

ANNA UNIVERSITY COIMBATORE

ME (Full Time) - Industrial Engineering

Semester No. 1					
Theory					
Course Code	Course Title	L	T	P	M
	Statistics for Engineers	3	-	-	100
	Production and Operations Management	3	-	-	100
	Operations Research	3	-	-	100
	Human Factors in Engineering and Design	3	-	-	100
	Logistics and Supply Chain Management	3	-	-	100
	Managerial Accounting and Finance	3	-	-	100

Practical					
Course Code	Course Title	L	T	P	M
	Industrial Engineering Laboratory I	-	-	3	100
Seminar					
	Seminar I	-	-	2	100
				Total	800

Semester No. 2					
Theory					
Course Code	Course Title	L	T	P	M
	Modelling and Simulation in Manufacturing	3	-	-	100
	Quality Engineering	3	-	-	100
	Engineering Optimisation : Theory and its Applications	3	-	-	100
	Elective I	3	-	-	100
	Elective II	3	-	-	100
	Elective III	3	-	-	100

Practical					
Course Code	Course Title	L	T	P	M
	Industrial Engineering Laboratory II	-	-	3	100
Seminar					
	Seminar II	-	-	2	100
				Total	800

Semester No. 3					
Course Code	Course Title	L	T	P	M
	Elective IV	3	-	-	100
	Elective V	3	-	-	100
	Elective VI	3	-	-	100
	Project Work Phase I	-	-	12	200
				Total	500
Semester No. 4					
Course Code	Course Title	L	T	P	M
	Project Work Phase II	-	-	24	400

Total 400

Total Marks 2500

List of Electives					
Course Code	Course Title	L	T	P	M
	Design for Manufacture and Assembly	3	-	-	100
	Management Information Systems	3	-	-	100
	Reliability Engineering	3	-	-	100
	Occupational Safety and Health Engineering	3	-	-	100
	Concurrent Engineering	3	-	-	100
	Lean Manufacturing	3	-	-	100
	Value Analysis and Engineering	3	-	-	100
	Maintenance Management	3	-	-	100
	Flexible Manufacturing Systems	3	-	-	100
	Marketing Management	3	-	-	100
	Intelligent Manufacturing Systems	3	-	-	100
	Automation in Manufacturing	3	-	-	100
	TPM	3	-	-	100
	Data Structures and Computing	3	-	-	100
	Facilities Planning and Design	3	-	-	100
	Robust Design	3	-	-	100

STATISTICS FOR ENGINEERS

3 0 0 100

PROBABILITY AND RANDOM VARIABLE: Probability – Random variables – Moments – Moment generating function – Standard distributions – Functions of random variables – Two-dimensional R.Vs – Correlation and Regression.(6)

ESTIMATION THEORY: Principle of least squares – Regression – Multiple and Partial correlations – Estimation of Parameters – Maximum likelihood estimates – Method of moments.(10)

TESTING OF HYPOTHESIS: Sampling distributions – Test based on Normal, t-distribution, chi-square, and F-distributions – Analysis of variance – One-way and two way classifications.(8)

DESIGN OF EXPERIMENTS: Completely Randomized Design – Randomized Block Design – Latin Square Design – 2 Factorial Design.(10)

TIME SERIES: Characteristics and Representation – Moving averages – Exponential smoothing – Auto Regressive Processes.(8)

TOTAL 42

REFERENCES:

1. Freund John, E and Miller, Irvin, “Probability and Statistics for Engineering”, 5th Edition, Prentice Hall, 1994.
2. Jay, L.Devore, “Probability and Statistics for Engineering and Sciences”, Brooks Cole Publishing Company, Monterey, California, 1982.
3. Montgomery D.C and Johnson, L.A, “Forecasting and Time series”, McGraw Hill.
4. Anderson, O.D, “Time series Analysis: Theory and Practice”, I.North-Holland, Amsterdam, 1982.
5. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 1999.

PRODUCTION AND OPERATIONS MANAGEMENT

3 0 0 100

INTRODUCTION: Scope of operations management, strategy and productivity, productivity tools. Forecasting - introduction, measures of forecast. Accuracy, forecasting methods - time series smoothing - regression models - exponential smoothing - seasonal forecasting - cyclic forecasting. Introduction to auto-regression models for forecasting. (7)

LONG TERM PLANNING: Product design. Capacity planning. Facility location – factors, location evaluation methods. Process selection and facility layout – Types of layouts for operations and production. Arrangement of facilities within departments. Flexible manufacturing system - concepts - advantages and limitation. (7)

PRODUCTION PLANNING AND CONTROL: Aggregate planning – approaches, graphical, empirical, and optimization. Development of a master production schedule, materials requirement planning (MRP- I), manufacturing resource planning (MRP -II), and ERP. (5)

INVENTORY ANALYSIS AND CONTROL: Definitions - ABC inventory system - EOQ models for purchased parts - inventory order policies - EMQ models for manufactured parts - lot sizing techniques. Inventory models under uncertainty. (6)

SCHEDULING AND CONTROLLING: Objectives in scheduling - major steps involved - information system linkages in production planning and control - production control in repetitive, batch and job shop manufacturing environment. Scheduling with resource constraints – allocation of units for a single resource - allocation of multiple resources - resource balancing. Line balancing - Helgeson Brine approach - Region approach. Stochastic mixed - product line balancing. (7)

JUST IN TIME MANUFACTURING: Introduction - elements of JIT - uniform production rate - pull versus push method- Kanban system - small lot size - quick, inexpensive set-up - continuous improvement.

Optimised production technology. (5)

PROJECT PLANNING: Evolution of network planning techniques - critical path method (CPM) - project evaluation and review technique (PERT). Network stochastic consideration. Project monitoring. Line of balance. (5)

Total 42

TEXT BOOKS:

1. Richard B Chase, Robert Jacobs F and Nicholas J Aquilano, "Operations Management for Competitive Advantage", McGraw-Hill/Irwin; Tenth Edition, 2003.
2. Gaither N, "Production and Operations Management: Problems Solving And Decision", Dryden Press; Fourth Edition, 1990.
3. Dilworth B James, "Operations Management Design, Planning and Control for Manufacturing and Services", McGraw Hill, Inc, New Delhi, 1992.

REFERENCES:

1. Bedworth D D, "Integrated Production Control Systems Management, Analysis, Design", John Wiley and Sons, New York, 1982.
2. Vollman T E, "Manufacturing Planning and Control Systems", Galgotia Publication (P) Ltd., New Delhi, 1998.
3. Buffa E S, "Modern Production/Operations Management", Wiley; Eighth Edition, January 30, 1987.

OPERATIONS RESEARCH

3 0 0 100

INTRODUCTION TO LINEAR PROGRAMMING: Concepts and development of OR, assumptions, formulation, graphical method, Simplex Algorithm. **9**

ADVANCED TOPICS IN LINEAR PROGRAMMING: Revised simplex method, duality theory, sensitivity analysis, Introduction to Integer Programming. **9**

NET WORK METHODS: Transportation, assignment, maximum flow, shortest route, spanning tree problems, PERT/CPM. **8**

DYNAMIC PROGRAMMING: Concepts, formulation, recursive approach, computation procedure. **8**

WAITING LINE MODELS: Queuing characteristics and terminology, single server and parallel server models, Introduction to Markov Process . **8**

TOTAL : 42

REFERENCES:

1. Hamdy A.Taha, "Operations Research: an introduction", 4th edition, Mc Millan Co., 2003.
2. Don T.Phillips, A.Ravindran & James Solberg, Operations Research: Principles and practice, John Wiley & Sons, 1992.
3. Guisseppi A.Forgionne, Quantitative decision making, Wordsworth Publishing Co., 1986.
4. Schaum's Outline Series Operations Research II Edition, Richard Broson, Govindasamy Naachimuthu, 2000.
5. Hillier and Lieberman, " Introduction to Operations Research", McGraw Hill International Edition, Seventh Edition, 2001.

HUMAN FACTORS IN ENGINEERING AND DESIGN

3 0 0 100

INTRODUCTION: Definition, human technological system, multidisciplinary engineering approach, human-machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development, human system modeling. (6)

INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications. (5)

HUMAN OUTPUT AND CONTROL: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices. (5)

WORKPLACE DESIGN: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, fatigue. (6)

ENVIRONMENTAL CONDITIONS: Illumination, climate, noise, motion, sound, vibration. (5)

BIOMECHANICS: Biostatic mechanics, statics of rigid bodies, upper extremity of hand, lower extremity and foot, bending, lifting and carrying, biodynamic mechanics, human body kinematics, kinetics, impact and collision. (5)

BIO THERMODYNAMICS AND BIOENERGETICS: Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress. (5)

HUMAN FACTORS APPLICATIONS: Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA's approach, virtual environments. (5)

Total 42

TEXT BOOK:

1. Chandler Allen Phillips, "Human Factors Engineering", John Wiley and Sons, New York, 2000.

REFERENCES:

1. Mark S Sanders, "Human Factors in Engineering and Design", McGraw Hill, New York, 1993.
2. Bridger R S, "Introduction to Ergonomics", Taylor and Francis, London, 2003.

LOGISTICS AND SUPPLY CHAIN MANAGEMENT

3 0 0 100

INTRODUCTION: Definition, decision phases in a supply chain, objectives of SCM, examples of supply chains, supply chain drivers, supply chain integration, supply chain performance measures. (4)

NETWORK DESIGN: Role of distribution in supply chain – distribution network design – factors influencing distribution network design, distribution networks in practice – network design in the supply chain – factors influencing the network design, framework for network design, models for facility location and capacity allocation – Impact of uncertainty on network design. (6)

INVENTORY MANAGEMENT: Cycle inventory – economies of scale to exploit fixed costs, quantity discounts, example problems – multi-echelon inventory – safety inventory in supply chain – safety level estimation, supply uncertainty, data aggregation, replenishment policies, managing safety inventory in practice – product availability – optimal level, affecting factors, supply chain contracts, examples. (9)

DISTRIBUTION STRATEGIES: Push strategy, pull strategy-Kanban replenishment systems, types, implementation, push-pull strategy. (4)

STRATEGIC ALLIANCE: Framework for strategic alliance - 3PL and 4PL – retailer-supplier partnerships – distribution integration – procurement and outsourcing –benefits, E-procurement – design for logistics – supplier integration into new product development – mass customization. (4)

CUSTOMER VALUE AND GLOBAL SUPPLY CHAINS: Customer value – dimensions, strategic pricing, measures, IT and customer value – global supply chain – introduction, driving factors, risks and advantages, issues, regional differences in logistics. (4)

INFORMATION TECHNOLOGY FOR SCM: Goals – standardization – infrastructure – interface devices, communications, databases, system architecture – system components – integrating the supply chain information technology - DSS for supply chain management. (5)

E-BUSINESS AND THE SUPPLY CHAIN: Value of information – Bullwhip effect, information and supply chain technology – customer relationship management, supplier relationship management. (6)

Total 42

TEXT BOOKS:

1. Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith, “Designing and Managing the Supply Chain”, Tata McGraw –Hill Publishing Company Ltd, New Delhi, 2003.
2. Chopra S and Meindl P, “Supply Chain Management: Strategy, Planning, and Operation”, Second edition, Prentice Hall India Pvt. Ltd, New Delhi, 2005.

REFERENCES:

1. Robert B Handfield, And Ernest L Nichols, “ Introduction To Supply Chain Management”, Prentice Hall, Inc, New Delhi, 1999.
2. Sahay B S, “Supply Chain Management”, Macmillan Company, 2000
3. David Brunt, And David Taylor, “Manufacturing Operations And Supply Chain Management : The Lean Approach”, Vikas Publishing House , New Delhi, 2001
4. Hartmud Stadler, And Christoph Kilger, “Supply Chain Management And Advanced Planning: Concepts, Models, Software”, Springer-Verlag, 2000
5. David F Ross, “Introduction To E-Supply Chain Management”, CRC Press, 2003.

MANAGERIAL ACCOUNTING AND FINANCE

3 0 0 100

FINANCIAL MANAGEMENT: Evolution, scope, objectives, functions, environment of corporate finance, Indian Financial system, Reserve Bank of India, Financial institutions, Financial markets, Merchant Banking Financial Services. (4)

SOURCES OF FINANCE: Long term - Retained earnings, equity, debenture, term loans, deferred credit, leasing, hire purchase; Short term - Accruals, trade-credit, short term bank finance, public deposit, commercial paper; Cost of capital, Leverage. (5)

CAPITAL BUDGETING : Process - cost/benefits, Investment appraisal criteria, time value of money, net present value, internal rate of return, profitability index, pay-back period, accounting rate of return, cash flows. (4)

WORKING CAPITAL MANAGEMENT : Overall considerations, influencing factors, working capital policy; Operating cycle analysis - procedure, problems; Cash management; Credit management - terms, credit-policy, credit-evaluation, control of accounts, receivable; Inventory Management - need, order quantity/point, pricing of raw material and valuation, monitoring and control of inventories. (7)

CAPITAL STRUCTURE : Net income approach, Net operating income approach, Traditional position, Modigliani and Miller position; Planning the capital structure, EBIT - EPS analysis, ROI – ROE analysis, Assessment of dept capacity; (3)

BUDGETING AND BUDGETARY CONTROL - Budget - meaning, purpose, types of budgets- sales, production, purchasing, labou, cash; Flexible budgets. (3)

COST ACCOUNTING AND CONTROL : Nature - Historical and future costs; Cost classification - labour, material, overhead; cost ladder, cost allocation, overhead absorption methods - DL, DM, number of pieces, LHR, MHR, Activity Based Costing; Accounting for service department expenses; Variance analysis for cost control - labour, material, overhead, variances, various types, illustrative problems. (8)

FINANCIAL STATEMENTS AND ANALYSIS: Double entry book keeping, journal, subsidiary books, bank reconciliation statement, ledger, trial balance, trading, profit and loss account, balance sheet; Financial statement analysis, types of financial ratios - liquidity, leverage, profitability, valuation ratios, time series analysis, common size analysis, Du-pont analysis. (8)

Total 42

TEXT BOOK:

1. Prasanna Chandra, "Fundamentals of Financial Management", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
2. Pandey I M "Management Accountitng", Vikas Publishing House, 2000.

REFERENCES:

1. Pandey I M, "Financial Management ", Tata McGraw Hill, 2003.
2. Van Horne, "Financial Management", McGraw Hill, 2002.
3. Ramachandra Aryasri A, Ramana Murthy V V, "Engineering Economics and Financial Management", Tata McGraw Hill, New Delhi, 2004.

MODELING AND SIMULATION IN MANUFACTURING SYSTEMS

3 0 0 100

MANUFACTURING SYSTEMS AND MODELS: Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building (8)

MATERIAL FLOW SYSTEMS: Assembly lines-Reliable serial systems, approaches to line balancing, sequencing mixed models. Transfer lines and general serial systems – paced lines without buffers, unpaced lines. Shop scheduling with many products. Flexible manufacturing systems- System components, planning and control. Group technology-Assigning machines to groups, assigning parts to machines. Facility layout-Quadratic assignments problem approach, graphic theoretic approach (12)

SUPPORTING COMPONENTS: Machine setup and operation sequencing-integrated assignment and sequencing. Material handling systems-conveyor analysis, AGV systems. Warehousing-storage and retrieval systems, order picking. (6)

GENERIC MODELING APPROACHES: Analytical queuing models, a single workstation, open networks, closed networks. Empirical simulation models-Event models, process models, simulation system, example manufacturing system (5)

SYNCHRONIZATION MANUFACTURING: Synchronization Vs Optimization, defining the structure, identifying the constraint, exploitation, buffer management. (5)

PETRI NETS: Basic definitions – dynamics of Petri nets, transformation methods, event graphs, modeling of manufacturing systems. (6)

Total: 42

TEXT BOOKS:

1. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc, 1993
2. Mengchu Zhou, "Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach", World scientific Publishing Company Pvt Ltd., 2000
3. Jean Marie Proth and Xiaolan Xie, " Petri Nets: A Tool for Design and Management of Manufacturing Systems", John Wiley

and Sons, New York, 1996.

REFERENCE:

1. P Brandimarte, A Villa, "Modeling Manufacturing Systems" Springer Verlag, Berlin, 1999

QUALITY ENGINEERING

3 0 0 100

CONCEPT OF QUALITY ENGINEERING: Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service. (5)

LOSS FUNCTION: Derivation –use-loss function for products/system- justification of improvements-loss function and inspection- quality evaluations and tolerances-N type, S type, L type (5)

ON-LINE QUALITY CONTROL: On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems-measurement error and process control parameters. (5)

ON-LINE QUALITY CONTROL ATTRIBUTES CHARACTERISTICS: Checking intervals- frequency of process diagnosis. (5)

ON-LINE QUALITY CONTROL METHODS FOR PROCESS IMPROVEMENTS: Production process improvement method- process diagnosis improvement method- process adjustment and recovery improvement methods. (6)

QUALITY ENGINEERING AND TPM: Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools–fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems. (5)

SIX SIGMA: Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method-roles and responsibilities –leaders, champion, black belt, green belts. (6)

IMPLEMENTATION OF SIX SIGMA: Do's and don'ts- readiness of organization –planning-management role- six sigma tools – sustaining six sigma. (5)

Total 42

TEXT BOOKS:

1. De Feo J A and Barnard W W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, New Delhi, 2005.
2. Taguchi G, Elsayed E A and Hsiang, T.C., "Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, International Edition, 1989
3. Pyzdek T and Berger R W, "Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996
4. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, New Delhi, Second reprint, 2002.

ENGINEERING OPTIMIZATION - THEORY AND ITS APPLICATIONS

3 0 0 100

NONLINEAR OPTIMIZATION: Introduction, unconstrained optimization, one-dimensional optimization, elimination methods, fibonacci method, golden section methods, interpolation methods, quadratic, cubic interpolations, direct root methods, multivariable optimization, direct search methods, pattern search methods, univariate method, Hooks and Jeeves method, Powel's method, Simplex method, descent methods, steepest descent, conjugate gradient, Newton methods. (9)

CONSTRAINED NONLINEAR OPTIMIZATION: Direct methods, the complex method, cutting plane method, Indirect methods, transformation techniques, interior and exterior penalty function methods, Khun-Tucker conditions, Lagrangian method. (6)

INTEGER AND DYNAMIC PROGRAMMING: Introduction to Integer Programming – Solution Techniques , Graphical method, the branch and bound technique, Gomary’s cutting plane method, Examples on the application in manufacturing / design systems – Introduction to Dynamic Programming , Bellman’s principle of optimality, examples on the application on routing problem, inventory problem, marketing problem.

(7)

NETWORK OPTIMIZATION MODELS: Terminology of Networks – the shortest route problem – the minimum spanning tree problem – the maximum flow problem – the minimum cost flow problem – the network simplex method. (6)

NON TRADITIONAL OPTIMIZATION – I: Introduction to non,traditional optimization, Computational Complexity – NP,Hard, NP,Complete, No free lunch theorem – Working principles of Simulated Annealing, Tabu Search, and Neural Networks, Simple applications.

(6)

NON TRADITIONAL OPTIMIZATION – II : Introduction to Genetic Algorithms, Ant Colony Algorithm, Particle Swarm Algorithm, Hybrid Algorithms, Simple Applications. (8)

Total 42

TEXT BOOKS:

1. Singiresu S Rao, “Engineering Optimization: Theory and Practice”, Wiley,Interscience, 3rd Edition, 1996.
2. Kalyanmoy Deb, “ Optimization for engineering design”, Prentice Hall India (Pvt) Ltd., New Delhi, 2000.

REFERENCES:

1. Saravanan R., “Manufacturing Optimization through Intelligent Techniques”, Taylor and Francis, 2006.
2. David E Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison, Wesley Pub Co., 1989.
3. Dimitri P Bertsekas, “Dynamic Programming: Deterministic and Stochastic Models”, Prentice Hall, 1987.
4. Harvey M Salkin, “Integer Programming”, Addison,Wesley Pub. Co., 1975.
5. Stephen G Nash and Ariela Sofer, “Linear and Nonlinear Programming”, McGraw Hill College Div., 1995.
6. Fred Glover, Manuel Laguna, and Fred Laguna, “Tabu Search”, Kluwer Academic Publishers, 1997.
7. Cihan H Dagli, “Artificial Neural Networks for Intelligent Manufacturing”, Chapman and Hall, London, 1994, ISBN 0 412 48050

DESIGN FOR MANUFACTURE AND ASSEMBLY

3 0 0 100

INTRODUCTION :Economics of process selection-General design principles of manufacturability-Proper material selection-Strength and mechanical factors-Application of form design. **5**

CASTING DESIGN AND WELDMENT DESIGN: Factors affecting casting design-Strength aspects-Sand casting and die casting design-Factors affecting weldment design-Gas and arc welding design **10**

FORMED METAL COMPONENTS AND NON METALLIC PARTS DESIGN: Design considerations for the manufacture of extruded, cold headed metal parts -Tube and section bends - powder metal parts-Thermo setting plastic parts-Reinforced -plastic/composite parts. **10**

MACHINED COMPONENTS DESIGN: Design considerations for the manufacture of Turned parts-drilled parts-milled parts, planned, shaped and slotted parts-Ground parts -parts produced by EDM. **10**

ADVANCED TECHNOLOGY REQUIREMENTS: Product design requirements for group technology concepts and CNC machining-Part family concept and design principles. 7

Total No of periods: 45

REFERENCES:

1. JAMES G.BRALLA - " Handbook of product design for manufacture ", McGraw Hill Book co.,19862.
2. HENRY PECK - " Designing for manufacture ", Sir issac Pitman & Sons Ltd.,1973.
3. MATOUSEK - " Engineering Design ", Blackie & Sons,1956.

MANAGEMENT INFORMATION SYSTEMS

3 0 0 100

INTRODUCTION: Definitions – management information system, elements of management information system – information –data, information, knowledge, quality and value of information (3)

DECISION MAKING PROCESS: Programmed versus non programmed decisions, behavioral model of organizational decision making, decision- making concepts for information system design – human information processing – limits, human cognition and learning. (3)

ORGANIZATIONAL SYSTEMS AND MANAGEMENT: System – definition, types, subsystems, system concepts and organizations – organizational structures, information processing model of organization structure, MIS and formal organizational structure – organizational planning –goals and objectives, hierarchy of planning, computational support for planning, Control process, nature of control in organizations, information systems support for control. 6)

INFORMATION TECHNOLOGY: Introduction – hardware – data management architecture – software – telecommunications and networks – the internet and internet-related technologies – trends in information technology. (4)

INFORMATION SYSTEMS DEVELOPMENT: Introduction – system planning – system analysis – system design – system implementation – system support - alternative methods of system development – information systems management – strategic approaches to IS management – introduction to operational issues of IS management. (8)

INFORMATION SYSTEMS: Introduction – office systems and knowledge work systems – basic data-gathering systems – management information systems – decision support systems – expert systems – geographic Information systems – executive information systems – information system trends. (8)

MANUFACTURING INFORMATION SYSTEM: Product data management :- ERP-introduction, architecture, application, case studies. (4)

QUALITY ASSURANCE, SECURITY AND ETHICS: Concepts of quality in information systems – quality assurance for applications – quality assurance with user-developed systems – computer crime – computer security – information system ethics. (6)

Total 42

TEXT BOOKS:

1. Davis G B and Olson M H, “Management Information Systems; Conceptual Foundations, Structure and Development”, McGraw Hill Company, New York, Second Edition, 1984.
2. Jessup L and Valacich J, “Information Systems Today”, Prentice Hall of India Pvt Ltd, 2003.

REFERENCES:

1. Murdick R G, Ross J E and Claggett J R, “Information Systems for Modern Management”, Prentice Hall of India Private Ltd., India, Third Edition, 1992.
2. Henry C Lucas Jr., “The Analysis, Design and Implementation of Information Systems”, McGraw Hill Company, New York, Fourth Edition, 1992.

3. Burch J E, Strater F R and Grudnikski G, "Information Systems: Theory and Practice", John Wiley and Sons, New York, 1987.
4. Leon Alexis, "Enterprise Resource Planning", Tata McGraw Hill Company, New Delhi, 1999.
5. Kenneth C Laudon, Jane P Laudon, "Management Information Systems", Prentice Hall Inc., 1999.
6. Ivica Crnkovic, Aunita Persson Dahlquist and Ulf Asklund, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House, 2003.

RELIABILITY ENGINEERING

3 0 0 100

CONCEPTS OF RELIABILITY: Definition of reliability- Reliability Vs Quality-Reliability function-MTTF – Hazard rate function- Bathtub curve – Derivation of the reliability function-constant failure rate model – Time dependent failure models- Weibull distribution – Normal distribution- The lognormal distribution.

(5)

RELIABILITY OF SYSTEM AND MODELS: serial configuration – parallel configuration – combined series parallel systems- system structure function, Minimal cuts and Minimal paths – Markov analysis – Load sharing systems, standby system, degraded systems , three state devices – covariate models , static models, dynamic models, physics of failure models.

(6)

DESIGN FOR RELIABILITY: Reliability design process- system effectiveness- Economic analysis and life cycle cost – Reliability allocation – ARINC, AGREE- Design methods- parts and material selection, Derating , stress-strength analysis – Failure Analysis – Identification of failure mode – Determine of causes – Assessment of effects – classification of severity- computation of critically index – corrective action- System safety and FTA.

(7)

DESIGN FOR MAINTAINABILITY: Analysis of downtime- The repair time distribution- stochastic point processes- system repair time – reliability under preventive maintenance- state dependent systems with repair- MTTR-mean system downtime – MTR – MH/OH – cost model- fault isolation and self diagnostics- Repair VS Replacement – Replacement model- proactive, preventive, predictive maintenance – maintenance & spares provisioning – Maintainability prediction and Demonstration- concepts and definition of availability.

(6)

OPTIMIZATION OF SYSTEM RELIABILITY: optimization techniques for system reliability with redundancy – Heuristic methods applied to optimal system reliability – Redundancy allocation by dynamic programming- Reliability optimization by non linear programming.

(6)

THE ANALYSIS OF FAILURE DATA AND RELIABILITY TESTING: Data collection – Empirical methods – ungrouped and grouped complete, censored data – static life estimation- test time calculation – Burn in testing, Acceptance, sequential, binomial testing – Accelerated life testing – other acceleration models – Experimental design- Reliability growth process- idealized growth curve- various growth models- Identifying failure and repair distributions.

(6)

PACKAGING AND TRANSPORTATION FOR RELIABILITY: objectives- preservation-packaging – transportation and subsequent storage – reliability and the customer. The purchase of equipment – installation- commissioning a new system – reliability prediction and control – Reliability Management – the people concerned with reliability, coordination, training.

(6)

Total 42

REFERENCES:

1. Charles E Ebling, " An introduction to Reliability and Maintainability Engg" , Tata Mc Graw –Hill, 2000.
2. Way kuo, Rajendra Prasad V, Frank A and Tillman, Ching- lai Hwang, " Optimal reliability design and applications , Cambridge University Press P Ltd., 2001.
3. Patrick D T o'connor, "Practical Reliability Engineering", John-Wiley and Sons inc, 2002.
4. Srinath I S, Engineering Design and Reliability, ISTE, 1999.
5. Oleg Vinogradov, "Introduction to Mechanical Reliability: A Designers Approach, Hemisphere Publications, 1991.
6. David J Smith, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth, 2002.

OCCUPATIONAL SAFETY AND HEALTH ENGINEERING

3 0 0 100

PHYSICAL HAZARDS

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs- vibration, types, effects, instruments,

surveying procedure, permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control **8**

CHEMICAL HAZARDS

Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard. Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling. Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education **9**

BIOLOGICAL AND ERGONOMICAL HAZARDS

Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program- laboratory safety program-animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries. **9**

OCCUPATIONAL HEALTH AND TOXICOLOGY

Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests. Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems **9**

OCCUPATIONAL PHYSIOLOGY

Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene. **7**

Total 42

TEXT BOOK

1. Hand book of “Occupational Safety and Health”, National Safety Council, Chicago, 1982

REFERENCE

1. Encyclopedia of “Occupational Health and Safety”, Vol.I and II, published by International Labour Office, Geneva, 1985

CONCURRENT ENGINEERING

3 0 0 100

CONCURRENT ENGINEERING: Introduction - basic concepts - traditional Vs concurrent approach - schemes and tools of concurrent engineering - application of computers in the practice of concurrent engineering. **(6)**

BASIC PROCESS ISSUES: Process models - types - importance. Relation between models,

specifications, technology, automation and process improvement. Fabrication processes - assembly processes - models of manufacturing, testing and inspection.

CONCURRENT ENGINEERING APPROACH IN MANUFACTURING SYSTEMS: System design procedure - features - intangibles - assembly resource alternatives - task assignment - tools and tool changing - material handling alternatives. (7)

CONCURRENT AUTOMATED FABRICATION SYSTEMS: Introduction - methodology - preliminary and detailed work content analysis - alternatives - human resource considerations. "Technical - Economic" performance evaluation - concurrent assembly work station - strategic issues - technical issues - economic analysis. (8)

ECONOMIC ANALYSIS OF SYSTEMS: Types of manufacturing cost - pro-forma, cash-flow, determining allowable investment - evaluation of investment alternatives - sensitivity analysis - effect of recycling and rework. (8)

CASE STUDIES OF CONCURRENT ENGINEERING PRACTICE: Automobile air-conditioning module - robot assembly of automobile rear-axles.

Total 42

TEXT BOOKS:

1. James L Nevins and Daniel E Whitney, "Concurrent Design of Products and Processes", McGraw Hill Publishing Company, 1989.
2. David D Bedworth, Mark R Handerson and Philip M Wilze, "Computer Integrated Design and Manufacturing", McGraw Hill International Edition, 1991.

REFERENCE:

1. Proceedings of the "Summer School on Applications of Concurrent Engineering to Product Development" held at PSG College of Technology, May 1994.

LEAN MANUFACTURING

3 0 0 100

INTRODUCTION: Functional areas of firm – Product design, manufacture, delivery – Principles of Production system – Role of inventory and information (5)

MANUFACTURING STRATEGY AND SUPPLY CHAIN: Forecasting systems – Dimensions of manufacturing strategy – Supply chain management concepts – Aggregate planning – Single stage inventory control (5)

DECENTRALIZED PULL SYSTEMS: Kanban systems – Constant work in process pull alternative (5)

MULTI STAGE PRODUCTION SYSTEMS: Materials requirement planning – Capacity planning – Managing change (6)

MULTISTAGE MODELS: Multistage product structure – Continuous time models for stationary data – Discrete time models for non-stationary data (6)

JUST IN TIME: Improving the production environment – Quality engineering – Improving product flow – The transition to lean (5)

SHOP SCHEDULING: Scheduling system requirements, goals and measures of performance – Flow shop and job shop scheduling (5)

SHOP FLOOR CONTROL : Control system architecture – Manufacturing execution system – Tool management system – Flexible manufacturing systems . (5)

Total 42

TEXT BOOKS:

1. Ronald G Askin, “Design and Analysis of Lean Production system”, John Wiley & Sons, 2002

REFERENCES:

1. Bedworth D D, "Integrated Production Control Systems Management, Analysis, Design", John Wiley and Sons, New York, 1982.
2. Vollman T E, "Manufacturing Planning and Control Systems", Galgotia Publication (P) Ltd., New Delhi, 1998.

VALUE ANALYSIS AND ENGINEERING

3 0 0 100

CONCEPTS: Introduction – status of VE in India and origin country – impact of VE application – types of values – types of function – function identification on product – function matrix – function analysis – elements of costs – calculation of costs – cost allocation to function – evaluation of worth in VE methodology (8)

TECHNIQUES: General techniques: brain storming – godson feasibility ranking – morphological analysis – ABC analysis – probability approach – make or buy. Function – cost-worth analysis – function analysis – system techniques – function analysis matrix – customer oriented FAST diagram – fire alarm – Langrange plan – evaluation methods – matrix in evaluation – break even analysis. (8)

TEAM APPROACH IN VE: Team structure – team building – selection of reconsultant – starting training – selection of remembers – conduct of VE project study – task flow diagram – pre-study phase – workshop phase- host study phase. (7)

COST MODELS: Matrix cost models – functional cost models – uses of project models – life cost – purpose and implication of LCC – economic principles of LCC – types of LCC – steps in LCC – case study (6)

VALUE ENGINEERING IN JOB PLAN: Orientation phase – information phase – functional analysis – creative phase – evaluation phase – recommendation phase – implementation phase – audit phase. (7)

CASE STUDIES:Example: water treatment plant – engineering management (6)

Total 42

TEXT BOOKS:

1. Richard J Park, “Value Engineering – A plan for inventions”, St.Lucie Press, London, 1998
2. Mukhophadhya A K, “Value Engineering”, Sage Publications Pvt. Ltd., New Delhi, 2003

REFERENCES:

1. Larry W Zimmelman. P E , “VE –A Practical approach for owners designers and contractors”, CBS Publishers, Delhi, 1992
2. Arthus E Mudge, “Value Engineering”, McGraw Hill book company, 1971

MAINTENANCE MANAGEMENT

3 0 0 100

MAINTENANCE CONCEPT:

Maintenance objectives and functions – Tero technology – Five zero concept – Maintenance costs and budgets – Maintenance organization. **6**

FAILURE DATA ANALYSIS: MTBF, MTTF, useful life – Survival curves – repair time distribution – exponential, Poisson, normal, Weibull applications – Standby systems - Availability of repairable systems – Maintainability prediction – Design for maintainability. **9**

MAINTENANCE MODELS: Maintenance policies – Imperfect maintenance – concept of minimal repair – Statistical aids for PM and break-down maintenance – PM schedules: deviations on both sides of target values – PM schedules for functional characteristics and large scale system – replacement models – DOM, opportunistic maintenance – Inspection and repair - Spare parts management. **9**

TOTAL PRODUCTIVE MAINTENANCE: TPM philosophy – Policy and objectives – Pillars - Zero breakdown – loss prevention – Overall Equipment Effectiveness (OEE) – Failure Mode Effect Analysis (FMEA) – Risk Priority Number (RPN). **9**

ADVANCED TECHNIQUES: Condition monitoring: WDM, Vibration and corrosion monitoring – Signature analysis – MMIS – Expert systems – Reliability centered maintenance (RCM). **9**

TOTAL : 42

REFERENCES:

1. Gopalakrishnan, P. Banerji, A.K. “Maintenance and spare parts management”, Prentice Hall of India, 1991.
2. Edward Hartmann, “Maintenance Management” Productivity and Quality publishing Pvt.Ltd. Madras, 1995.
3. Seiichi Nakagima, “Introduction to Total Productive Maintenance” Productivity Press (India) Pvt.Ltd., 1993.

FLEXIBLE MANUFACTURING SYSTEMS

3 0 0 100

INTRODUCTION: Definition of an FMS - types and configurations concepts - types of flexibility and performance measures. Functions of FMS host computer - FMS host and area controller function distribution. **(5)**

DEVELOPMENT AND IMPLEMENTATION OF AN FMS: Planning phases - integration - system configuration - FMS layouts - simulation - FMS project development steps. Project management - equipment development - host system development - planning - hardware and software development.

AUTOMATED MATERIAL HANDLING AND STORAGE: Functions - types - analysis of material handling equipments. Design of conveyor and AGV systems, storage system performance - AS/RS - carousel storage system - WIP storage system - interfacing handling storage with manufacturing.

MODELLING AND ANALYSIS OF FMS: Types of analysis: queuing- single server, multiple servers, queue disciplines, markovian queing models. Simulation and petrinet modelling techniques.

DISTRIBUTED NUMERICAL CONTROL AND PROGRAMMABLE CONTROLLERS: DNC system - communication between DNC computer and machine control unit - hierarchical processing of data in DNC system - features of DNC systems, PLC - control system architecture - elements of programmable controllers: languages, control system flowchart, comparison of programming methods.

PROCESS PLANNING: Approaches to process planning, study of a typical process planning, manufacturing planning and control, overview of production control.

RECONFIGURABLE MACHINES AND SYSTEMS: Challenges, enabling technologies for

reconfiguration– system level design issues in RMS – reconfigurable machines.

FMS RELATIONALE: Economic and technological justification for FMS – JIT, KANBAN, Poke Yoka. Tool management of FMS, typical case studies - future prospects.

Total 42

TEXT BOOKS:

1. Parrish D J, “Flexible Manufacturing”, Butter Worth Heinemann Ltd, Oxford, 1993.
2. Groover M P, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall India (P) Ltd, 1989.
3. Tien-Chien chang, Richard A Wysk, “An Introduction to Automated Process Planning Systems”, Prentice Hall, Inc., Englewood cliffs, New Jersey, 1985

REFERENCES:

1. Considine D M and Considine G D, “Standard Handbook of Industrial Automation”, Chapman and Hall, London, 1986.
2. Viswanadham N and Narahari Y, “Performance Modeling of Automated Manufacturing Systems”, Prentice Hall India (P) Ltd, 1992.
3. Ranky P G, “The Design and Operation of FMS”, IFS Pub. UK, 1988.

MARKETING MANAGEMENT

3 0 0 100

ROLE OF MARKETING IN ORGANISATIONS: Core concepts of marketing, product concept, selling concept and marketing concept, marketing process, analyzing market opportunities, designing marketing strategies, planning marketing programmes, organizing, implementing and controlling the marketing effort, marketing planning, current marketing situation, opportunity and issue analysis, action programmes, profit and loss statement. (7)

MEASURING AND FORECASTING MARKET DEMANDS: Concepts in demand measurement, estimating current demand, estimating future demand, market segmentation, general approach to segmenting a market, patterns of market segmentation, market segmentation procedures, base for segmenting customer markets and industrial markets, market targeting - evaluating the market segments, selecting the market segments; Trend forecasting. (7)

LAUNCHING NEW PRODUCTS AND SERVICES: New product development, effective organisational arrangements, idea generation, idea screening, concept development and testing, product development, market testing, commercialisation, consumer adoption process, product life cycle - introductory stage, growth stage, maturity stage and decline stage. (7)

PLANNING MARKETING PROGRAMMES: Managing product lines, brands and packaging, product mix decisions, product line decisions, brand decisions, packaging and labeling decisions, managing service businesses and ancillary services - classification of services, marketing strategies for service firms, managing product support services, pricing strategies and programs - setting the price, adapting the price, initiating and responding to price changes. (7)

MANAGING MARKETING CHANNELS: Nature of marketing channels, channel design decision, channel management decisions, channel dynamics, channel co-operation, conflict and competition, retailing, wholesaling and distribution systems, nature and importance of retailing, types of retailers, wholesaling, physical distribution. (8)

COMMUNICATION AND PROMOTION-MIX STRATEGIES: The communication process, steps in developing effective communication, measuring promotion results, managing the sales force, designing the sales force, principles of personal selling.

Total 42

TEXT BOOKS:

1. Philip Kotler, "Marketing Management Analysis, Planning, Implementation and Control", Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
2. Ramanuj Majundar, "Marketing Research", Wiley Eastern Ltd, 1991.

REFERENCES:

1. Stanton and William., "Fundamentals of Marketing", McGraw Hill, Tokyo, 1995.
2. Boyd and Kapoor, "Readings in Marketing Management", McGraw Hill Book Co. Ltd., 1989.
3. Ekzel M J and Walkar B J, "Marketing", McGraw Hill, 1997.

INTELLIGENT MANUFACTURING SYSTEMS

3 0 0 100

HUMAN AND MACHINE INTELLIGENCE: Concepts of fifth generation computing - Programming in AI environment, developing artificial intelligence system, natural language processing, neural networks. (8)

KNOWLEDGE REPRESENTATION FOR SMART SYSTEMS: Forward chaining, backward chaining, use of probability and fuzzy logic. Semantic nets-structure and objects, ruled systems for semantic nets; certainty factors, automated learning. (8)

LANGUAGES USED IN AI: Using PROLOG to design expert systems, converting rules to PROLOG, conceptual example, introduction to LISP, function evaluation, lists, predicates, rule creation.(8)

EXPERT SYSTEM DEVELOPMENT: Definition- choice of domain, collection of knowledge base, selection of inference mechanism, case studies of expert system development in design and manufacturing. (5)

EXPERT SYSTEM TOOLS: Expert systems – controlling reasoning – rule based system –canonical systems – rules and meta rules – associative nets and frame systems – graphs trees and networks – representing uncertainty – probability in expert systems-learning- forms of learning – inductive learning – decision trees – knowledge in learning – Heuristic classification – Heuristic matching - case studies in expert systems – MYCIN – Meta-Dendral.- general structure of an expert system shell, examples of creation of an expert system using an expert system tool Fundamentals of object oriented programming, creating structure and object, object operations, invoking procedures, programming applications, object oriented expert system. (8)

INDUSTRIAL APPLICATION OF AI AND EXPERT SYSTEMS: Robotic vision systems, image processing techniques, application to object recognition and inspection, automatic speech recognition. (5)

Total 42

TEXT BOOKS:

1. Robert Levine et al, "A Comprehensive Guide to AI and Expert Systems", McGraw Hill Inc,1986.
2. Henry C Mishkoff, "Understanding AI", BPB Publication, New Delhi, 1986.
3. Peter Jackson, "Introduction to Expert Systems", First Indian Reprint, 2000, Addison-Wesley.

REFERENCES:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 1995.
 2. Elaine Rich et al., "Artificial Intelligence", McGraw Hill, 1995.
- Winston P H, "Artificial Intelligence", Addison-Wesley, Reading, Massachusetts, Third Edition,1992

TOTAL PRODUCTIVE MAINTENANCE

3 0 0 100

BASIC PRINCIPLES AND CONCEPTS: Six basic principles-new demands of production-continuous productivity improvement-TPM definition-development stages of TPM-principle of learning –improving machine performance-the team approach-zero defects and TPM (6)

OVERALL EQUIPMENT EFFECTIVENESS: Power of OEE-six major losses-OEE metrics-OEE calculation for a single machine- plant OEE calculations-process average method-weighted process average method- total equipment effectiveness equipment performance (TEEP)- financial aspects of OEE – case studies. (6)

RESTORING EQUIPMENT TO ‘NEW’ CONDITION: Specific goals for equipment, operators, technicians-detecting minor machine defects-setting comp. standards-typical examples- machine tags-one point lessons –typical examples. (6)

AUTONOMOUS MAINTENANCE: Seven levels-initial cleaning- preventive cleaning machines-cleaning and lubrication standard- general inspection, autonomous inspection-process discipline-independent autonomous maintenance. (6)

MACHINE PREVENTIVE MAINTENANCE PLAN: Elements of a complete preventive maintenance-PM checklist-PM schedules-inspection specification, replacement parts numbers-PM procedure-part logs-quality checks-PM master plan. (6)

PREPARATORY STAGES OF TPM IMPLEMENTATION: Introduction of TPM to the organization-creation of organization structure- Basic TPM policies and aids- master plan- Kick start. (6)

TPM IMPLEMENTATION STAGES: Small group activities- implementing AM- establishing planned maintenance- training and education- developing equipment management program- perfecting TPM implementation – raising TPM levels- Case studies. (6)

Total 42

TEXT BOOKS:

1. Hansen R C, “Overall Equipment Effectiveness”, Industrial Press, USA, First Edition, 2001
2. Robinson C J and Ginder A P, “Implementing TPM: The North American Experience”, Productivity Press, USA, 1995

DATA STRUCTURES AND COMPUTING

3 0 0 100

INTRODUCTION: Basic concepts of OOPs – Templates – Algorithm Analysis – ADT - List (Singly, Doubly and Circular) Implementation - Array, Pointer, Cursor Implementation. **8**

BASIC DATA STRUCTURES: Stacks and Queues – ADT, Implementation and Applications - Trees – General, Binary, Binary Search, Expression Search, AVL, Splay, B-Trees – Implementations - Tree Traversals. **10**

ADVANCED DATA STRUCTURES: Set – Implementation – Basic operations on set – Priority Queue – Implementation - Graphs – Directed Graphs – Shortest Path Problem - Undirected Graph - Spanning Trees – Graph Traversals. **10**

MEMORY MANAGEMENT: Issues - Managing Equal Sized Blocks - Garbage Collection Algorithms for Equal Sized Blocks - Storage Allocation for Objects with Mixed Sizes - Buddy Systems - Storage Compaction. **6**

SEARCHING, SORTING AND DESIGN TECHNIQUES: Searching Techniques, Sorting – Internal Sorting – Bubble Sort, Insertion Sort, Quick Sort, Heap Sort, Bin Sort, Radix Sort – External Sorting – Merge Sort, Multi-way Merge Sort, Polyphase Sorting - Design Techniques - Divide and Conquer - Dynamic Programming - Greedy Algorithm – Backtracking - Local Search Algorithms. **8**

Total: 42

TEXTBOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education, 2002
2. Aho, Hopcroft, Ullman, “Data Structures and Algorithms”, Pearson Education, 2002.

REFERNCES:

1. Horowitz, Sahni, Rajasekaran, “Computer Algorithms”, Galgotia, 2000
2. Tanenbaum A.S., Langram Y, Augestien M.J., ”Data Structures using C & C++”, Prentice Hall of India, 2002

FACILITIES PLANNING AND DESIGN

3 0 0 100

FACILITY LOCATION AND ANALYSIS:Location decisions - Qualitative and Quantitative factors, Simple models in single facility and multi facility problems. **8**

LAYOUT DESIGN: Facilities requirement, need for layout study – types of layout; Design cycle – SLP procedure – Algorithms – ALDEP, CORELAP, CRAFT. **9**

CELLULAR LAYOUT: Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Assembly Line balancing. **9**

INTRODUCTION TO MATERIAL HANDLING: Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging. **9**

WAREHOUSE DESIGN

Introduction – Measuring & Benchmarking warehouse performance – Warehouse operations, Receiving and putaway principles, Pallet Storage and Retrieval system, Case Picking systems – Warehouse layout – Computerizing warehouse operations. **7**

TOTAL : 42

REFERENCES:

1. Tompkins, J.A. and J.A.White, “Facilities planning”, John Wiley, 2003.
2. Richard Francis.L. and John A.White, “Facilities Layout and location”, an analytical approach, Prentice Hall Inc., 2002.
3. James Apple, M.Plant layout and “Material Handling”, John Wiley, 1977.
4. Sundaresh Heragu, “Facilities Design”, PWS Publishing Company, Boston, 1997.
5. Edward Frazelle, “World-Class Warehousing and Material Handling”, McGraw Hill Publishers, 2002.

ROBUST DESIGN

3 0 0 100

INTRODUCTION: Planning of experiments, terminology, ANOVA rationale, basics of quality by design, Loss function, Tolerance design, Single factor experiments, tests on means. **8**

FACTORIAL EXPERIMENTS: Multi factor experiments - EMS rules – 2 & 3 factors, 2^K design, confounding, Fractional, Nested designs – Response Surface Methodology. **10**

ORTHOGONAL EXPERIMENTS: Selection and application of orthogonal arrays for design, Conduct of experiments, collection and analysis of simple experiments, Modifying orthogonal arrays. **9**

ROBUST DESIGN PROCESS: Comparison of classical and Taguchi's approach, variability due to noise factors, classification of quality characteristics and parameters, objective functions in robust design, S/N ratios. **8**

PRODUCT / PROCESS IMPROVEMENT: Inner and outer OA experiments, Optimization using S/N ratios, attribute data analysis, a critique of robust design, multi response optimization – Case studies. **7**

TOTAL : 45

REFERENCES:

1. Phillip J.Ross, Taguchi techniques for quality engineering, Prentice Hall, 1996.
2. D.C. Montgomery, Design and Analysis of experiments, John Wiley and Sons, 2003.
3. Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.

INDUSTRIAL ENGINEERING LABORATORY- I

0 0 3 100

1. Generation and testing of random numbers and simulation of discrete systems
2. Solving linear programming using MS Excel
3. Solving non-linear problems using MS Excel
4. Facility layout design and analysis using software
5. Forecasting using MS Excel
6. capacity planning using MS Excel
7. master production schedule using MS Excel
8. materials requirement planning for a typical industry using MS Excel
9. Aggregate planning using MS Excel
10. Inventory analysis, EOQ, EMQ, Lot sizing –case study

INDUSTRIAL ENGINEERING LABORATORY- II

1. Project evolution study using – PERT/CPM practices
2. Life estimation based on Weibull plot of product failure data
3. Value engineering of design/process alternatives
4. Reliability analysis of field failure data
5. Quality function deployment-interpretation and analysis
6. Value stream mapping – current, future state maps
7. Sensor interface for a typical manufacturing automation set up

8. Process automation using pneumatics/hydraulics
9. DoE Plan; Analysis of Mean, ANOVA for experimental data
10. Reliability analysis of systems using Weibull plot