22U511 (Pages: 3) Name: ……………………….

Reg. No: ………………….

FIFTH SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2024

(CBCSS-UG)

(Regular/Supplementary/Improvement)

CC20U MTS5 D03 – LINEAR MATHEMATICAL MODELS

(Mathematics – Open Course)

(2020 Admission onwards)

Time: 2 Hours Maximum: 60 Marks

Credit: 3

Section A

Answer ***all*** questions. Each question carries 2 marks.

1. Find the slope of the line through the origin and $(11,-2)$
2. Write the equation of the line through $(3,-4)$ and perpendicular to $x+y=4$.
3. Use the echelon method to solve the following system of two equations in two unknowns $12s-5t=9,\ 3s-8t=-18$.
4. Write the augmented matrix for the following system.
$$x-y+5z=-6,\qquad 3x+3y-z=10,\qquad x+3y+2z=5$$
5. Replace R_1 by $R_1+(-3)R_2$ for the matrix $A=\begin{pmatrix}1 & 0 & 1\\ 2 & -2 & -1\\ 3 & 0 & 0\end{pmatrix}$
6. Find values of the variables for the matrix equation
$$\begin{bmatrix}9 & 7\\ 6-q & p\end{bmatrix}=\begin{bmatrix}m-3 & n+5\\ 8 & 2\end{bmatrix}$$
7. Draw the graph of the line $4x-3y=12$
8. Graph the linear inequality $x-4y>4$
9. Happy Ice Cream Cone Company makes cake cones and sugar cones, both of which must be processed in the mixing department and the baking department. Manufacturing one batch of cake cones requires 1 hour in the mixing department and 2 hours in the baking department, and producing one batch of sugar cones requires 2 hours in the mixing department and 1 hour in the baking department. Each department is operated for at most 12 hours per day. Write a system of inequalities that expresses these restrictions.
10. State corner point theorem
11. Consider the following linear programming problem
Maximize $Z=57x_1+37x_2$, subject to $6x_1+4x_2\le 24,\ 5x_1+8x_2\le 66,\ 9x_1+2x_2\le 26,\ x_1,x_2\ge 0$ determine the number of slack variables needed, name them, and use slack variables to convert the constraints it into linear equations.

 Turn Over

12. Find the inverse of the matrix if it exists, $\begin{bmatrix} 4 & 8 \\ 2 & 4 \end{bmatrix}$

(Ceiling: 20 Marks)

Section B

Answer ***all*** questions. Each question carries 5 marks.

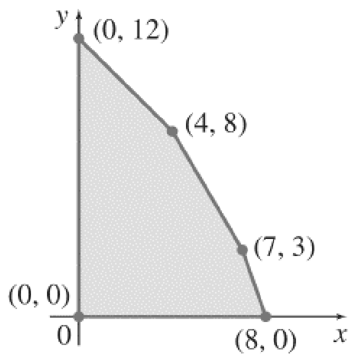
13. Graph the feasible region for each system of inequalities. Tell whether each region is bounded or unbounded.

(a) $x + y \leq 1,\ x - y \geq 2$

(b) $-x - y < 5,\ 2x - y < 4$

14. The following graph shows region of feasible solutions. Use these regions find maximum and minimum values of the given objective functions.

$(a)\ z = \ 0.40x + 0.75y\,,\qquad (b)\ z = 1.50x + 0.25y$



15. Write the initial simplex tableau for the following linear programming problem.

Maximize $7x_1 + x_2$ subject to $4x_1 + 2x_2 \leq\ 5, x_{\ 1} + 2x_2 \leq 4,\ \ x_1, x_2 \geq 0$

16. Use the Gauss-Jordan method to solve $3x - 4y = 1,\ 5x + 2y = 19$

17. Observe that the operation 'matrix multiplication' is not commutative by taking two 3×3 matrices.

18. Use slopes to show that the square with vertices at $(-2,5), (4,5), (4,-1), (-2,-1)$ has diagonals that are perpendicular.

19. Write the dual of the following primal linear programming problem. Show that dual of the dual is primal.

$Minimize\ w = 7y_1 + 5y_2 + 8y_3$ subject to

$$3y_1 + 3y_2 + y_3 \geq 10, 4y_1 + 5y_2 \geq 25, y_1, y_2 \geq 0$$

(Ceiling: 30 Marks)

Section C

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

20. 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?

21. Use inverse of the coefficient matrix solve

$2x + y = 1, \qquad 3y + z = 8, \qquad 4x - y - 3z = 8$

(1 × 10 = 10 Marks)

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