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D5BMT2305 **Reg. No.....**

Name: .....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2025

(Regular/Improvement/Supplementary)

MATHEMATICS

GMAT5B09T: LINEAR PROGRAMMING

Time: 2 Hours **Maximum Marks: 60**

SECTION A: Answer the following questions. Each carries *two* marks.

(Ceiling 20 marks)

1. Convert the linear programming problem below to the canonical form.

   Minimize $f(x, y) = 2x + 5y - z$

   subject to $x - 4y + 3z \geq 20$

   $y + 4z \leq 25$

   $x, y, z \geq 0$

2. Give an example of a convex set in $\mathbb{R}^2$ that has no extreme points.
3. Define basic feasible solution for a balanced transportation problem.
4. Draw and shade appropriate region in $\mathbb{R}^2$ of an unbounded convex subset having exactly one extreme point.
5. Reformulate the given canonical minimization linear programming problem as canonical slack minimization linear programming problem.

   Minimize $f(x, y, z) = 20x + 30y + 25z$

   subject to $x + 2y + 2z \geq 200$

   $2x + 2y + z \geq 150$

   $x, y, z \geq 0.$
6. Draw the Tucker tableau of the given problem.

   Maximize $f(x, y) = 7x + 8y - 9$

   subject to $x + 2y \leq 3$

   $4x + 5y \geq 6$

   $x, y \geq 0$
7. When do you say a tableau is minimum basic feasible?
8. Define canonical maximization linear programming problem.
9. If the canonical maximization linear programming problem is unbounded, what can you say about its dual?

(PTO)

10. Explain unbalanced transportation problem.
11. Write the balanced assignment problem
12. Define permutation set of zeros.

SECTION B: Answer the following questions. Each carries *five* marks.

(Ceiling 30 marks)

13. A publishing firm prints two magazines, the Monitor and the Recorder, each in units of one hundred. Each unit of the Monitor requires 1 unit of ink, 3 units of paper, and 4 hours of printing press time to print; each unit of the Recorder requires 2 units of ink, 3 units of paper, and 5 hours of printing press time to print. The firm has 20 units of ink, 40 units of paper, and 60 hours of printing press time available. If the profit realized upon sale is \$200 per unit of the Monitor and \$300 per unit of the Recorder, how many units of each magazine should the firm print so as to maximize profits?
    a) Convert the above problem to the canonical form.
    b) Define the constraint set.
    c) Write a feasible solution.
14. Maximize $f(x, y) = 7x + 8y - 9$

    subject to $x + 2y \leq 3$

    $4x + 5y \leq 6$

    $x, y \geq 0$

    a) Draw the Tucker tableau of the given problem.
    b) Pivot on 4 in the Tucker tableau.
15. Solve the dual canonical linear programming problem given below:

	x_1	x_2	-1	
y_1	1	2	20	$= -t_1$
y_2	2	2	30	$= -t_2$
y_3	2	1	25	$= -t_3$
-1	200	150	0	$= f$
	$= s_1$	$= s_2$	$= g$	

16. A manufacturer of widgets owns three warehouses and sells to three markets. The supply of each warehouse, the demand of each market, and the shipping cost per ton of widgets from each warehouse to each market are as follows:

	Market 1	Market 2	Market 3	
Warehouse 1	\$2/ton	\$1/ton	\$2/ton	40 tons
Warehouse 2	\$9/ton	\$4/ton	\$7/ton	60 tons
Warehouse 3	\$1/ton	\$2/ton	\$9/ton	10 tons
	40 tons	50 tons	20 tons	110 tons

How should the manufacturer ship the widgets so as to minimize total transportation cost? Use VAM.

17. Use VAM to obtain a feasible solution.

8	2	3	7	42
9	4	5	6	17
7	1	6	5	17
9	14	24	29	

18. Use Hungarian algorithm to the given below assignment tableau to a tableau of nonnegative integers.

	J1	J2	J3	
P1	0.5	2	1	1
P2	1.2	1/6	7	1
P3	5/9	0	3.14	1
	1	1	1	

(PTO)

19. Use VAM to obtain a feasible solution.

5	9	10	6	4
10	7	5	4	5
4	5	5	4	2
6	5	7	5	3
3	4	4	3	

SECTION C: Answer any *one* question. The question carries *ten* marks.

20. Solve the problem below by sketching the constraint set and applying theorems.

Maximize $f(x, y) = 5x + 2y$

subject to $x + 3y \leq 14$

$2x + y \leq 8$

$x, y \geq 0.$

21. Solve using the dual simplex algorithm.

	X_1	X_2	-1	
Y_1	1	2	20	$= -t_1$
Y_2	2	2	30	$= -t_2$
Y_3	2	1	25	$= -t_3$
-1	200	150	0	= f
	$= s_1$	$= s_2$	= g	

(1 x 10 = 10 Marks)