

SEMESTER I

15MN01 / 15ML01 STATISTICS, QUALITY CONTROL AND RELIABILITY ENGINEERING

2 2 0 3

SAMPLING CONCEPTS: Lot-by-Lot acceptance sampling for attributes – acceptance sampling problem, single sampling plans for attributes, double, multiple and sequential sampling plan, chain sampling, continuous sampling, skip-lot sampling plans. (5+5)

ONE FACTOR EXPERIMENTS: Analysis of variance technique – strategy of experimental design, one-way analysis of variance, completely randomized design, randomized complete block design. (3+3)

STATISTICAL QUALITY CONTROL: Methods and philosophy of statistical process control – Introduction – chance and assignable causes of quality variation, statistical basis of control charts, control charts for variables, control charts for attributes. (4+4)

RELIABILITY: Definition of reliability – reliability vs quality, the failure distribution, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability - constant failure rate model - time-dependent failure models - exponential, Weibull and normal distribution. (3+3)

RELIABILITY OF SYSTEMS AND PHYSICAL RELIABILITY MODELS: Serial configuration, parallel configuration, combined series parallel systems, system structure function, minimal cuts and minimal paths – load sharing systems – standby systems – degraded systems, three state devices – physical reliability models - covariate models, static models, dynamic models, physics of failure models. (5+5)

DESIGN FOR RELIABILITY, MAINTAINABILITY AND AVAILABILITY: Reliability specification and system measurements - reliability allocation - design methods – failure analysis – system safety and fault tree analysis – analysis of down time – the repair time distribution, reliability under preventive maintenance, maintenance requirements, availability concepts and definitions, system availability. (6+6)

THE ANALYSIS OF FAILURE DATA AND RELIABILITY TESTING: Data collection – empirical methods, ungrouped and grouped complete data, ungrouped and grouped censored data – static life estimation – test time calculation, burn in testing, acceptance testing. (4+4)

Total L: 30 + T: 30 = 60

REFERENCES:

1. Ronald E Walpole, Raymond H Myers, Sharon L Myers and Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, New Delhi 2007.
2. Douglas C Montgomery, "Introduction to Statistical Quality Control", John Wiley & Sons, New York 2009.
3. Dale H Besterfield, "Quality Control", Pearson Education, New Delhi 2008.
4. Charles E Ebeling, "An Introduction to Reliability and Maintainability Engineering", Tata McGraw-Hill, New Delhi 2009.
5. Trivedi K S, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", Prentice Hall, New Delhi, 2008.
6. Amitava Mitra, "Fundamentals of Quality Control and Improvement", John Wiley and Sons, New Jersey, 2008.

15MN02/15ML02 MANUFACTURING ENGINEERING AND INDUSTRIAL MANAGEMENT

3 0 0 3

MANUFACTURING PROCESSES: Casting process-sand casting, shell moulding, investment casting, die-casting. Fabrication processes- electric arc welding, gas welding, resistance welding, welding design. Metal forming processes- nature of plastic deformation, rolling, forging, extrusion, wire and tube drawing. Test methods for formability. (4)

ABRASIVE PROCESSES: Grinding- wheel specifications and selection, types of grinding process, cylindrical grinding, centre less grinding, surface grinding, honing, lapping, super finishing, polishing and buffing. (3)

NON CONVENTIONAL MACHINING: Principles, processes and parameters - ultrasonic machining, electrical discharge machining, electro chemical machining, electron and laser beam machining, plasma arc machining and water jet machining. (3)

RAPID PROTOTYPING: Principles, processes and parameters - stereo lithography, laminated object manufacturing, selective laser sintering, FDM, SGC and 3D printing. (3)

PRINCIPLES OF MANAGEMENT: Nature of management, evolution of management, organizational structure, fundamentals of planning, organizing, leading & controlling. (2)

ORGANIZATIONAL BEHAVIOUR: Introduction, values & attitudes, ethics, social responsibility, personality & personality attributes,

motivation, emotions, group processes & teams, interpersonal communication, leadership, conflict, negotiation & stress management, Organizational design – determinants, parameters, organization & environment, organizational culture. (3)

OPERATIONS RESEARCH: Characteristics, phases & scope of operations research, linear programming – formulation, graphical method, simplex method, transportation problem – MODI method, assignment problem – Hungarian method. (7)

INFORMATION TECHNOLOGY: Digital product development, PLM, ERP, use of CAD/CAM/CAE, automated process planning, planning of resources, tomorrow's industry – AI, ANN applications. (5)

BUSINESS STATISTICS: Statistics and business decisions, collection of statistics data, presentation and analysis of statistics data, measures of central tendency & dispersion, interpolation & extrapolation, correlation & regression. (4)

PROJECT MANAGEMENT: Definition, project selection and criteria, role of project managers, project planning – project activity scheduling, project requirements. (3)

QUALITY MANAGEMENT SYSTEMS: Quality management – planning, control, assurance, improvement, QMS implementation planning, documentation planning, defining organizational process, refine, deploy, improve. (4)

ENVIRONMENTAL ISSUES: Environmental Pollution, sustainability engineering, various management techniques to control Environmental pollution – Various control acts for Air, Water, Solid waste, light and Noise pollution. (4)

Total L: 45

REFERENCES:

1. Mikell P Groover, "Fundamentals of Modern Manufacturing Materials, Processes and System", John-Wiley and Sons, New York, 1999.
2. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Company Inc, 1995.
3. Prasad L M, "Principles and Practice of Management", S Chand & Company Ltd., New Delhi, 2008.
4. Gupta P K and Hira D S, "Operations Research", S Chand & Company Ltd., New Delhi, 2004.
5. Shenoy G V, Srivastava U K and Sharma S C, "Business Statistics", New Age International Publishers, New Delhi, 2002.
6. Jack R Meredith and Samuel J Mantel, "Project Management: A managerial Approach", John Wiley & Sons, Inc., Delhi, 2010.
7. Radhakrishnan P, Subramanyan P and Raju V, "CAD/CAM/CIM", New Age International Publishers, 2002.

15MN03/15MC32 ENGINEERING ECONOMIC ANALYSIS

3 0 0 3

INTRODUCTION - Present economic policy - liberalisation - privatisation - globalisation - scope for industrial growth - interest and time value of money cash-flow diagram, simple interest - compound interest - single payments - uniform series payments - interest factors and tables - nominal and effective interest rates - continuous compounding - uniform continuous payments. (7)

METHODS FOR EVALUATION OF TANGIBLE ALTERNATIVES: Present worth comparison - equal, unequal lived assets - study period – assets with infinite life - capitalized cost, bond valuation. Equivalent uniform annual cost comparison – situations for EUAC - Rate of return comparisons IRR – MARR IRR misconceptions. (7)

REPLACEMENT ANALYSIS: Review of conventional approach – group replacement - analysis with time value accounting – replacement due to deterioration, obsolescence, inadequacy – economic life for cyclic replacements - current salvage value of the defender - defender and challenger with different lives - additional one year assessment. (6)

RISK AND MULTI STAGE SEQUENTIAL DECISION ANALYSIS: RECOGNIZING RISK - including risk in economic analysis – expected value - payoff table - decision tree - discounted decision tree. (5)

PROJECT FEASIBILITY ANALYSIS: Case study - report preparation. depreciation - reasons - depreciation accounts - causes of declining value - depreciation methods. Cost - volume - profit analysis: review of conventional approach - analysis with time value - linear - non-linear - multi product break even analysis. - review of project management - PERT - CPM - crashing - cost system. (6)

MARKETING FEASIBILITY: Types of market - identification of investment opportunities - market and demand analysis - forecasting demand (review) - forecast control - Secondary sources of information. (5)

TECHNICAL FEASIBILITY: Product design - concept of concurrent engineering - make Vs buy decisions – BPO – value analysis – FAST approach – product life cycle management. (4)

FINANCIAL FEASIBILITY: Means of financing - financial institutions - all India - state level - profitability - cash flows of a project – tax factors in investment analysis effects of inflation in economic analysis. (5)

Total L: 45

REFERENCES:

1. James L Riggs, David D Bedworth and Sabah U Randhawa, "Engineering Economics", McGraw Hill Book Company, New Delhi, 2004.
2. Prasanna Chandra, "Projects Preparation, Appraisal and Implementation", Tata McGraw Hill, New Delhi, 2004.
3. Norman N Barish, "Economic Analysis for Engineering and Managerial Decision Making", McGraw Hill Book Company, 1983.
4. Leland T Blank and Anthony J Tarquin, "Engineering Economy", McGraw Hill Book Company, 1998.
5. John A White et. al, "Principles of Engineering Economic Analysis", John Wiley and Sons, New York, 1998.
6. William G Sullivan, Elin M Wicks and Patrick Koelling C "Engineering Economy", Pearson Education Inc., Delhi, 2001.

15MN04 SIMULATION MODELING AND ANALYSIS

3 0 0 3

INTRODUCTION TO SIMULATION: Definition – history - nature of computer modeling and simulation, limitations of simulation, areas of application. System and environment: Components of a system – types of simulation - discrete and continuous systems. (4)

MANUAL SIMULATION: Simulation of Queuing Systems - single channel and multi channel queue - lead time demand - inventory system, reliability problem, time-shared computer model, job-shop model, Supply Chain Modeling. (5)

RANDOM NUMBER GENERATION AND TESTING: Techniques for generating random numbers - midsquare method - midproduct method - constant multiplier technique - additive congruential method - linear congruential method – combined linear congruential generators – feedback shift register generators - tests for random numbers – frequency test - the Kolmogorov-Smirnov test, the chi-square test. Independence test – runs up and runs down, runs above and below the mean, autocorrelation test, Gap test, Poker test. (7)

RANDOM VARIATE GENERATION: Inverse transform technique - exponential distribution, uniform distribution, Weibull distribution, Triangular distribution. Empirical continuous distribution - generating approximate normal variates - Erlang distribution. empirical discrete distribution - discrete uniform distribution - poisson distribution - geometric distribution - acceptance - rejection technique for poisson distribution - gamma distribution. (6)

INPUT MODELING: Introduction - steps to build a useful model of input data - data collection, identifying the distribution with data, parameter estimation, suggested estimators, goodness of fit tests, selecting input models without data, models of arrival processes. (5)

VERIFICATION AND VALIDATION OF SIMULATION MODELS: Introduction - model building - variance reduction techniques, antithetic variables, calibration and validation of models. (4)

OUTPUT ANALYSIS: Types of simulation with respect to output analysis - stochastic nature of output data, measures of performance and their estimation, output analysis for terminating simulation, output analysis for steady state simulation, Welch Algorithm, Batch Mean Methods. (3)

MANUFACTURING SYSTEMS MODELING: Objectives and performance measures – modeling system randomness – sources of randomness, machine downtime. (5)

CASE STUDIES: Study of various simulation software, Simulation of manufacturing systems, Material Handling system. (6)

Total L: 45

REFERENCES:

1. Jerry Banks, John S, Carson II, Barry L Nelson and David M Nicol, "Discrete Event System Simulation", Prentice Hall Inc., 2006.
2. Law A M, "Simulation Modeling and Analysis", Tata McGraw Hill Companies Inc, 2008.
3. Gordon G, "Systems Simulation", Prentice Hall Ltd., 2006.
4. Narsingh Deo, "System Simulation with Digital Computer", Prentice Hall of India, 2007.
5. Francis Neelamkovil, "Computer Simulation and Modeling", John Wiley and Sons, 1987.
6. Ruth M Davis and Robert M O'Keefe, "Simulation Modeling with Pascal", Prentice Hall Inc., 1989.
7. Berlekamp- Welch algorithm, Ronald Cohn Jesse Russell, VSD, 2013.

15MN05/15MC35 OPERATIONS MANAGEMENT

3 0 0 3

INTRODUCTION: Operations function, globalization, factors affecting operation management, new trends in operation management. Operations strategy – forming operation strategies, strategy deployment, world class manufacturing practices. (3)

UNDERSTANDING PROCESSES: Design of processes – types of production processes, major factors affecting process design decisions. Process Planning- steps in process planning, make-or-buy decision, process analysis, automated process plan. Product Development Process – organization for product development, performance measure, management accounting. (6)

DESIGNING OPERATIONS: Facilities layout – globalization of operations, factors affecting location decisions, location planning methods, other issues, basic layout, designing product, process layout, hybrid layout, layout design procedures- CRAFT, ALDEP, CORELAP, layout design for services. Capacity Planning – capacity and strategy, managing demand, break-even analysis. (8)

PLANNING AND CONTROL OF OPERATIONS: Forecasting – strategic role of forecasting, components of forecasting demand,, forecasting methods- time series methods, regression methods, seasonal forecasting, cyclic forecasting, accuracy of forecasts. Aggregate Production Planning - framework, basic strategies, approaches to aggregate planning, graphical, empirical, and optimisation. Resource Planning –basic building blocks - MRP-I, MRP-II, ERP. (8)

INVENTORY ANALYSIS AND CONTROL: Definitions, elements of inventory management, Inventory classification & control systems - ABC, XYZ, FSN, VED. Material management, inventory control, Lot sizing techniques, models of inventory, purchase model with instantaneous replenishment and without shortages, manufacturing models without shortages, purchase model with shortages, inventory models with price breaks, quantity discounts, inventory order policies, Inventory models under uncertainty. (8)

SCHEDULING AND PROJECT PLANNING: Objectives in scheduling , major steps involved , dispatching rules. Project planning - network planning techniques - critical path method (CPM), project evaluation and review technique (PERT), cost crashing, resource leveling. (7)

LEAN MANUFACTURING: Introduction, elements of JIT, uniform production rate, pull Vs push method, Kanban system, small lot size, quick & inexpensive set-up, continuous improvement. (5)

Total L: 45

REFERENCES:

1. Norman Gaither and Greg Frazier, "Operations Management", Cengage Learning, New Delhi, 2009.
2. Roberta S Russell and Bernard W Taylor III, "Operations Management", Prentice Hall of India, New Delhi, 2007.
3. Jay Heizer and Barry Render, "Operations Management", Pearson Education, 2010.
4. Bedworth D D, "Integrated Production Control systems Management, Analysis, Design", John Wiley and Sons, New York, 1982.
5. Dilworth B James, "Operations Management, Design, Planning and Control for Manufacturing and Services", McGraw Hill, Inc, New Delhi, 1992.
6. Vollman T E, "Manufacturing Planning and Control Systems", Galgotia Publication (P) Ltd., New Delhi, 1998.
7. Mahadevan B, "Operation Management: Theory and Practice", Dorling Kindersley (India) Pvt. Ltd., Delhi, 2008.

15MN51 INDUSTRIAL ENGINEERING LABORATORY

0 0 4 2

LIST OF EXPERIMENTS

1. Design of Experiments / ANOVA using Statistical Software (MiniTAB)
2. Normality analysis and Hypothesis testing using Statistical Software (MiniTAB)
3. Solving inventory problems using software (Arena)
4. Manufacturing system simulation and its performance measurement using software (Arena)
5. Manufacturing system simulation and its performance measurement using software (WITNESS)
6. 5s practice and Line balancing using manufacturing systems (Lean Torch Factory)
7. Study of Poka-Yoke
8. RFID simulation in lean factory
9. Gauge repeatability and reproducibility.

Total P: 45

REFERENCES:

1. Laboratory Manual Prepared by Department of Mechanical Engineering.
2. David Kelton W, Randall P Sadowski and Nancy B Swets, "Simulation with Arena" McGraw-Hill Education, 1998.

15MN61/15MC61/15MD61/15ML61 INDUSTRY VISIT & TECHNICAL SEMINAR**0 0 4 2**

VISIT TO A PUMP MANUFACTURING INDUSTRY: Introduction, Bill of materials of an industrial pump, study of part drawings, component suppliers, process flow – precedence diagram, manufacturing methods, product testing, production planning and quality assurance.

VISIT TO AN AUTO ANCILLARY INDUSTRY: Introduction, organization structure, roles and responsibilities of various functions, cross functional teams, quality systems – *ISO/TS 16949*, study on continuous improvement activities – *5S, Kaizen and Poka-yoke*. Occupational safety and health – Case studies.

TECHNICAL SEMINAR: Technical presentations by the students on current topics (based on research publications) related to his or her specialization. *Study on preparation and submission of technical papers to reputed technical Journals.*

The contents in italics indicate self study topics – faculty will ensure that questions from these topics are there in CA tests, assignments and final examination.

Total P: 60**REFERENCES :**

1. William K Dalton and Gregg Bruce R, "Modern Materials and Manufacturing Processes", Pearson Education, 2007.
2. Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.
3. Gayle Woodside, "Environmental, Safety and Health Engineering", John Wiley and Sons Inc., 1997.
4. Mitchell John H, "Writing for Professional and Technical Journals", John Wiley and Sons Inc., 2001.

SEMESTER II**15MN06 ADVANCED OPTIMIZATION TECHNIQUES****3 2 0 4**

NONLINEAR OPTIMIZATION: Introduction – unconstrained optimization - one-dimensional optimization – elimination methods – Fibonacci method, golden section methods – interpolation methods – quadratic, direct route method – multivariable optimization - direct search methods – pattern search methods – univariate method, hooks and jeeves method, simplex method – descent methods – steepest descent, Newton methods. (9+3)

CONSTRAINED NONLINEAR OPTIMIZATION: Direct methods – the complex method, cutting plane method – indirect methods – interior and exterior penalty function methods, Khun-Tucker conditions, Lagrangian method. (7+2)

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. (8+3)

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. (8+3)

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. (7+2)

NON-TRADITIONAL OPTIMIZATION – II: Introduction to Genetic Algorithms, Ant Colony Algorithm, Particle Swap Algorithm, Hybrid Algorithms, TLBO, Simple Applications. (8+3)

Total L: 45 +T: 30 = 75

REFERENCES:

1. Singiresu S Rao, "Engineering Optimization: Theory and Practice", Wiley-Interscience, 1996.
2. Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall India Pvt. Ltd., New Delhi, 2000.
3. David E Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley Pub Co., 1989.
4. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", Prentice Hall of India, 2005.
5. Maurice Clerc, "Particle Swarm Optimization", ISTE, 2007
6. Dimitri P Bertsekas, "Dynamic Programming: Deterministic and Stochastic Models", Prentice Hall, 1987.
7. Harvey M Salkin, "Integer Programming", Addison-Wesley Pub. Co., 1975.

15MN07 QUALITY ENGINEERING AND ERGNOMICS

3 0 0 3

INTRODUCTION: Definitions of the terms - quality, quality planning, quality control, quality assurance, quality management, Total Quality Management (TQM) as per ISO 8402 - overview on TQM - the TQM axioms - commitment - scientific knowledge - involvement - consequences of total quality. (7)

QUALITY MANAGEMENT PHILOSOPHY: Deming's fourteen points on quality management - five DDs - implementing the deming philosophy - action plan - the deming cycle - questions and opinions of deming. Developing a habit of quality - Juran quality trilogy - the universal break through sequence - comparison Juran and Deming approach- Pareto analysis - quality costing - Quality Function Deployment (QFD) (6)

KAIZEN: Meaning - Kaizen and innovation - the Kaizen management practices - total quality control (TQC) - approaches of Faigenbaum, Ishikawa - Kaizen and TQC - Kanban systems - small group activities - comparison of Kaizen and Deming's approach. (6)

ISO 9000 SERIES QUALITY SYSTEM STANDARDS: The structure of ISO 9000 series quality system standards - certification process - action plan development for cases. (5)

INTRODUCTION TO WORKPLACE DESIGN: 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)

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

INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, and 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. (4)

Total L: 45+ T: 15 = 60

REFERENCES:

1. Logothetics N, "Managing for Total Quality - From Deming to Taguchi and SPC", Prentice Hall Ltd., New Delhi, 1997.
2. Juran J M and Gryna F M, "Quality Planning and Analysis - From Product Development through Use", Tata McGraw Hill Publishing Limited, New Delhi, 2004.
3. Deming W E, "Out of the Crisis," MIT Press, Cambridge, MA, 1982.
4. Juran J M and Juran on "Leadership for Quality" An Executive Handbook, The Free Press, New York, 1989.
5. Parker S and Wal T, "Job and Work Design, Organizing Work to Promote Well-Being and Effectiveness", Sage Publications, California, 1998.

15MN08 / 15MC23 SUPPLY CHAIN MANAGEMENT

3 0 0 3

INTRODUCTION: Definition, house of supply chain – customer satisfaction, integration, coordination - decision phases in a supply chain, objectives of SCM, examples of supply chains, supply chain drivers, supply chain performance measures. (5)

SUPPLY CHAIN NETWORK DESIGN: Data collection – data aggregation, transportation modes and rates, mileage estimation, warehouse costs, warehouse capacity, potential warehouse locations, service level requirements and future demand. Network design in the supply chain – factors influencing the network design, framework for network design decisions, models for facility

location and capacity allocation – capacitated plant location model, gravity location model, allocating demand to production facilities, simultaneous location of plants and warehouses – impact of uncertainty on network design. (9)

INVENTORY MANAGEMENT: Single warehouse inventory model - cycle inventory – economies of scale to exploit fixed costs, quantity discounts, short term discounting, multi-echelon inventory, example problems. managing uncertainty – safety inventory in the supply chain –safety level estimation, impact of supply uncertainty, impact of aggregation, impact of replenishment policies, managing safety inventory in multi echelon supply chain, managing safety inventory in practice – product availability – optimal level, affecting factors, supply chain contracts – risk pooling – examples. value of information – Bullwhip effect, information and supply chain technology. (10)

DISTRIBUTION NETWORK DESIGN AND STRATEGIES: Role of distribution in supply chain – distribution network design – factors influencing distribution network design. push strategy – pull strategy – Kanban replenishment systems, types, implementation, and push-pull strategy – demand driven strategy – impact of internet on supply chain strategy. distribution networks in practice – direct shipment, cross docking, warehousing, transshipment. (6)

STRATEGIC ALLIANCE: Framework for strategic alliance - 3PL and 4PL – retailer-supplier partnerships – distribution integration – procurement and outsourcing – benefits, make/buy decisions, E-Procurement, supplier relationship management – supplier scoring and assessment, supplier selection and contracts – E-Business and the supply chain. design for logistics- Reverse logistics –Cases in Paper industry – Furniture industry – supplier integration into new product development – mass customization. (6)

CUSTOMER VALUE AND GLOBAL SUPPLY CHAINS: Customer value – dimensions, strategic pricing, customer value measures, information technology and customer value – customer relationship management. global supply chains – 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)

Total: L: 45

REFERENCES:

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”, Prentice Hall India Pvt. Ltd, New Delhi, 2007.
3. Robert B Handfield and Ernest L Nichols, “Introduction to Supply Chain Management”, Prentice Hall, Inc. New Delhi, 1999.
4. Sahay B S, “Supply Chain Management”, Macmillan Company, 2000.
5. David Brunt and David Taylor, “Manufacturing Operations and Supply Chain Management : The Lean Approach”, Vikas Publishing House, New Delhi, 2001.
6. Hartmud Stadler and Christoph Kilger, “Supply Chain Management and Advanced Planning: Concepts, Models, Software”, Springer-Verlag, 2000.
7. David F Ross, “Introduction to E-Supply Chain Management”, CRC Press, 2003.

15MN09/15MC08 MODELING AND ANALYSIS OF ADVANCED MANUFACTURING SYSTEMS

3 0 0 3

MANUFACTURING SYSTEMS AND MODELS: Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building. (3)

FLOW SHOP SYSTEMS: Assembly lines - reliable serial systems - approaches to line balancing – largest candidate rule, kilbridge & wester method, ranked positional weight heuristic, COMSOAL, – sequencing mixed models. Transfer lines and general serial systems – paced lines with & without buffers, unpaced lines. (8)

FACILITY LAYOUT: Types of layouts – advantages, limitations, systematic layout planning, layout design procedures - quadratic assignments approach, graph theoretic approach, robotics and automated assembly. (6)

CELLULAR SYSTEMS: Group technology – coding schemes – assigning machines to groups – production flow analysis, binary ordering algorithm, single pass heuristic, similarity coefficient method. (6)

FLEXIBLE MANUFACTURING SYSTEMS: System components – planning and control hierarchy – system design, system setup, scheduling and control – flow shop scheduling, job shop scheduling, Flexible inspection systems. (5)

MATERIAL HANDLING AND STORAGE: Material handling principles, equipments – conveyor analysis, AGV systems, Warehousing – warehouse components, analysis of storage and retrieval systems, carousal storage systems, Introduction to Material handling and storage software. (8)

GENERIC MODELING APPROACHES: Queuing models – notations, performance measures, m/m/1 queue, m/m/m queue, batch arrival queuing systems, queues with breakdowns – queuing networks – open and closed networks, central server model. Petri net modeling - classical petrinets – transformation firing and reachability, reachability graphs – representation schemes – timed Petri nets - modeling of manufacturing systems. (9)

Total: L: 45

REFERENCES:

1. Ronald G Askin, "Modeling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc, 1993.
2. Viswanatham N and Narahari Y "Performance Modeling of Automated Manufacturing Systems", Prentice Hall Inc., 1992.
3. Mengchu Zhou, "Modeling, Simulation and Control of Flexible Manufacturing Systems: A Petri Net Approach", World Scientific Publishing Company Pvt. Ltd., 2000.
4. Jean Marie Proth and Xiaolan Xie, "Petri Nets: A Tool for Design and Management of Manufacturing Systems", John Wiley and Sons, New York, 1996.
5. Brandimarte P and Villa A, "Modeling Manufacturing Systems" Springer Verlag, Berlin, 1999.

15MN10 PROJECT MANAGEMENT

3 0 0 3

PROJECT MANAGEMENT: Definition of Project, why project management, Project Life Cycle, Selecting Projects Strategically – Project Management maturity, Project selection and criteria of choice, the nature of project selection models, types of project selection models, analysis under uncertainty-the management of risk, project portfolio process, project proposals. (5)

PROJECT INITIATION: Role of project managers – project management and project manager, special demands on the project manager, problems of cultural differences, impact of institutional environments, multicultural communication and managerial behavior. Working and partnering with others – Nature of negotiation, partnering, chartering and scope change, conflict and the project life cycle, requirements and principles of negotiation. Role of Projects in organization – projects as part of functional organization, pure project organization, the matrix organization, mixed organizational systems, choosing an organizational form, the project team. (6)

PROJECT PLANNING: Initial project coordination and the project plan, systems integration, the action plan. Project costs and Budgets – estimating project budgets, expert opinion, analogy, parametric estimate; cost engineering – example, contingency amount, elements of budgets and estimates improving the process of cost estimation. (4)

TOOLS & TECHNIQUES: Network diagram – critical path, late times, slack, float, calendar scheduling. Network Techniques – PERT and CPM, Introduction to GERT Network, Case studies in PERT/CPM. Risk analysis using simulation. WBS, responsibility matrix, events and milestones, Gantt charts. (7)

RESOURCE MANAGEMENT: Allocating resources on the project – crashing a project, resource allocation problem, resource loading, resource leveling, constrained resource scheduling, multi-project scheduling and resource allocation. (5)

RISK MANAGEMENT: Risk analysis – objectives of risk analysis, identify the risk, determine the most important risk, identify control measures. Performing risk analysis – objectives and desired result, design of risk analysis, activities and time frame for implementing risk analysis. Risk management – choosing, implementing and evaluating control measures, Performing risk management, Implementing Risk management. (5)

PROJECT CONTROL: The planning, monitoring and controlling cycle, information needs and reporting, earned value analysis, computerized PMIS. Controlling Project execution – fundamental purpose of control, types of control processes, design of control system, control of change and scope creep. (5)

PROJECT EVALUATION AND TERMINATION: Project evaluation – goals of the system, project audit, construction and use of audit report, project audit life cycle, essentials of audit/evaluation, measurement. Completing the project – varieties of project termination, when to terminate a project, termination process, final report. (4)

PLM: Introduction to PLM, PLM and project management, ERP and PLM, Elements of PLM, Beyond PLM. (4)

Total L: 45

REFERENCES:

1. John M Nicholas, "Project Management for Business and Technology", Prentice Hall India Pvt. Ltd., New Delhi, 2002.
2. Anastasia Pagnoni, "Project Engineering – Computer Oriented Planning and Operational Decision Making", Springer Verlag, 1990.
3. Parameshwar P Iyer, "Engineering Project Management- with Case Studies", Wheeler Publishing, 1996.
4. Dennis Lock, "The Essentials of Project Management", Gower Publishing Ltd., 1997.
5. Vasant Desai, "Project Management", Himalaya Publishing House, 2001.
6. Joseph Phillips, "IT Project Management on Track from Start to Finish", Tata McGraw Hill, 2004.
7. Jack R Meredith and Samuel J Mantel, "Project management: A Managerial Approach", John Wiley & Sons, Inc., New Delhi, 2010.

15MN52 OPERATIONS RESEARCH LABORATORY**0 0 2 1****LIST OF EXPERIMENTS**

1. Current state and Future state Value Stream Mapping using VSM graphics software
2. Solving Linear programming and Non-Linear Programming problems using Excel solver
3. Solving Transportation and Assignment problems using Excel solver
4. Project evaluation and review based on time and cost (MS Project)
5. Process control with control charts using Statistical Software
6. Measurement System Analysis and Process capability study using Statistical Software(MiniTAB)
7. Study on failure mode using XFMEA Software
8. Layout optimization using manufacturing systems simulation software (VIP-Planopt)
9. Study on reliability using component/product failure data (Weibull++)

REFERENCES:

1. Laboratory Manual by Department of Mechanical Engineering.
2. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag and Preetam Basu, "Introduction to Operations Research", McGraw Hill Education New Delhi, India, 2012.

Total P: 30**SEMESTER III****15MN53 MANUFACTURING SYSTEMS DESIGN LABORATORY****0 0 2 1**

1. Lean Inventory Management using Kanban Production System.
2. Project management using MS Project.
3. Solving Transportation and Assignment problems using Excel solver
4. Study of Inventory Accounting Module by using open source ERP Package (ERPnext)
5. Study of Purchase and Warehouse Management using open source ERP Package(ODOO)
6. Solving inventory, scheduling lot sizing problems using manufacturing systems simulation software.
7. Material requirement planning using ERP package.
8. Sales and operation planning using Excel.
9. Layout design using software.
10. Performance measure using SCOR model.

Total P: 30**15MN71 PROJECT WORK I****0 0 6 3**

- ❖ Identification of a real life problem in thrust areas
- ❖ Developing a mathematical model for solving the above problem
- ❖ Finalisation of system requirements and specification
- ❖ Proposing different solutions for the problem based on literature survey
- ❖ Future trends in providing alternate solutions
- ❖ Consolidated report preparation of the above

Total: P: 90

SEMESTER IV

15MN72 PROJECT WORK II

0 0 28 14

- ❖ **The project work involves the following:**
 - ❖ **Preparing a project - brief proposal including**
 - ❖ Problem Identification
 - ❖ A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
 - ❖ List of possible solutions including alternatives and constraints
 - ❖ Cost benefit analysis
 - ❖ Time Line of activities
- ❖ **A report highlighting the design finalization [based on functional requirements & standards (if any)]**
 - ❖ **A presentation including the following:**
 - ❖ Implementation Phase (Hardware / Software / both)
 - ❖ Testing & Validation of the developed system
 - ❖ Learning in the Project
- ❖ **Consolidated report preparation**

Total P: 420