M.G. Science Institute (Autonomous) B.Sc. (Hons.) Mathematics

MAE 354 T: operation research-1

Semester: V	Course Title: operation research-1	Credit: 4
Course No.: 354 T	MINOR (T)	Hours: 4/week

COs with cognitive Abilities:

CO1	**REMEMBERING**	Students will be able to recall and define basic concepts such as convex sets, convex combinations, extreme points, and fundamental theorems of convexity.
CO2	**UNDERSTANDING**	Students will be able to explain the formulation techniques of linear programming problems and interpret different types of LPP through examples.
CO3	**APPLYING**	Students will be able to apply the Simplex Method, Big-M (Penalty) Method, and Dual Simplex Method to obtain optimal solutions of linear programming problems.
CO4	**ANALYZING**	Students will be able to analyze primal and dual relationships, interpret solutions of dual problems, and examine project networks using PERT and CPM to identify critical paths and floats.
CO5	**EVALUATING**	Students will be able to evaluate strategies in two-person zero-sum games using maximin and minimax principles, dominance rules, and compare different solution methods.
CO6	**CREATING**	Students will be able to construct and solve complex game theory models (2×n and 3×3 games) and develop approximate solutions using iterative and advanced methods.

Unit	Detailed Syllabus	No. of Hours of Teaching
I	Convex set, Extreme points of a convex set, convex combination, Examples of Convex sets and Theorems on convexity. Formulation techniques of LP problems (Only Examples). Simplex method for solving LPP, Big-M (Penalty) method	15

II	Introduction, Definition of the dual problem, General rules for converting any primal problem into it's dual, how to interpret the solution of the dual from its primal and vice versa, Comparison of the solution of the primal and its dual. Find initial solution for dual simplex table, Mathematical procedure to find solution by dual simplex method	15
III	Introduction, origin of PERT & CPM, applications of PERT & CPM, framework of PERT & CPM, construction of project network, dummy activities and events, rules for network construction, finding the critical path, concepts of float, total float and free float and its interpretations.	15
IV	Introduction, Two person zero-sum games, Maximin and Minimax Principles, Mixed strategies, expected pay-off, solution of 2x2 mixed strategy game, solution of mixed strategy game by the method of oddments, Dominance Principle, solution of mixed game by matrix method, solution of a two person zero-sum 2 x n game, Algebraic method for solving a game, solution of 3 x 3 games with mixed strategy by the method of oddments, Iterative method for approximate solution.	15

Suggested Reference Books:

1. Mathematical models in O.R. - J. K. Sharma,Tata-MacGraw Hills book-company.
2. Operations Research – Nita H Shah, Ravi Gor and Hardik Soni. PHI – Learning.
3. Optimization method in O.R. & System Analysis - K. V. Mittal, New Age inter. Publishers.
4. Operation Research - S. D. Sharma, Kedarnath Ramnath & Co.
5. Operation Research - Kanti Swaroop & Man Mohan, Sultan Chand & Co.
6. Linear Programming - L. I. Gass, Tata MacGraw Hills book-company.
7. Linear Programming - G. Hadley, Narosa Publishing house.
8. Operation Research- A. M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education.
9. Operations Research by J. K. Sharma.
10. Operations Research by S. D. Sharma.
11. Operations Research by Man Mohan, Kanti Swaroop and P. K. Gupta

MAE 355 P: Mathematics Minor Practical

Semester: V	Course Title:	Credit: 4
Course No.: 355 P	MINOR (P)	Hours: 8/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Recall and define the fundamental concepts of graph theory such as order, size, degree, completeness, and connectedness of graphs.
CO2	UNDERSTANDING	Explain the construction and interpretation of adjacency and incidence matrices, and identify walks, paths, and cycles in given graphs.
CO3	APPLYING	Apply algorithms such as Breadth First Search (BFS), Backtracking, and Dijkstra's algorithm to find shortest paths in connected and weighted graphs.
CO4	ANALYSING	Analyze graph connectivity using adjacency matrices and fusion algorithms; differentiate between connected and disconnected graphs based on algorithmic results.
CO5	EVALUATING	Evaluate the correctness and efficiency of graph algorithms such as Prim's, Kruskal's, and Fleury's, and determine minimal spanning trees or Euler tours.
CO6	CREATING	Design and implement new graph-based models or algorithms to solve real-world network and optimization problems, demonstrating innovation and critical thinking.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3			
CO 2	3	3	3		
CO 3		3	3	3	
CO 4	3	3		3	
CO 5		3	3	3	3
CO 6			3	3	3

(Manual/Computer)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Verification of convex sets and determination of extreme points with graphical examples.	5
2.	Formation of convex combinations and illustrating theorems on convexity.	5
3.	Formulation of Linear Programming Problems (LPP) from real-life situations.	5
4.	Solution of LPP using the Simplex Method (with at least two variables).	5

5.	Application of the Big-M (Penalty) Method to solve LPP with ≥ or = constraints.	5
6.	Application of the Two-Phase Method to solve degenerate Linear Programming Problems.	5
7.	Formulation of the dual problem from a given primal problem.	5
8.	Conversion of different types of LPPs into their duals (maximization/minimization forms).	5
9.	Interpretation of the dual solution from the primal solution.	5
10.	Verification of complementary slackness conditions between primal and dual.	5
11.	Obtaining an initial solution for the Dual Simplex Method.	5
12.	Solving LPP using the Dual Simplex Method step-by-step.	5
13.	Construction of a project network from a given activity list (with and without dummy activities).	5
14.	Application of rules for network construction and event numbering.	5
15.	Determination of the Critical Path of a project network.	5
16.	Calculation of Total Float, Free Float, and Independent Float of activities.	5
17.	PERT analysis: estimation of project duration using optimistic, pessimistic, and most likely times.	5
18.	Application-based case study: Solving a real-life scheduling problem using PERT/CPM.	5
19.	Solving a two-person zero-sum game using Maximin and Minimax principles.	5
20.	Solution of a 2×2 mixed strategy game by the method of oddments.	5
21.	Application of the Dominance Principle to reduce a payoff matrix.	5
22.	Solving a 2×n or m×2 game using the Matrix Method.	5
23	Solution of a 3×3 mixed strategy game using the Method of Oddments.	5
24.	Iterative Method for approximate solution of games without a saddle point.	5