24U3100 (Pages: 4) Name : .....

Reg. No : .....

THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025

(FYUGP)

CC24UMAT3MN205 - OPTIMIZATION TECHNIQUES

(Mathematics - Minor Course)

(2024 Admission - Regular)

Time: 2.0 Hours Maximum: 70 Marks

Credit: 4

Part A (Short answer questions)

Answer ***all*** questions. Each question carries 3 marks.

1. Write the Canonical form of a minimization Linear Programming Problem with 3 variables and 3 constraints. [Level:2] [CO1, CO2]

2. Give any three basic assumptions required for the formulation of a linear programming model. [Level:2] [CO1]

3. Reduce the following LP problem to the standard form, [Level:2] [CO1]

$$\begin{aligned} \text{Minimize} \quad & Z = 2x_1 + x_2 + 3x_3 \\ \text{Subject to} \quad & -5x_1 + 2x_2 \leq 5 \\ & 3x_1 + 2x_2 + 4x_3 \geq 7 \\ & 2x_1 + 5x_3 \leq 3 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

4. Introducing Slack, Surplus and Artificial variables, wherever it is required, obtain an initial basic feasible solution for the Big M method [Level:2] [CO1, CO3]

$$\begin{aligned} \text{Minimize} \quad & Z = 25x + 20y \\ \text{Subject to} \quad & 16x + 12y \geq 100 \\ & 8x + 16y \geq 80 \\ & x, y \geq 0 \end{aligned}$$

5. What do you meant by the two-phase method for solving a given LP problem? Why is it used? [Level:2] [CO3]

6. Define a balanced transportation problem. [Level:2] [CO4]

7. Write a short note on Degeneracy in LP problems. [Level:2] [CO1]

8. Consider the Transportation Problem, [Level:3] [CO4]

	Destinations				Supply
	D_1	D_2	D_3	D_4	
P	21	16	25	13	11
Source Q	17	18	14	23	13
R	32	27	18	41	19
Demand	6	10	12	15	

Express it as a linear programming problem.

9. Consider the Transportation Problem, [Level:3] [CO4]

	Destinations					Supply
	I	II	III	IV	V	
P	20	28	32	55	70	50
Source Q	48	36	40	44	25	100
R	35	55	22	45	48	150
Requirement	100	70	50	40	40	

Determine whether the solution

$x_{11} = 50, x_{22} = 70, x_{25} = 30, x_{31} = 50, x_{33} = 50, x_{34} = 40, x_{35} = 10$ is optimal?

10. Obtain an initial basic feasible solution using North West Corner Method, [Level:3] [CO4]

	Destinations			Supply
	A	B	C	
A	7	6	9	20
Source B	5	7	3	28
C	4	5	8	17
Demand	21	25	19	

(Ceiling: 24 Marks)

Part B (Paragraph questions/Problem)

Answer ***all*** questions. The question carries 6 marks.

11. A firm manufactures headache pills in two sizes A and B. Size A contains 2 grains of aspirin, 5 grains of bicarbonate and 1 grain of codeine. Size B contains 1 grain of aspirin, 8 grains of bicarbonate and 6 grains of codeine. It is found by users that it requires at least 12 grains of aspirin, 74 grains of bicarbonate and 24 grains of codeine for providing immediate effect. It is required to determine the least number of pills a patient should take to get immediate relief. Formulate the problem as a linear programming model. [Level:3] [CO1, CO2]

12. [Level:3] [CO2]

Solve graphically

$$\begin{aligned} \text{Maximize} \quad & Z = x + y \\ \text{Subject to} \quad & x + 2y \leq 2000 \\ & x + y \leq 1500 \\ & y \leq 600 \\ & x, y \geq 0 \end{aligned}$$

13. Show that [Level:3] [CO1, CO2]

$$\begin{aligned} \text{Maximize} \quad & Z = 3a + 2b \\ \text{Subject to} \quad & a - b \leq 1 \\ & a + b \geq 3 \\ & a, b \geq 0 \end{aligned}$$

is unbounded.

14. A simplex table associated with a given maximization LP problem is given by [Level:3] [CO2]

Basic variable	Profit Coefft	C_j RHS	6 x_1	8 x_2	0 S_1	0 S_2
S_1	0	80	20	0	1	-2
x_2	8	11	$\frac{1}{2}$	1	0	$\frac{1}{10}$
$C_j - Z_j$			2	0	0	$-\frac{4}{5}$

Determine whether the solution obtained is optimal. Give reasons. Also, if the present solution is not optimal, construct the next simplex table.

15. Obtain the optimal solution of the Phase One problem of (Phase One problem of Two Phase Method) [Level:3] [CO3]

$$\begin{aligned} \text{Maximize} \quad & Z = 5x_1 + 3x_2 \\ \text{Subject to} \quad & 2x_1 + x_2 \leq 1 \\ & x_1 + 4x_2 \geq 6 \\ & x_1, x_2 \geq 0 \end{aligned}$$

16. Obtain an initial basic feasible solution using Minimum Cost Cell Method, [Level:3] [CO4]

	Destinations I	II	III	IV	V	Capacity
P	3	4	6	8	8	20
Source Q	2	10	0	5	8	30
R	7	11	20	40	3	15
S	1	0	9	14	16	13
Demand	40	6	8	18	6	

17. Five jobs are to be assigned to 5 machines to minimize the total time required to process the jobs on machines. The times in hours for processing each job on each machine are given in the matrix below. By using assignment algorithm make the assignment for minimizing the time of processing. [Level:3] [CO5]

	I	II	III	IV	V
P	2	4	3	5	4
Q	7	4	6	8	4
R	2	9	8	10	4
S	8	6	12	7	4
T	2	8	5	8	8

18. Obtain an initial basic feasible solution using Vogel's Approximation Method. [Level:3] [CO4]

	Destinations					Supply
	I	II	III	IV	V	
P	20	28	32	55	70	50
Source Q	48	36	40	44	25	100
R	35	55	22	45	48	150
Demand	100	70	50	40	40	

(Ceiling: 36 Marks)

Part C (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

19. Solve using Simplex Method, [Level:3] [CO2]

$$\begin{aligned} \text{Minimize} \quad & Z = x - 3y + 2z \\ \text{Subject to} \quad & 3x - y + 3z \leq 7 \\ & -2x + 4y \leq 12 \\ & -4x + 3y + 8z \leq 10 \\ & x, y, z \geq 0 \end{aligned}$$

20. Solve the transportation problem for minimum cost, [Level:3] [CO4]

	Destinations			Supply
	I	II	III	
P	5	7	8	70
Source Q	4	4	6	30
R	6	7	7	50
Requirement	65	42	43	

(1 × 10 = 10 Marks)

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