Reg. No .... Name **24P169**

M.Sc. DEGREE END SEMESTER EXAMINATION - NOVEMBER 2025

SEMESTER 1 : MATHEMATICS

COURSE : 24P1MATT05 : OPTIMIZATION TECHNIQUES

(For Regular - 2025 Admission and Improvement/Supplementary 2024 Admission)

Time : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1. Define spanning Tree of a Graph. (U, CO 3)
2. What are the methods used to solve unconstrained non- linear programming problem ? (R, CO 1)
3. Explain fixed charge problem. (R, CO 2)
4. Explain Lagrange multipliers. (R, CO 4)
5. State sufficient and necessary condition for a function to be maximum. (R, CO 4)
6. Find the dual of the primal (A, CO 1)

$$\begin{aligned} \text{Minimize} \quad & 2x_1 + 3x_2 \\ \text{subject to} \quad & 3x_1 + 45x_2 \le 1 \\ & 2x_1 + x_2 = 17 \\ & 8x_1 + 2x_2 \ge 10 \\ & x_1, x_2 \ge 0 \end{aligned}$$

7. Define graph and directed graph. (R, CO 3)
8. In a Branch-and-Bound problem, if $X_1 = 5$ and $X_2 = 3.7$, then which variable would be a possible branching option and how? (U, CO 2)
9. Explain a cut? (U, CO 3)
10. Define Simplex Multipliers (R, CO 1)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11. Minimize $f(x) = 3x_1^2 + x_2^2 + 2x_1x_2 + 6x_1 + 2x_2$ subject to $2x_1 - x_2 = 4.$ (A, CO 4)
12. Describe the maximum flow algorithm. (U, CO 3)
13. Show that if $\{x_i\}$ and $\{y_i\}$ are two flows in a graph, then $\{ax_i + by_i\}$, where a and b are real constants, is also a flow. (U, CO 3)
14. Solve graphically, (U, CO 2)

$$\begin{aligned} \text{Maximize} \quad & z = x + 2y \\ \text{subject to,} \quad & 3x + 2y \le 9 \\ & x \le 2 \\ & x, y \ge 0 \text{ and integers.} \end{aligned}$$

15. Prove that the value of the objective function f(X) for any feasible solution of the primal is not less than the value of the objective function ϕ(Y) for any feasible solution of dual. (U, CO 1)

16. Solve the following problem using cutting plane method (Cr)

$$\begin{aligned} \text{Maximize} \quad & z = x_1 + x_2 \\ \text{subject to} \quad & 2x_1 + 5x_2 \leq 16 \\ & 6x_1 + 5x_2 \leq 30 \\ & x_1, x_2 \geq 0 \end{aligned}$$

17. Discuss Taylors series development in two dimensions and hence state the sufficient condition for minimum. (U, CO 4)

18. What can be concluded regarding the solution of the problem Max $f(x) = 3x_1 + 4x_2$ subject to $4x_1 + 3x_2 \geq 12, x_1 + 2x_2 \leq 2$, $x_1, x_2 \geq 0$. (A, CO 1)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. Describe 0 - 1 variable programming. (U, CO 2)

20. Use two phase method to solve (A, CO 1)
Max $z = x_1 + x_2$ subject to
$7x_1 - 6x_2 \leq 5,$
$6x_1 + 3x_2 \geq 7$
$-3x_1 + 8x_2 \leq 6$
x_1, x_2 are non negative .

21. Find the minimum path from v_0 to v_8 in the graph in which the number along a directed arc denotes its length. (U, CO 3)

Arc	(0,1)	(1,4)	(4,7)	(7,4)	(0,2)	(0,3)	
Length	2	10	3	2	6	8	
Arc	(1,5)	(1,2)	(2,5)	(5,4)	(5,7)	(2,3)	(3,5)
Length	8	3	1	1	5	1	2
Arc	(3,6)	(6,7)	(7,6)	(6,8)	(7,8)		
Length	2	6	1	7	10		

22. Solve the problem through classical Lagrangian technique. (A, CO 4)
(a) Minimize $f(x) = x_1^2 + x_2^2 - 4x_1 + 2x_2 + 5$ subject to $g(x) = x_1 + x_2 = 4.$
(b) Minimize $f(x) = (x_1 - 2)^2 + (x_2 - 1)^2$ subject to $g(x) = x_1 - 2x_2 + 1 = 0.$

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	Apply simplex method to solve Linear Programming problem.	U	2, 6, 10, 15, 18, 20	12
CO 2	Evaluate optimal solution of ILPP by cutting plane and branch and bound method	A	3, 8, 14, 19	9
CO 3	Apply algorithm to find Goal programming, minimum path and maximum flow problem	A	1, 7, 9, 12, 13, 21	12
CO 4	Solve non linear problem with different algorithm	A	4, 5, 11, 17, 22	11

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;