D2AMT2405 **(2 Pages)** **Name.....**
Reg.No.....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2025
(Regular/Improvement/Supplementary)

MATHEMATICS
FMTH2C10: OPERATIONS RESEARCH

Time: 3 Hours **Maximum Weightage: 30**

Part A: Answer *all* questions. Each carries 1 weightage.

1. Prove that the sum of two convex function is again a convex function.
2. Define basic feasible solution in linear programming problem.
3. Write the dual of the linear programming problem:
   Maximise $x_1 + 6x_2 + 4x_3 + 6x_4$
   subject to $2x_1 + 3x_2 + 17\,x_3 + 80x_4 \leq 48,\quad 8\,x_1 + 4x_2 + 4x_3 + 4x_4 = 2,$
   $x_1, x_2 \geq 0$ and x_3 and x_4 are unrestricted in sign.
4. What are simplex multipliers in a linear programming problem?
5. What is meant by degeneracy in transportation problem?
6. Define transportation matrix. Write an example for transportation matrix.
7. Prove that the Maximum flow in a graph is equal to the minimum of the capacities of possible cuts in it.
8. Explain the terms: mixed strategy, pure strategy, and optimal strategy, with reference to any matrix game.

(8 × 1 = 8 weightage)

Part B: Answer any *two* questions from each unit. Each carries 2 weightage.

Unit 1

9. State and prove necessary and sufficient conditions for a differentiable function $f(x)$ defined in a convex domain to be a convex function.
10. Prove that a vertex of the convex set of feasible solution is a basic feasible solution.
11. Explain briefly the Simplex Algorithm for solving linear programming problem.

Unit 2

12. Prove that the optimal value of the Primal if it exists is equal to the optimum value of the dual.

(P.T.O.)

13. State and prove complementary slackness conditions.
14. Prove that the transportation array has a triangular basis.

Unit 3

15. State and prove fundamental theorem of rectangular games.
16. Define Spanning tree of a graph. Describe an algorithm for finding the spanning tree of minimum length of a graph.
17. Describe cutting plane method to solve an integer linear programming problem.

(6 × 2 = 12 weightage)

Part C: Answer any *two* questions. Each carries 5 weightage.

18. a) What is meant by canonical form of equations?

    b) Maximize $f(x) = 5x_1 + 3x_2 + x_3$ subject to constrains $2x_1 + x_2 + x_3 = 3$; $-x_1 + 2x_3 = 4$; $x_1, x_2, x_3 \geq 0$.

19. a) Solve the transportation problem for minimum cost with cost coefficients demands and supplies as in the following table.

	D_1	D_2	D_3	D_4	
O_1	3	2	5	4	25
O_2	4	1	7	6	35
O_3	7	8	3	5	30
	10	18	20	42	

    b) What is Caterer Problem in Operation Research?

20. a) Describe the branch and bounded method in integer linear programming problem. Illustrate with an example.

    b). What is meant by Mixed integer linear programming problem?

21. a) Solve graphically the game, whose pay-off matrix is $\begin{bmatrix} 1 & -1 & 2 \\ 2 & 3 & 1 \end{bmatrix}$.

    b) State and prove mini max theorem in theory of games.

(2 × 5 = 10 weightage)