.
4. Most Probable Number (MPN) Determination
5. Measure mineral and phenolphthalein acidity
6. Measure Fluorides or Iron contents in water
7. To determine the acidity of various water samples
8. Measurement of noise levels at various locations using sound level meter, Calculate cumulative noise level at any one location.
9. Site visit to water treatment plant and Detailed Report
10. To Study air and water control acts and rules

411099: Project Work

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 06 hours / week	Pr/Or: 06 (TW:01 and Oral:05)	Termwork: 50 Marks Oral: 100 Marks

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A per submitted project phase II plan 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**.

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:

i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
ii. Improvement of existing machine / equipment / process.
iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
iv. Computer aided design, analysis *of* components such as stress analysis.
v. Problems related to Productivity improvements/Value Engineering/Material Handling Systems
vi. Energy Audit of an organization, Industrial evaluation of machine devices.
vii. Design of a test rig for performance evaluation of machine devices.
viii. Product design and development.
ix. Analysis, evaluation and experimental verification of any engineering problem encountered.
x. Quality systems and management. Total Quality Management.
xi. Quality improvements, In-process Inspection, Online gauging.
xii. Low cost automation, Computer Aided Automation in Manufacturing.
xiii. Time and Motion study, Job evaluation and Merit rating
xiv. Ergonomics and safety aspects under industrial environment
xv. Management Information System.
xvi. 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 Final Project Report shall be submitted to the college. The students shall present their Final Project Phase-II report. Before the examiners. The oral examination, shall be based on the term work submitted and jointly conducted by an internal and 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:

5.1 Title page
5.2 Certificate form Institute
5.3 Completion Certificate form Industry, if sponsored.
5.4 Acknowledgement
5.5 Abstract
5.6 Index
5.7 Nomenclature and Symbols
5.8 Actual Content
5.9 Conclusion
5.10 References.

6. Front cover: The front cover shall have the following details in block capitals

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.

1 Blank sheets: No blank sheets be left anywhere in the report.

2 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 training at……..in partial fulfillment of the requirement of the

B.E. Production Engineering Course of University of Pune at ……during the academic Year ……

Date: (Guide) Place:

(Examiner) (Head of Department)