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SECOND SEMESTER (CUFYUGP) DEGREE EXAMINATION, APRIL 2026

MATHEMATICS

MAT2FM106 (1)/ MAT3FM106 (1)
Graph Theory and LPP

2024 Admissions

Maximum Time : 1.5 Hours	**Maximum Marks : 50**

Section A

All Questions can be answered. Each Question carries 2 marks (Ceiling : 16 Marks)

1	Find the number of edges in a complete graph K_{50}
2	Draw a 3-regular graph with exactly 5 edges
3	Define a walk in a graph. Is it true that"Every walk is a path "
4	Let G be an acyclic graph with 20 vertices and 5 connected components. Find its total number of edges
5	Draw a complete bipartite graph $K_{3,4}$ and and find $\kappa(K_{3,4})$.
6	Graph the linear inequality $x \leq y - 2$ and mark its boundary.
7	Graph the feasible region for the given system of inequalities. Write whether each region is bounded or unbounded. $4x - y < 6 \qquad 3x + y < 9$
8	What do you mean by basic variables
9	For the linear programming problem given below, determine the number of slack variables needed, name them, and use slack variables to convert each constraint into a linear equation. Minimize $z = 4x_1 - 5x_2 - x_3$ subject to: $5x_1 + 2x_2 + 4x_3 \leq 4 \qquad 2x_1 + 3x_3 \leq 7 \qquad x_3 \leq 8 \qquad x_1, x_2, x_3 \geq 0$
10	State the dual problem for the following linear programming problem Maximize $z = x_1 + 3x_2$ subject to: $3x_1 - x_2 \leq 5 \qquad x_1 - 2x_2 \leq 4 \qquad x_1, x_2 \geq 0$

Section B

All Questions can be answered. Each Question carries 6 marks (Ceiling : 24 Marks))

11	Let G be a $k-$regular graph, where k is an odd number. Prove that the number of edges in G is a multiple of k.
12	Let G be a graph with 4 connected components and 24 edges. What is the maximum possible number of vertices in G?
13	Solve the following linear programming problem. Minimize $z = 2x - 3y$ subject to: $x + 2y \leq 10 \qquad 3x + y \leq 9 \qquad x, y \geq 0$
14	Formulate a Linear Programming Problem for the case given below: A dietician is planning a snack package of fruit and nuts. Each ounce of fruit will supply zero units of protein, 2 units of carbohydrates, and 1 unit of fat, and will contain 20 calories. Each ounce of nuts will supply 3 units of protein, 1 unit of carbohydrate, and 2 units of fat, and will contain 30 calories. Every package must provide at least 6 units of protein, at least 10 units of carbohydrates, and no more than 9 units of fat. Find the number of ounces of fruit and number of ounces of nuts that will meet the requirement with the least number of calories. What is the least number of calories?
15	Introduce slack variables as necessary, then write the initial simplex tableau for the following linear programming problem. Maximize $z = 2x_1 - 3x_2$ subject to: $2x_1 - 3x_2 \leq 6 \qquad x_1 + 2x_2 \leq 4 \qquad x_1 + 3x_2 \leq 5 \qquad x_1, x_2 \geq 0$

Section C

Answer any ONE. Each Question carries 10 marks (1x10=10 Marks))

16	Prove that it is impossible to have a group of nine people at a party such that each one knows exactly five of the others in the group.
17	Solve by simplex method Maximize $z = 4x_1 + 6x_2$ subject to: $x_1 - 5x_2 \leq 25 \qquad 4x_1 - 3x_2 \leq 1 \qquad x_1, x_2 \geq 0$

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SECOND SEMESTER (CUFYUGP) DEGREE EXAMINATION, APRIL 2025

MATHEMATICS

MAT2FM106 (1) Graph Theory and LPP

2024 Admissions

Maximum Time : 1.5 Hours	**Maximum Marks : 50**

Section A

All Questions can be answered. Each Question carries 2 marks (Ceiling : 16 Marks)

1	Define adjacent edges and isolated edges
2	Draw a longest cycle in the complete bipartite graph $K_{4,5}$
3	Let T be a tree with 25 vertices. Find its total number of edges
4	Draw a complete graph K_5 and find $\kappa(K_5)$.
5	Define cut vertex of a graph. Find the number of cut vertex in th complete bipartite graph $K_{7,1}$.
6	Graph the linear inequality $2x + 3y \leq 12$ and mark its boundary.
7	Graph the feasible region for the given system of inequalities. Write whether each region is bounded or unbounded. $x + y \leq 1 \qquad x - y \geq 2$
8	Write as linear inequalities. Identify all variables used: "Product A requires 3 hours on a machine, while product B needs 5 hours on the same machine. The machine is available for at most 60 hours per week.".
9	Define slack variable. Give examples
10	For the linear programming problem given below, determine the number of slack variables needed, name them, and use slack variables to convert each constraint into a linear equation. Minimize $z = x_1 + 3x_2 - 4x_3$ subject to: $x_1 - 2x_2 - 2x_3 \leq 5 \qquad 2x_1 - x_2 \leq 10 \qquad x_1, x_2, x_3 \geq 0$

Section B

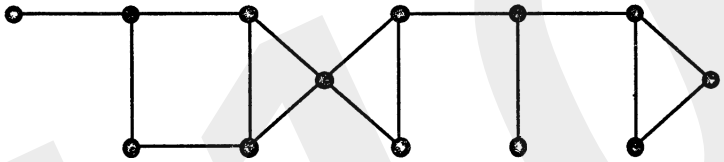
All Questions can be answered. Each Question carries 6 marks (Ceiling : 24 Marks))

11	Show that "In any graph G there is an even number of odd vertices."
12	Let G be a connected graph. (a) If G has 17 edges what is the maximum possible number of vertices in G? (b) If G has 21 vertices what is the minimum possible number of edges in G?
13	Let G be a graph with exactly one spanning tree. Prove that G is a tree.
14	Solve the following linear programming problem. Minimize $z = 2x + 4y$ subject to: $x + 2y \geq 10 \qquad 3x + y \geq 10 \qquad x, y \geq 0$
15	A health enthusiast wishes to mix two types of foods in his diet, in such a way that vitamin content of the mixture contains at least 10 units of vitamin B and 13 units of vitamin C. Food (F1) contains 1 unit/kg of vitamin B and 2 units/kg of vitamin C. Food (F2) contains 2 unit/kg of vitamin B and contains 1 unit/kg of vitamin C. F1 costs Rs 60/kg and F2 costs Rs 80/kg. Frame his diet plan making a linear programming problem in order to minimize the cost of the mixture.

Section C

Answer any ONE. Each Question carries 10 marks (1x10=10 Marks))

16	Solve by simplex method Maximize $z = 5x_1 + 2x_2$ subject to: $2x_1 + 5x_2 \leq 15 \qquad 3x_1 + x_2 \leq 10 \qquad x_1, x_2 \geq 0$

17	Let G be the graph as given below  (a) Find a closed walk of length 6. Is your walk a trail? (b) Find a closed trail of length 6. Is your trail a cycle? (c) What is the length of the longest cycle in G? (d) What is the length of a longest path in G?