LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **MATHEMATICS**

SIXTH SEMESTER – **NOVEMBER 2022**

UMT 6502 – OPERATIONS RESEARCH

Date: 03-12-2022 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

PART – A

Answer ALL questions **(10 x 2 = 20 Marks)**

1. Write the standard form of Linear programming problem.
2. Define optimal feasible solution in linear programming.
3. What is a slack variable in a linear programming problem?
4. Convert the following primal problem to dual problem.

   Maximize $z = 4x_1 + 3x_2$

   Subject to $2x_1 + x_2 \leq 10$; $x_1 \leq 4$; $x_2 \leq 7$ and $x_1, x_2 \geq 0$.
5. When do you say that a feasible solution of a transportation problem degenerate?
6. What is an unbalanced assignment problem?
7. Define payoff matrix in a game.
8. When is a game called as a two-person zero sum game?
9. What is dangling in a network?
10. Define a path, cycle and tree in a network.

PART – B

Answer any FIVE questions **(5 x 8 = 40 Marks)**

11. A company has two plants, each of which produces and supplies two products A, B. The plants can each work up to 16 hours a day. In plant 1, it takes 3 hours to prepare and pack 1000 gallons of A and 1 hour to prepare and pack 1 quintal of B. In plant 2, it takes 2 hours to prepare and pack 1000 gallons of A and 1.5 hours to prepare and pack 1 quintal of B. In plant 1 it costs Rs. 15,000 to prepare and pack 1000 gallons of A and Rs. 28,000 to prepare and pack 1 quintal of B, whereas in plant 2, these costs are Rs. 18,000 and Rs. 26,000 respectively. The company is obliged to produce daily at least 10,000 gallons of A and 8 quintals of B. Formulate this problem as an LP model to find out as to how the company should organize its production so that the required amounts of the two products be obtained at the minimum cost.

12. Solve the following linear programming problem graphically:

    Minimize $z = 20x_1 + 10x_2$ subject to $x_1 + 2x_2 \leq 40$; $3x_1 + x_2 \geq 30$; $4x_1 + 3x_2 \geq 60$ and $x_1, x_2 \geq 0$.

13. Use the simplex method to solve the following linear programming problem.

Maximize $Z = 5\,x_1 + 3x_2$ subject to the constraints

$$x_1 + x_2 \leq 2$$
$$5x_1 + 2x_2 \leq 10$$
$$3\,x_1 + 8x_2 \leq 12$$
$$\text{and} \quad x_1, x_2 \geq 0.$$

14. Determine an initial basic feasible solution to the following transportation problem by (a) North West Corner rule and (b) Least Cost method.

		Destination				
		D1	**D2**	**D3**	**D4**	**Supply**
Source	**S1**	21	16	13	3	11
	S2	17	18	14	23	13
	S3	32	27	18	41	19
	Demand	6	6	8	23	

15. Solve the following assignment problem.

		Persons				
		P1	**P2**	**P3**	**P4**	**P5**
Jobs	**J1**	10	5	13	15	16
	J2	3	9	18	13	6
	J3	10	7	2	2	2
	J4	7	11	9	7	12
	J5	7	9	10	4	12

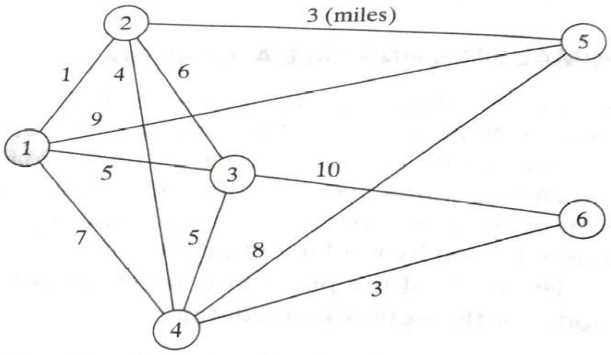
16. Solve the following game using graphical method.

$$\begin{array}{c} \\ Player\ A \end{array} \begin{array}{c} Player\ B \\ \begin{bmatrix} -6 & 7 \\ 4 & -5 \\ -1 & 2 \\ -2 & 5 \\ 7 & -6 \end{bmatrix} \end{array}$$

17. Solve the following game using the dominance principle.

	Player B			
Player A	**B1**	**B2**	**B3**	**B4**
A1	3	2	4	0
A2	3	4	2	4
A3	4	2	4	0
A4	0	4	0	8

18. A TV cable company is in the process of providing cable service to five new housing development areas. The following figure depicts possible TV linkages among the five areas in which the TV company is labelled 1 and the areas are labelled from 2 to 6. The cable miles are shown on each arc. Determine the most economical cable network.



PART – C

Answer any TWO questions **(2 x 20 = 40 Marks)**

19. Use the simplex method to solve the following linear programming problem:

Maximize $Z = 3x_1 + 5x_2 + 4x_3$ subject to the constraints

$$2x_1 + 3x_2 \leq 8$$
$$2x_2 + 5x_3 \leq 10$$
$$3x_1 + 2x_2 + 4x_3 \leq 15$$
and $x_1, x_2, x_3 \geq 0$.

20. Using the penalty method solve the following linear programming problem:

Minimize $Z = 5x_1 + 3x_2$ subject to the constraints

$$2x_1 + 4x_2 \leq 12$$
$$2x_1 + 2x_2 = 10$$
$$5x_1 + 2x_2 \geq 12$$
and $x_1, x_2 \geq 0$.

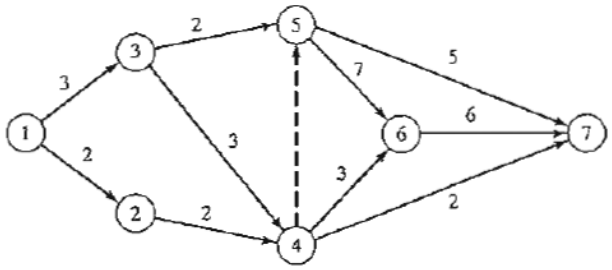
21. Find the optimal solution to the following transportation problem.

		Destination				
Source		**D1**	**D2**	**D3**	**D4**	**Supply**
	S1	19	30	50	10	**7**
	S2	70	30	40	60	**9**
	S3	40	8	70	20	**18**
	Demand	**5**	**8**	**7**	**14**	**34**

22. (a). Solve the following game.

Player A	Player B			
	B1	**B2**	**B3**	**B4**
A1	2	-2	4	1
A2	6	1	12	3
A3	-3	2	0	6
A4	2	-3	7	1

(b). Determine the critical path for the following network.



(10+10)

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