

UNIVERSITY OF DELHI

**Scheme of Examination
and
Courses of Reading
for
M.A./M.Sc. Applied Operational Research
Examinations**

Part- I Examination

Part-II Examination

UNIVERSITY OF DELHI
M.A./M.Sc. IN APPLIED OPERATIONAL RESEARCH
SCHEME OF EXAMINATION

Part I- Examination	Duration (Hours)	Maximum Marks
Course- I : Computer Programming and Numerical Methods		
(a) Computer Programming		40
(b) Numerical Methods	3	40
(c) Minor project using (a)		20
Course- II : Statistical Methods	3	100
Course-III : Linear Programming	3	100
Course-IV : Inventory Management	3	100
Course- V : Queueing and Simulation	3	100
Course- VI : Marketing Management	3	100
Course -VII : Database Management System And Visual Programming		
(a)Theorv	3	60
(b) Practical	4	40
Course- VIII : Industrial Statistics	3	100
Part II - Examination	Duration (Hours)	Maximum Marks
Course- IX : Network Analysis and Theory of Sequencing	3	100
Course- X : Theory of Reliability and Maintenance	3	100
Course- XI : Mathematical Programming	3	100
Course-XII : Software Engineering	3	100

Course - XIII and XIV : Optionals (Any two of the following)

(i)	Advanced Mathematical Programming	3	100
(ii)	Applied Queueing Systems	3	100
(iii)	Advanced Inventory Management	3	100
(iv)	Applied Reliability Methods	3	100
(v)	Marketing Research	3	100
(vi)	Financial Management	3	100
(vii)	Theory of Control	3	100
(viii)	WEB Programming using JAVA		
	(a) Theory	3	60
	(b) Practical	4	40
(ix)	Data Warehousing and Data Mining	3	100

Course- XV : Industrial and Project Work 200

The work will start in the beginning of M.A./ M.Sc. Part-II under approved supervisors from amongst the members of the staff and the report is to be submitted for evaluation by March 31. It will carry 200 marks.

Project Report	:	100 Marks
Viva-voce	:	50 Marks
Internal Assessment	:	50 Marks

Note: (a) The students have to secure 50% marks in each course.

(b) In courses having minor project/ practical, students have to secure 50% marks separately in minor project/practical.

(c) In Course-VII Part-(b), Course- XIII and XIV(viii) Part-(b),10 marks are reserved for class record and 10 marks for viva-voce.

(d) In Course-I (C), 10 marks are reserved for project report and 10 marks for viva-voce.

Course-I : Computer Programming and Numerical Methods

Part(a) Computer Programming

Introduction to UNIX / WINDOWS NT / WINDOWS Operating System, File and Memory Management. Elementary Data Structure in C++, Arrays. Stacks, Queues. Link Lists, Trees and Fundamental File Structure Concepts and its Access. Introduction to Object Oriented Programming. Object and Classes in C++. Functions, Structures, Arrays, Operator Overloading, Inheritance, Pointer, Memory Management, Polymorphism, Exceptions, Templates, Container Classes, File and Streams.

Part(b) Numerical Methods

Theory of interpolation with error terms, Numerical integration with error terms, Trapezoidal, Simpson's 1/3rd, 3/8th, Weeddle's and Gauss quadrature formulas, Gregory's Euler Maclaurin's formula.

Numerical solution of ordinary differential equations. One step methods for initial value problems and boundary value problems.

Books suggested :

1. Afzal Amir. : Unix Unbounded, Beginning Approach, 2nd Edition, Prentice Hall, 1998.
2. Kernighan, B.W. and Pika, R. : The Unix Programming Environment, Prentice Hall, 1984.
3. Graham Glass : Unix for Programmers and Users, A Complete Guide, Prentice Hall, 1993.
4. Dewhurst, S.C. and Stark, K.T. : Programming with C++, Prentice Hall, 1995.
5. Meyers Scott : Effective C++, 50 Specific Ways to Improve Your Program and Designs, Addison-Wesley, 1992.
6. Bjarne Stroustrup : The C++ Programming Language. 2nd Edition, Addison-Wesley, 1991.
7. Scarborough, J.B. : Numerical Mathematical Analysis, Oxford Book Co. 1966.
8. Jain, M.K., Iyengar. S.R.K. and Jain, R.K. : Numerical Methods for Scientific and Engineering Computations, Wiley

Eastern Ltd. 1993.

9. Vandergraft, J. S. : Introduction of Numerical Computations
2nd Ed., Academic Press. 1983.

Part-(c) A minor project using (a)

Course –II : Statistical Methods

Probability spaces, Conditional probability, Random variables, Expectation, Characteristic functions, Generating functions. Law of large numbers, Central limit Theorem. Discrete and Continuous probability distributions. Compound distribution. Linear regression analysis, Correlation, Curve-Fitting, Pearson's System.

Sampling distribution of \bar{x} and S^2 for Normal Population; t, χ^2 & F distributions, and tests of significance based on them. Theory of point estimation and interval estimation. Theory of testing of hypothesis: Simple and composite hypothesis, Neyman Pearson lemma and likelihood ratio tests.

Books suggested :

1. Feller, W. : An Introduction to Probability Theory and its Applications : Volume I. 5th Ed.. John Wiley and Sons, 1985.
2. Kendall, MG., Stuart : Advanced Theory of Statistics, Volume I and II
M.G. and Stuart, A. Charles Griffin and Co. Ltd., 1961.
3. Meyer, Paul L. : Introduction to Probability and Statistical Applications, 2nd Ed., Addison Wesley, 1971.
4. Freund, J.F. and : Mathematical Statistics, 5th Ed., Prentice Hall of
Walpole, R.E. India, 1999.
5. Hogg, R.B. and : Introduction to Mathematical Statistics, 4th Edn.
Craig. A.T. Macmillan Publishing Co. Inc.1978.

Course – III : Linear Programming

Convex sets and convex cones. Convex function and their properties. Theory of Simplex Method, Simplex Algorithm. Degeneracy. Duality theorem, Transportation problem, Assignment problem. Revised Simplex method. Parametric linear programming. Sensitivity analysis, Dual- simplex method. Bounded variable problem. Decomposition in Linear Programming. Rectangular games : methods of solution. Equivalence of rectangular games and linear programming.

simplex method. Bounded variable problem. Decomposition in Linear Programming. Rectangular games : methods of solution. Equivalence of rectangular games and linear programming.

Case studies.

Books suggested :

1. Gass, S.I. : Linear Programming (3rd Edition), McGraw Hill, NY, 1985.
2. Hadley, G. : Linear Programming, Narosa, 1987.
3. Hadley, G. : Linear Algebra, Narosa, 1987.
4. Bazara. M. S., Jarvis, J. and Sherali H. : Linear Programming and Network Flows, Wiley, NY, 1990.
5. Ignizio, J.P. and Cavelier, T.M. : Linear Programming, Prentice Hall, NJ, 1994.
6. McKinsey, J.C.C. : Introduction to Theory of Games, McGraw Hill Book Co., NY, 1952.

Course – IV : Inventory Management

Concept of inventory. Estimation of different cost functions. Classification of items, Inventory control with deterministic and stochastic demands with and without lead time. Power demand pattern. Deterioration. Perishibility in inventory models. Safety Stock level. All units and incremental discounts inventory models. Multi-item model with constraints. Individual and Joint Order policy. Optimum warehousing capacity. Simple periodic review model. Production Scheduling model.

Value analysis, Codification and standardization of items, Simulation in inventory. Computer aid in controlling inventories.

Case studies relating to inventory decisions.

Books suggested :

1. Hadley, G. and Whitin T.M. : Analysis of Inventory Systems, Prentice Hall, 1963.
2. Naddor, E. : Inventory System. John Wiley, 1966.

3. Hansmann, F. : Operations Research in Production and Inventory Control, Prentice Hall, 1968.
4. Arrow K., Karlin J.S. and Scarf, H. : Studies in Mathematical Theory of Inventory and Production, Stanford University Press, 1958.
5. Buchan, J. and Koenisberg, E. : Scientific Inventory Management, Prentice Hall, 1963.
6. Silver, E. and Peterson. R. : Decision System for Inventory Management and Production Control, Wiley, NY, 1985.

Course - V : Queueing and Simulation

Introduction to Stochastic Processes, Markov Chain and Markov Processes. Description of Queues, Probability description of arrivals and service times. Basic structure of Queueing Models.

Mathematical Queueing Models : M/M/1, M/M/C, M/G/1, G/M/1, M/D/1, M/D/C, M/E_k/1 and E_k/M/1. Solutions for the queue length, waiting time and busy period. Basic idea of priority and other queue disciplines. Simulation and Monte Carlo Techniques. Book-keeping aspects of Simulation. Monte Carlo method applied to Queueing Theory. Application of Queueing Theory to Machine Interference Problem.

Case studies.

Books suggested :

1. Kleinrock,. Leonard : Queueing Systems, Volume I : John Wiley, 1975.
2. Gross, Donald and Harris, CM. : Fundamentals of Queueing Theory, 2nd Edn.. John Wiley, 1985.
3. Cox, D.R. and Smith, W.L. : Queues, Mathuen, 1961.
4. Medhi, J. : Stochastic Models in Queueing Theory, Academic Press, 1991.
5. Panico, J.N.A. : Queueing Theory, 1969.
6. Satty, T. L. : Elements of Queueing Theory with Applications, Dover, NY, 1983.

Course - VI : Marketing Management

Concept of marketing and its role in business and public organisations. Marketing decisions. Need for scientific marketing analysis, Uses and limitations of mathematical models in marketing. Classifications of market structure depending upon the nature of competitive conditions.

Introduction of a new product, Consumer behaviour, Utility measure for product search, Break-even analysis for product evaluation, PERT and CPM in product development.

Demand elasticities and elasticity theorem, Factors affecting pricing decision, Pricing methods, Joint optimization of price, quality and promotional effort, Purchasing under fluctuating prices.

Promotional decisions in the presence of competition, Game theory models for promotional effort, Spatial allocation of promotional effort, Media allocation for advertisement, Brand switching analysis.

Channels of distribution, Transportation decision, Locating company's wholesale dealers and warehouses.

Case studies relating to marketing decisions.

Books suggested :

1. William R. King : Quantitative Analysis for Marketing Management McGraw Hill Co., 1967.
2. Bass, Buzzel (ed) : Mathematical Models and Methods in Marketing, Irwin Series, 1971.
3. Lillien, G.L., Kotler, P. and Subramaniam : Marketing Models, Prentice Hall of India, 1998.
4. Border, N.H. and Marshal, W.V : Advertising Management-Text and Cases, Richard D. Irwin Inc. 1967.
5. Howard. J.M. : Consumer Behaviour in Marketing Strategies, Prentice Hall, 1989.
6. Montegomery, D.B. & Urban. G.L. : Management Science in Marketing, Prentice Hall, 1979.

Course - VII : Database Management System and Visual Programming

Part - (a) Theory

Introduction to Database Systems, Data Models, Relational Model, The ER Methodology for Logical Design, Relational Algebra, SQL, Design Theory for Relational Databases,

Object Oriented Database Systems, Physical Level Organization, Query Processing & Optimization, Security and Integrity, Concurrency Control and Crash Recovery, Distributed Systems.

Introduction to Client Server Programming : Visual programming environment, iconic systems and their specifications including syntactic and semantic aspects. Messages and message passing, Programming with graphic devices, Implementation with visual systems, Introduction to Visual Basic.

Books suggested :

1. Date, C.J. : An Introduction to Database Systems, 6th Edition, Addison Wesley, 1995.
2. Korth, H.F., Silberschatz, A. : Database System Concepts, McGraw Hill, and Sudarshan. S. 1998.
3. Ramakrishnan, Raghu : Database Management System, McGraw Hill, 1998.
4. B.C. Dasai : Database System, BPB, 1998.

Part - (b) Practical based on VII (a)

Course - VIII : Industrial Statistics

Time-series: Components of time series, Measurement of trend, seasonal and cyclical components, Forecasting techniques.

Statistical Quality control, Control Charts, Sampling acceptance plans, Properties and determination of parameters of single and double sampling plans for LTPD, AQL requirements, OC-curve scheme for determination of parameters for single sampling plan.

Econometrics : Theory of regression for single equation models and simultaneous equation models, Distributed lag-models, Multicollinearity.

Case studies in application of econometric models and other specialised aspects of Econometrics.

Books suggested :

1. Montegomery, D.C. : Forecasting & Time Series Analysis, and Johnson, L.A. McGraw Hill. 1990.

2. Duncan, A.J. : Quality Control and Industrial Statistics, D.B. Taraporevala and Sons, 1965.
3. Johnston, J. : Econometric Methods, 3rd Edn., McGraw Hill, 1984.
4. Brown, R.G. : Smoothing, Forecasting and Prediction of Discrete Time Series, Prentice Hall Inc., 1972.

Course - IX : Network Analysis and Theory of Sequencing

Flows in networks, Maximal flow, Distribution and General Minimal Cost Flow problems, Shortest Path and Travelling Salesman Problem, Construction of minimal spanning tree and its applications.

PERT and CPM with activity times known and probabilistic, Various types of floats, Updating of PERT charts, Project crashing, Formulation of CPM as a linear programming problem, Resource leveling and Resource Scheduling.

Sequencing Problem, Flow shop problem and general n/m job-shop problem.

Books suggested:

1. Ford, L.R. and Fulkerson, D.R. : Flows in Network, Princeton University Press, 1962.
2. Bazaraa M.S. : Linear Programming and
Jarvis, J. and Sherali, H. Network Flows, Wiles, NY, 1990.
3. Ahuja, R.K., Magnati, T.L. : Network Flows - Theory,
and Orlin, B. Algorithm and Applications,
Prentice Hall, NJ, 1983.
4. Jenson, P.A. and : Network Flows Programming,
Barnes, W.J. John Wiley and Sons, 1980.
5. Elmaghraby, S. E. : Activity Networks, Project Planning,
and Control, John Wiley and Sons,
1977.
6. Moder Joseph J. and : Project Management with PERT &
Philips Cecil R. CPM, Van Nostrand Reinhold Co.,
1970.
7. Convey, R.W., Maxwell, W.L. : Theory of Scheduling, Addison
and Miller, L.W. Wesley, 1967.

8. Fiench, S. : Sequencing and Scheduling, Ellis Horwood Limited, 1982.

Course- X : Theory of Reliability and Maintenance

Part A

Basic of Reliability including structured function. Classes of life distributions. Series, Parallel, Standby configurations, Bridge structure, Reliability models of maintained & nonmaintained systems, Availability theory and its modelling for various configurations.

Part B

Renewal theory and its application to one-unit repairable systems with simple different maintenance policies (Age, Block, Preventive & Corrective). Minimal repair replacement policies, ordering policies, Notions of Ageing.

Optimization problem with respect to system reliability, Overhaul and repair decisions, Reliability allocations problems.

Case Studies.

Books suggested:

1. Barlow, R.E. and Proschan, F. : Mathematical Theory of Reliability, John Wiley & Sons, 1965.
2. Barlow, R.E. and Proschan, F. : Statistical Theory of Reliability and Life Testing, Holt, Rinehart & Winston Inc., 1975.
3. Jardine, A.K.S. : Maintenance, Replacement and Reliability, Pitman Publications, 1973.
4. Morse, P.M. : Queues, Inventories and Maintenance, John Wiley & Sons, 1958.
5. Rau, John G. : Optimization and Probability in Systems Engineering, V.N. Reinhold Co. 1970.
6. Cox, D.R. : Renewal Theory, Mathew, London, 1962.

7. Kuo, W., Rajendra Prasad. V. : Optimal Reliability Design :
Tillman, F.A. and Hwang C.L. Fundamentals and Applications,
Cambridge University Press, 2001.
8. Lewis, E.E. : Introduction to Reliability
Engineering, John Wiley & Sons,
1987.
9. Srinath, L.S. : Reliability Engineering, Affiliated
East -West Press, 1991.

Course- XI : Mathematical Programming

Convex sets, Convex functions and their properties, Fritz-John's optimality conditions, Kuhn-Tucker's optimality conditions, Quadratic Programming : Methods due to Beale and Wolfe, Duality in quadratic programming.

Elements of Dynamic Programming, Integer Programming : Dantzig's Method. Gomory's Method for all integer and mixed integer programming, Branch and bound technique, E. Balas' Algorithm for 0-1 Programming.

Goal Programming: Lexico-graphic and Weighted Vector Approach for Multiobjective Linear Programming Problems.

Books suggested:

1. Bazaraa, M.S. and C.M. : Non-Linear Programming,
Shetty (Theory and applications)
John Wiley and sons, 1993.
2. Hadley, G. : Non-linear and Dynamic Programming,
Addison Wesley, 1964.
3. Hu Te : Integer Programming and Network
Flows, Addison Wesley, 1970.
4. Kunzi, H.P. : Non-linear Programming, Blaisdell,
Amsterdam, 1966.
5. Ignizio, James P. : Linear Programming in Single and
Multiple Objective Functions, Prentice Hall,
NJ, 1994.
6. Cohon, J.L. : Multiobjective Programming and
Planning, Academic Press, NY, 1978.

7. Bellman, R. : Dynamic Programming, Princeton University Press, NJ, 1965.

Course – XII : Software Engineering

A historical overview of software technology, Software production and its difficulties. Software life cycle models, Stepwise Refinement, CASE and Other Tools of the Trade.

Modularity and Objects, Requirements analysis, Requirements specification methods, Software planning and project management, Software design.

Software verification, validation, and testing, Introduction to Software Reliability, Importance of Software testing, Difference between hardware and software reliability, Software Reliability and Availability, Modelling Software Reliability and its uses, Markovian models, NHPP models, Parameter estimation, Reliability of Modular software, Introduction to COTS.

Release time problems, Release time problem based on cost criterion, Reliability criterion, Cost-reliability criterion, Penalty cost, Testing effort, Random life cycle, Warranty and risk cost, Bicriterion release policy.

Software implementation and integration, Software maintenance.

Case Studies.

Books suggested :

1. Schach, S.R. : Classical and Object-Oriented Software Engineering, Fourth ed., WCB/McGraw-Hill, New York, NY 1998.
2. Pfleeger, S.L. : Software Engineering : Theory and Practice, Prentice Hall, NJ, 1998.
3. Sommerville, I. : Software Engineering, Fifth edition, Addison- Wesley, 1996.
4. Shooman, M.L. : Software Engineering, McGraw Hill Book Co., 1983.
5. Musa, J.D., Iannino. A. and Okumoto, K. : Software Reliability: Measurement, Prediction and Application, McGraw Hill Book Co., 1987.
6. Kapur, P.K., Garg, R.B. Kumar, S. : Contributions to Hardware and Software and Reliability, World Scientific, Singapore, 1999.

7. Kuo, W., Prasad, V.R. and Tillman, F.A. and Hwang, C.L. : Optimal Reliability Design : Fundamentals and Applications, Cambridge University Press, 2001.

Course - XIII and XIV (i) : Advanced Mathematical Programming

Feasible direction method. Rosen's gradient Projection method, Generalized convexity and their properties, Fritz-John's generalized optimality conditions, Duality in convex programming, Stochastic, Fractional, Indefinite and Geometric Programming. Non-differentiable Programming: Optimality conditions and duality relations. Multi-objective linear programming : Vector maximum and Interactive approaches.

Books suggested :

1. Avriel, M. : Nonlinear Programming : Analysis and Methods, Prentice Hall Inc. NJ, 1976.
2. Zeutendijk, G. : Methods of Feasible Direction, Elsevier Publishing Co., 1960.
3. Bazaraa, M.S. and Shetty, C.M. : Non-Linear Programming : Theory and Algorithms, John Wiley & Sons, 1993.
4. Steuer, R.E. : Multiple Criteria Optimization – Theory, Computation and Applications, John Wiley and Sons, N.Y., 1986.
5. Ignizio, James P. : Linear Programming in Single and Multiple Objective Functions, Prentice Hall Inc., 1994.
6. Mangasarian, O.L. : Nonlinear Programming, McGraw Hill, 1969.

Course - XIII and XIV (ii) : Applied Queueing Systems

Probability distribution of phase type. Quasi Birth and Death processes, G/PH/I queueing models and their algorithmic solution.

Combinatorial method and its application in queueing theory.

Duality principle of queueing theory. Introduction to different queueing network models. Use of queueing theory in manufacturing systems. Queueing theory in practice.

Individual and social optimization of Markovian queueing models. M/G/I model with server's vacations and different priorities.

Case Studies.

Books suggested :

1. Buzacott, J. A. and Shanthi Kumar, J.O. : Stochastic Models of Manufacturing Systems, Prentice Hall, 1993.
2. Medhi, J. : Stochastic Models in Queueing Theory, Academic Press, Inc., 1992.
3. Neuts, M.F. : Matrix Geometric Solutions in Stochastic Models, John Hopkins, Univ. Press London, 1981.
4. Taha, H.A. : Operations Research : An Introduction : 5th Edn., Maxwell Macmillian International, 1992.
5. Takacs, L. : Combinatorial Methods in the Theory of Stochastic Processes, John Wiley, New York, 1967.
6. Takagi, H. : Queueing Analysis, Vol. I, Elsevier Science Publishers, North Holland, 1991.

Course-XIII and XIV (iii) : Advanced Inventory Management

Dynamic inventory models, Probabilistic reorder point inventory models with and without lead time. Distribution free analysis, Minmax solution of inventory model, Capacity expansion and warehousing problem, Periodic review and continuous review models. Two bin inventory system, Inventory management of items with deterioration. Production and production functions, Production planning and inventory management, Planning and control in multiechelon inventory management. Planning and control in multiechelon inventory system. Material management, Material planning and handling, Purchasing function, Material Requirement Planning.

Books suggested:

1. Arrow K.J. Karlin's and Scarff. H. : Studies in the Mathematical Theory of Inventory and Production, Stanford University Press, 1958.
2. Gokaran B.R. and Pylee M.V. : Essentiality of Material Management, Samaiya Publication, 1975.
3. Johnson L.A. and Montgomery, D.C. : Operations Research in Production Planning, Scheduling and Inventory Control, John Wiley, 1974.

4. Love, Stephen : Inventory Control, McGraw Hill, 1979.
5. Plossl, G.W. : Production and Inventory Control : Principles and Techniques, Prentice Hall, 1986.
6. Schwang, L.B. : Multi-level Production Inventory Control System – Theory and Practice, TIME Publication, 1981.
7. Starr, M.K. and Miller D.W. : Inventory Control - Theory and Practice, Prentice Hall, 1962.
8. Hillier, F.S. and Liberman, G.J. : Operations Research, Holden Day, 1996.
9. Naddor, E. : Inventory Systems, John Wiley Sons, 1963.

Course- XIII and XIV (iv) : Applied Reliability Methods

Part-A

System Modelling : Markov Renewal Process (Semi-Markov Process), Applications to analyse 2-unit and multiunit systems, Preventive Maintenance policies and Ordering policies for these systems. Generalized availability measures, Replacement policies and Ordering policies under extended Minimal Repair, Application of these policies to Computing Systems.

Part-B

Reliability in Design : Failure Mode Effects & Criticality Analysis (FMECA), Fault Tree Analysis (FTA).

Probability Plotting : Probability plotting techniques, Straight line fitting, Censored plots for Lognormal, Weibull, Extreme value and Binomial distributions.

Quality Systems : Principles & concepts of Quality Management, and its implementation. Total Quality Management, Quality motivation & reward, Quality system standards (ISO-9000).

Human Reliability Modelling: Concept of human error, types & causes of human error. Human reliability modelling in continuous time, Human error prediction technique.

Computerised Methods : Reliability evaluation software.

Books suggested:

1. O' Connor, Patrick D.T. : Practical Reliability Engineering, John Wiley, 1991.
2. Villemeur, Alain : Reliability, Availability, Maintainability, and Safety Assessment, John Wiley, 1991.
3. Kanji, Gopal K. and Asher, Mike : Total Quality Management Process : A Systematic Approach, CARTAX Publishing Co., 1993.
4. Lewis, E.E. : Introduction to Reliability Engineering, John Wiley & Sons, 1987.
5. Osaki, S. : Stochastic System Reliability Modelling, World Scientific Publications, 1985.
6. Srinivasan, S.K. & Subramanian, R. : Probabilistic Analysis of Redundant Systems, Springer-Verlag, 1977.
7. Kapur, P.K., Garg, R.B. and Kumar, S. : Contributions to Hardware and Software, Reliability, World Scientific, Singapore, 1999.
8. Dhillon, B.S. & Chanan Singh : Engineering Reliability : New Techniques & Applications, John Wiley & Sons, 1981.
9. Kececioglu, Dimitri : Reliability Engineering Hand Book Vol. 2., Prentice Hall, 1991.
10. Gertman, D.L. and Blackman : Human Reliability and Safety Analysis Data Handbook. John Wiley, 1994.
11. Neufelder, Ann Marie : Ensuring Software Reliability, Marcel Dekker, 1993.
12. Sahner, R.A. and Trivedi, K. S. : Performance and Reliability Analysis of Computer Systems, Kluwer Academic Press, 1996.

Courses -XIII and XIV (v) : Marketing Research

Marketing Research and its objectives, Methods of collecting Primary and Secondary data; Marketing Research as a Cost-incurring function- Bayesian approach. Analysis of the data. Consumer behaviour Marketing strategies. Application of Cluster analysis,

Discriminant Analysis and Factor analysis and Automatic Interaction Detection to marketing problems. Studies relating to Pricing, Promotion (Diffusion models), Purchasing and distribution decisions.

Cojoint Analysis, Multidimensional Scaling.

Experimental design and Analysis of variance.

Books suggested:

1. Boyd, Harper W., Westfall, Ralph and Starch, Stanley F. : Marketing Research -Text and Cases, Richard D. Irwin, LC, 1999.
2. Green, P.E., Tull, D.S. and Album, G. : Research for Marketing Decisions, Prentice Hall of India, 1999.
3. Sethna, Baheruz N. and Leonard Groeneveld : Research Methods in Marketing and Management, Tata McGraw Hill Publishing Co. Ltd.1984.
4. Vijay Mahajan & Peterson, Robart A. : Models for Innovation Diffusion and Related Research Papers, SAGE Publication, 1990.
5. Tull, D.S. and Hawkins, D.L. : Marketing Methods-Measurement and Methods, Prentice Hall of India, 1993.

Course- XIII and XIV (vi) - Financial Management

Elements of Financial Management : Financial Analysis and Planning, Capital Budgeting Decisions under certainty and uncertainty, Application of Goal Programming in Capital Budgeting Decisions. Cost of Capital, Capital Structure and Dividend Policies. Working Capital Management, Short term and Long term Financial Planning, Introduction to Portfolio Management. Application of Stochastic Processes in Finance.

Case studies.

Books suggested:

1. Brigham, E.F., Gapenski, L.C. and Michael C.E. : Financial Management : Theory and Practice, The Dryden Press, 9th edi., 1998.
2. Khan, M.Y. and Jain, P.K. : Financial Management, Tata McGraw Hill Pub. Co., New Delhi, 2000.

3. Clark, J.J., Hendland, T.J. and Pritchard R.E. : Capital Budgeting: Planning and Control of Capital Expenditures, Prentice Hall, Englewood Cliffs, NJ, 1986.
4. Donaldson, G. and Bertrand, F. : Corporate Debt Capacity : A Study of Corporate Debt Policy and the Determination of Corporate Debt Capacity, Beard Books, 2000.
5. Fischer, D.E. and Jordan, R.J. : Security Analysis and Portfolio Management, Prentice Hall of India, 1995.
6. Levy, H. and Sarnat, M. : Capital Investment and Financial Decisions, Prentice Hall, Englewood Cliffs, NJ, 1982.
7. Mao, J.C.T. : Quantitative Decision of Financial Decisions, McMillan, NY, 1969.
8. Van Horne, J. C. : Financial Management and Policy, Prentice Hall, Englewood Cliffs, NJ, 11th edi., 1977.
9. Yadav, R.A. : Financial Ratios and the Prediction of Corporate Failure Concept, New Delhi, 1987.

Course- XIII and XIV(vii) : Theory of Control

Fundamentals of optimal control, Problem formulation, Identification and control, Mathematical models of continuous and discrete time optimal control problems, Necessary and sufficient conditions for optimality (discrete and continuous), Some special continuous time optimal control problems, Relationship of the Maximum Principle to Dynamic Programming, Computational methods, Stochastic control.

Case Studies.

Books suggested:

1. Citron, S.T. : Elements of Optimal Control, Holt Rinehart and Winston, 1969.

2. Pontryagin, L.S. : The Mathematical Theory of Optimal Processes, John Wiley, 1962.
3. Lee, E.B. and Markue : Foundation of Optimal Control, John Wiley, 1967.
4. Kirk, D. : Optimal Control Theory : An Introduction, Prentice Hall, 1970.
5. Bryson and Yo-Clei Ho. : Applied Optimal Control, Cimu and Company 1960.
6. Seirstad, A. and Sydsater, K. : Optimal Control with Economic Applications, North Holland, 1987.
7. Vidal, R.V.V. : Notes on Static and Dynamic Optimization, IMSOR, Denmark, 1978.

Course - XIII and XIV (viii) : WEB Programming using JAVA

Part - (a) Theory

Introduction to Java Programming, Basic Syntax & Structure, Applets, Control Structures, Methods, Arrays, Strings, Object Oriented Programming Concepts (Objects, Classes, Inheritance), GUI Component (Panels and Frames), Multimedia (Sound, Graphics, Images and Animation), Error and Exception Handling, Multithreading and Input/Output Streams.

Introduction to Internet, HTML and E-commerce.

Books suggested:

1. Deitel, H.M. and Deitel, P. J. : JAVA, How to Program, Prentice Hall, 2000.
2. Bruce, E. : Thinking in Java, Prentice Hall, 1998.
3. Mary Campione and Kathy Wirath : The Java Tutorial : Object Oriented Programming for the Internet, Addison Wesley, 1996.

Part - (b) Practical based on part (a)

Course- XIII and XIV (ix) : Data Warehousing and Data Mining

Overview of Data Warehouse, Online Analytical Processing (OLAP). Introduction to Data Mining, The Knowledge in Databases (KDD) process, Limitation of traditional query tools. Association rules, Classification, Clustering, Regression, Patterns, Time series. Measuring predictive performance, Efficiency, Data preparation, Data Reduction, Mathematical Solutions, Statistical Methods, Distance Solutions. Decision Trees, Decision Rules, Neural Networks, Genetic Algorithms. Text mining, Text categorization. Mining Web Logs.

Case Studies.

Books suggested:

1. Fayaad, U.M., Piatetsky-Shapiro. G. : Advances in Knowledge
Smyth, P. and Uthurusamy, R. Discovery and Data Mining,
MIT Press, 1996.
2. Berry, M.J.A. and Linoff, G. : Data Mining Techniques for
Marketing – Sales and Costumer Support, John Wiley, 1997.
3. Berson, A. and Stephen, J. S. : Data Warehousing, Data Mining and
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