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D 110215 (Pages : 4) Name.......................................

Reg. No...................................

FIFTH SEMESTER (CBCSS–UG) DEGREE EXAMINATION, NOVEMBER 2024

Mathematics

MTS 5D 03—LINEAR MATHEMATICAL MODELS

(2020 Admission onwards)

Time : Two Hours Maximum : 60 Marks

Section A

Short answer type.
All questions can be answered.
Each question carries 2 marks.
(Ceiling 20).

1. Find the equation of the line through (0, -3) and having slope $\frac{3}{4}$.

2. Find k such that the line through (4, –1) and (k, 2) is perpendicular to $5x - 2y = -1$.

3. Solve the following system of equations :

$$\begin{aligned} 3x + 10y &= 115 \\ 11x + 4y &= 95 \end{aligned}$$

4. Let $B = \begin{bmatrix} 2 & 3 & -2 \\ 2 & 4 & 0 \\ 0 & 1 & 2 \end{bmatrix}$ and $D = \begin{bmatrix} 6 \\ 1 \\ 0 \end{bmatrix}$. Find BD.

5. Find the values of the variables in the equation $\begin{bmatrix} s-4 & t+2 \\ -5 & 7 \end{bmatrix} = \begin{bmatrix} 6 & 2 \\ -5 & r \end{bmatrix}$.

6. Graph the linear inequality $2x - 3y \leq 12$

7. Graph the feasible region for the following system of inequalities and tell whether the region is bounded or unbounded :

$$\begin{aligned} x + y &\leq 1 \\ x - y &\geq 2 \end{aligned}$$

Turn over

8. Identify all variables used and express the statement given below as linear inequaliti[...] Wong spends 3 hours selling a small computer and 5 hours selling a larger model. Sh[...] more than 45 hours per week.

9. Restate the following linear programming problem by introducing slack variables.

Maximize $z = 3x_1 = 2x_2 + x_3$

subject to $z = 3x_1 = 2x_2 + x_3$

$$2x_1 + x_2 + x_3 \le 150$$
$$2x_1 + 2x_2 + 8x_3 \le 200$$
$$2x_1 + 3x_2 + x_3 \le 320$$
with $x_1 \ge 0, x_2 \ge 0, x_3 \ge 0.$

10. Write the solution that can be read from the following simplex tableau :

x_1	x_2	x_3	s_1	s_2	z	
1	5	0	1	2	0	6
0	2	1	2	3	0	15
0	4	0	1	-2	1	64

11. What is a standard minimum form of a linear programming problem ?

12. Write the dual of the following linear programming problem:

Maximize $z = 2x_1 + 5x_2$

subject to $x_1 + x_2 \le 10$

$$2x_1 + x_2 \le 8$$
with $x_1 \ge 0, x_2 \ge 0$

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Section B

Paragraph / Problem type.
All questions can be answered.
Each question carries 5 marks.
(Ceiling 30).

13. Producing x units of tacos costs $C(x) = 5x + 20$, revenue is $R(x) = 15x$ where C (x) and R (x) are in dollars.

    a) What is the break-even quantity ?

    b) What is the profit from 100 units ?

    c) How many units will produce a profit of \$500 ?

14. Using Gauss-Jordan method to solve :

$$2x - 2y = -5$$
$$2y + z = 0$$
$$2x + z = -7$$

15. Find the inverse of $A = \begin{bmatrix} 2 & -5 & 7 \\ 4 & -3 & 2 \\ 15 & 2 & 6 \end{bmatrix}$.

16. Explain briefly solving a linear programming problem by the graphical method.

17. A 4 – H member raises only goats and pigs. She wants to raise no more than 16 animals, including no more than 10 goats. She spends \$25 to raise a goat and \$75 to raise a pig, and she has \$900 available for this project. Each goat produces \$12 in profit and each pig \$40 in profit. How many goats and how many pigs should she raise to maximize total profit ?

18. Using simplex method solve the linear programming problem whose initial tableau is given below.

x_1	x_2	x_3	s_1	s_2	s_3	z	
2	1	2	1	0	0	0	25
4	3	2	0	1	0	0	40
3	1	6	0	0	1	0	60
-4	-2	-3	0	0	0	1	0

19. Explain how to solve non-standard problems.

(Ceiling 30)

Turn over

Section C

Essay type

Answer any **one** *of the following questions.*
The question carries 10 marks.

20. Solve the following system of equations by using inverse of the co-efficient matrix :

$$x - 2y + 3z = 4$$
$$y - z + w = -8$$
$$-2x + 2y - 2z + 4w = 12$$
$$2y - 3z + w = -4$$

21. Solve using artificial variables :

maximize $z = 3x_1 + 2x_2$

subject to $x_1 + x_2 = 50$

$$4x_1 + 2x_2 \geq 120$$
$$5x_1 + 2x_2 \leq 200$$

with $x_1 \geq 0, x_2 \geq 0$

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