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D3BMC2306 **Reg. No.....**

Name: .....

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2024

(Regular/Improvement/Supplementary)

COMPUTER SCIENCE AND MATHEMATICS (DOUBLE MAIN)

GDMA3B05T: LPP AND APPLICATIONS

Time: 2 ½ Hours **Maximum Marks: 80**

SECTION A: Answer the following questions. Each carries *two* marks.
(Ceiling 25 marks)

1. Find the Norms of the following in $\mathbb{R}^4$.
   (a)$(1,7,-2,3)$ (b) $(-1,2,-2,-2)$
2. Write the following as a Canonical Maximization LPP.
   Maximize; $f(x,y) = x + y$
   Subject to,
   $x - y \geq 3$
   $2x + y \leq 12$
   $0 \leq x \leq 3$
   $0 \leq y \leq 5$
3. An animal feed company must produce at least 200 kgs of a mixture consisting of ingredients X_1 and X_2 daily. X_1 costs Rs.3 per kg and X_2 costs Rs.8 per kg. No more than 80 kgs of X_1 can be used and at least 60 kgs of X_2 must be used.
   Formulate a mathematical model to the problem.
4. Write the general form of canonical slack minimization LPP.
5. Comment on the LPP's feasible solution.
6. Construct the Tucker tableau for the problem.
   Maximize; $f(x,y) = 5x - 8y$
   Subject to,
   $-x - 3y \leq -3$
   $4x - 7y \leq 3$
   $5x - y \leq -2$
   $x, y \geq 0$
7. Pivot on the element 3 for the following canonical minimum tableau:

x_1	-1	1	5
x_2	1	3	10
x_3	2	5	-2
-1	1	9	10
	$= t_1$	$= t_2$	$= g$

(PTO)

8. How can we find a basic solution of an LPP?
9. Define a Dual canonical LPP.
10. Write the dual of the following canonical LPP.

    Minimize; $g(x_1, x_2) = 15x_1 + 20x_2$

    Subject to,

    $3x_1 + x_2 \geq 6$

    $7x_1 - 2x_2 \geq 1$

    $x_1 + 3x_2 \geq 4$

    $x_1, x_2 \geq 0$
11. Write the Matrix form of a canonical maximization LPP.
12. Write the tableau of dual LPP of the following minimization tables`au:

y_1	4	3	0
y_2	2	-5	-4
-1	3	2	0
	$= s_1$	$= s_2$	$= g$

13. Apply north-west corner rule to the following transportation problem to find a basic feasible solution:

	M_1	M_2	M_3	Supply
W_1	1	4	6	14
W_2	4	2	5	16
W_3	3	1	8	10
W_4	9	4	2	19
Demand	10	21	28	

14. Obtain a basic feasible solution for the following transportation problem:

	D_1	D_2	D_3	Supply
O_1	5	17	10	144
O_2	11	3	8	178
O_3	13	4	18	128
Demand	120	200	130	

15. Define a cycle in a transportation tableau. Give an example.

SECTION B: Answer the following questions. Each carries *five* marks.
(Ceiling 35 marks)

16. Solve the following LPP by graphical method:
    Maximize; $f(x, y) = x + y$
    Subject to,
    $x - y \leq 3$
    $2x + y \leq 12$
    $0 \leq x \leq 4$
    $0 \leq y \leq 6$
17. 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 profit? Formulate the corresponding LPP and solve it by graphical method.
18. Solve the LPP represented by the following tableau using Simplex algorithm:

x	x	-2	1	-3
y	y	1	-2	-2
-1	-1	1	0	0
		$= t_1$	$= t_2$	$= g$

19. Solve the LPP represented by the following tableau:

x	x	y	-1	
3	3	2	1	$=-t_1$
-9	-9	-2	0	$=-t_2$
3	3	1	0	$=-t_3$
3	3	2	1	$=f$

20. Apply Simplex algorithm to solve the LPP represented by the following tableau:

x_1	x_2	-1	
-1	-1	-3	$=-t_1$
1	1	2	$=-t_2$
2	-4	0	$=f$

21. State the duality equation. Prove that for any pair of feasible solutions of dual canonical LPP, we have $g \geq f$.
22. Prove that "If a canonical minimization linear programming problem is unbounded, then the dual canonical maximization linear programming problem is infeasible".

(PTO)

23. Solve the following assignment problem:

	J_1	J_2	J_3	J_4	J_5
P_1	8	6	3	5	10
P_2	2	4	3	5	4
P_3	5	7	5	4	3
P_4	6	9	2	4	2
P_5	4	6	5	3	6

SECTION C: Answer any *two* questions. Each carries *ten* marks.

24. A feed-mix company is preparing a mixture of three feeds, say feed I, feed II and feed III. Each unit of feed I contains 1 gram of protein, 2 grams of fat, and costs 20 cents; each unit of feed II contains 2 grams of protein, 2 grams of fat, and costs 30 cents; each unit of feed III contains 2 grams of protein, 1 gram of fat, and costs 25 cents. If the mixture of these three feeds must contain at least 200 grams of protein and at least 150 grams of fat, how many units of each feed should the company use so as to minimize costs? Formulate the above problem as linear programming problem and solve it using simplex method.

25. State and prove the Duality theorem.
26. Find a basic feasible solution by minimum entry method and solve the following transportation problem:

	D_1	D_2	D_3	D_4	Supply
O_1	1	2	3	4	6
O_2	4	3	2	0	8
O_3	0	2	2	1	10
Demand	4	6	8	6	

27. Use the Hungarian algorithm to solve the balanced assignment problem below:

1.1	$^{17}/_{10}$	$^{4}/_{5}$	1.6	2
0.9	0.7	1.2	$^{3}/_{5}$	$^{3}/_{2}$
$^{13}/_{10}$	$^{16}/_{10}$	1.5	$^{6}/_{5}$	1.6
2.1	$^{12}/_{5}$	1.7	$^{14}/_{5}$	2.6
1.4	1	$^{6}/_{5}$	$^{11}/_{10}$	$^{3}/_{2}$

(2 x 10 = 20 Marks)