Proposed Syllabus

for

Generic Elective: Operational Research Papers for Students of B.Sc.(Hons.)/B.A.(Hons.)

under the
Choice Based Credit System

Department of Operational Research
University of Delhi
Delhi-110007

Proposed Scheme for Choice Based Credit System in

Generic Elective : Operational Research Papers for Students of B.Sc.(Hons.)/B.A.(Hons.)

Sem.	CORE COURSE (DCC) (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (4)	Generic Elective (GE)
I				**GE 1** Introduction to Operational Research and Linear Programming (Theory and practical)
II				**GE 2** Inventory Management (Theory and practical)
III				**GE 3** Queueing and Reliability Theory (Theory and practical)
IV				**GE 4** Integer Programming and Theory of Games (Theory and practical)
V				
VI				

Generic Elective: Course (GE)

GE1 Introduction to Operational Research and Linear Programming (Theory and practical)

GE2 Inventory Management (Theory and practical)

GE3 Queueing and Reliability Theory (Theory and practical)

GE4 Integer Programming and Theory of Games (Theory and practical)

GE 1: Introduction to Operational Research and Linear programming

Origin & Development of OR, Different Phases of OR study, Methodology of OR, Scope and Limitations of OR, OR in decision making, Applications of OR.

Linear Programming: Linear combination of vectors, Linearly independent / dependent vectors, Basis of a vector space, Convex set and its properties, Extreme points. General Linear programming problem (LPP), Standard and canonical form of LPP. Formulation of LPP, Graphical solution. Simplex method, Artificial variable techniques- Two Phase Method; Charnes M Method, Special cases in LPP. Finding Inverse of a matrix using Simplex method, Solving system of linear equations using Simplex method.

Duality: Definition of the dual problem, Primal-dual relationships, Economic Interpretation of Duality, Dual simplex Method.

Sensitivity analysis: Shadow Price, Graphical and simplex method based approach for changes in cost and resource vector.

References/Suggested Readings:

1. G. Hadley: Linear Programming. Narosa, 2002 (reprint).
2. A. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.
3. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition, 2010.
4. F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata McGraw Hill. 2010.

Practical/Lab to be performed on a computer using OR/Statistical packages

1. To solve Linear Programming Problem using Graphical Method with
    (i) multiple constraints
    (ii) Unbounded solution
    (iii) Infeasible solution
    (iv) Alternative or multiple solution
2. Solution of LPP with simplex method.
3. Solution of LPP with unrestricted variables through Simplex method.
4. Problem solving using M-Charnes method.
5. Problem solving using Two Phase method.
6. Illustration of following special cases in LPP using Simplex method
    (i) Unrestricted variables
    (ii) Unbounded solution
    (iii) Infeasible solution
    (iv) Alternative or multiple solution
7. Problems based on Dual simplex method.
8. Problems based on sensitivity analysis.

GE 2: Inventory Management

Introduction to inventory systems, Different costs in inventory system, Selective inventory classification (VED, XML, FNSD, ABC) and its use in controlling inventory.

Deterministic continuous review models: Basic Economic order quantity (EOQ) model (with and without shortages), EOQ with finite supply (with and without shortages), EOQ with backorders, Determination of reorder point for all the models. Multi-item EOQ model with constraints, All-unit quantity discount model.

Probabilistic inventory models: Single period probabilistic inventory models with discrete and continuous demand.

References/Suggested Readings:

1. Donald Waters: Inventory Control, John Wiley, 2010.
2. F.S. Hillier and G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata McGraw Hill, 2010.
3. G. Hadley, T. M. Whitin: Analysis o f Inventory- Systems, D. B. Taraporevala and Sons, Published by arrangement with Prentice Hall Inc., 1979.
4. Buffa, Elwood S. and Sarin Rakesh K., Modern Production / Operations Management, 8th Edition, Wiley India, 2009.

Practical/Lab to be performed on a computer using OR/Statistical packages

1. Problems based on selective inventory classification. (ABC and FNS analysis)
2. To find optimal inventory policy for EOQ model.
3. To find optimal inventory policy for EOQ model with finite supply.
4. To find optimal inventory policy for EOQ model with backorders.
5. To solve EOQ model with constraints.
6. To solve All-units quantity discounts model.
7. To find optimal inventory policy for Probabilistic inventory model with discrete demand.
8. To find optimal inventory policy for Probabilistic inventory model with continuous demand.

GE 3: Queuing and Reliability Theory

Queuing Theory: Basics of queuing system, Kendall's notation, performance measures, Little's formula, Birth-death process, Markovian models: - Single server with finite and infinite capacity, multi servers' queues.

Reliability Theory: Basics of reliability, hazard rate, mean time before failure (MTBF), failure time distribution functions, reliability of configurations- series, parallel, mixed configuration, k out of n system and standby system, Reliability and Availability models, Time dependent and independent Replacement policies, Concepts and definitions of Preventive Maintenance, Corrective Maintenance and Age Replacement.

References/Suggested Readings:

1. F.S. Hiller and G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata McGraw Hill, 2010.
2. D. Gross, John F. Shortle, James M. Thompson and C. Harris, Fundamentals of Queuing Theory, 4th Edition, Wiley India, 2008.
3. Srinath. L. S., Reliability Engineering, East West Press, New Delhi, 2005.
4. Trivedi K.S., Probability and Statistics with reliability, Queuing and Computer Science Applications, Prentice-Hall of India, New Delhi, 2011.
5. John G. Rau, Optimization and Probability in Systems Engineering, V. N. Reinhold Co. 1970.

Practical/Lab to be performed on a computer using OR/Statistical packages

1. To determine the performance measures for M/M/1 queuing model.
2. To determine the performance measures for M/M/1/N queuing model.
3. To determine the performance measures for M/M/C/∞ queuing model.
4. To determine the performance measures for M/M/C/N queuing model.
5. Problems based on Simulation: Random number generation.
6. Problems based on Monte Carlo method.
7. Calculation of hazard rate, MTBF for series & parallel system
8. Calculation of hazard rate, MTBF for Mixed configuration.
9. Problems based on reliability optimization.

GE 4: Integer Programming and Theory of Games

Integer Programming Problem (IPP): Pure and mixed IPP, Methods for solving IPP: Branch & Bound method, Gomory's cutting plane method. Applications of IPP.

Theory of Games: Introduction to Game theory, Formulation of two-person zero-sum rectangular game; Solution of rectangular games with saddle points; dominance principle; rectangular games without saddle point – mixed strategy, Graphical, algebraic and linear programming solution of m x n games.

References/Suggested Readings:

1. Hamdy A. Taha : Operations Research-An Introduction, Prentice Hall, 9th Edition, 2010
2. P. R. Thie and G. E. Keough: An Introduction to Linear Programming and Game Theory, Wiley, New Jersey, 3rd edition, 2008.
3. F.S. Hillier and G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata McGraw Hill, 2010.

Practical/Lab to be performed on a computer using OR/Statistical packages

1. Solution of IPP using Branch and Bound method.
2. Solution of IPP using Gomory's cutting plane method.
3. Solution of Capital Budgeting Problem.
4. Solution of Fixed charge problem.
5. Solution of cargo loading problem.
6. Solution of production planning problem.
7. Solution of Two-Person Zero-Sum pure and mixed strategy game.
8. Linear programming solution of game problem.