LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **STATISTICS**

SIXTH SEMESTER – **APRIL 2022**

17UST6MC01 – OPERATIONS RESEARCH

Date: 15-06-2022 Dept. No. Max. : 50 Marks

Time: 01:00-04:00

SECTION – A

Answer ALL questions. Each carries TWO marks. **(10 x 2 = 20 Marks)**

1. What is an 'Artificial Variable' and why is it necessary to introduce it?
2. What are Slack and Surplus variables?
3. In an LPP with some 'unrestricted variables', what changes are made in order to ensure non-negativity requirements?
4. Define 'primal problem' when an LPP is written in 'symmetrical' primal-dual form.
5. Define a LOOP in Transportation Table and give an example.
6. What is meant by 'unbalanced transportation problem'?
7. Explain 'assignment problem' with an example.
8. What are 'zero sum' and 'non zero sum' games?
9. Find the minimax and maximin values for the following payoff matrix:
$$\begin{bmatrix} 1 & 3 & 6 \\ 2 & 1 & 3 \\ 6 & 2 & 1 \end{bmatrix}.$$
10. Define a Critical Path, stating the conditions for a critical activity (i, j).

SECTION – B

Answer any FIVE questions. Each carries EIGHT marks. **(5 x 8 = 40 Marks)**

11. A firm manufactures headache pills in two sizes A and B. Size A contains 2 grains of aspirin, 5 grains of bicarbonate and 1 grain of codeine. Size B contains 1 grain of aspirin, 8 grains of bicarbonate and 6 grains of codeine. It is found by users that it requires at least 12 grains of aspirin, 74 grains of bicarbonate and 24 grains of codeine for providing immediate effect. It is required to determine the least number of pills a patient should take to get immediate relief. **Formulate** the problem as an LPP.
12. Show that the following LPP has **alternative optima**:
    Maximize $z = 2x_1 + 4x_2$ subject to the constraints:
    $x_1 + 2x_2 \leq 5$, $x_1 + x_2 \leq 4$; and $x_1, x_2 \geq 0$.
13. Show that the following system of linear equations has a **degenerate solution**:
    $2x_1 + x_2 - x_3 = 2$
    $3x_1 + 2x_2 + x_3 = 3$.
14. Discuss the relationship between primal LPP and its dual LPP.
15. Explain **Vogel's method** by obtaining initial BFS of the following TP:

	D_1	D_2	D_3	Supply
O_1	13	15	16	17
O_2	7	11	2	12
O_3	19	20	9	16
Demand	14	8	23	

16. State a procedure of drawing minimum number of lines to cover all the zeroes (0's) of a reduced matrix in Assignment Problem.
17. Construct the network diagram comprising activities A, B, …, H and I such that the following constraints are satisfied:

    A < B; B < E, J; C < G; D < C, F, A; E, J < I; F < H; G < B; H < B.

The notation X < Y means that the activity X must be finished before Y can begin.

18. Solve graphically the game whose payoff matrix is $\begin{bmatrix} 2 & 3 & 11 \\ 7 & 5 & 2 \end{bmatrix}$.

SECTION – C

Answer any TWO questions. Each carries TWENTY marks. (2 x 20 = 40 Marks)

19(a) Use Big-M method to solve the following L.P.P.:
Maximize $z = 3x_1 + 2x_2 + 3x_3$
subject to the constraints:
$2x_1 + x_2 + x_3 \leq 2, \quad 3x_1 + 4x_2 + 2x_3 \geq 8, \quad x_1, x_2, x_3 \geq 0.$ **(10)**

(b) Use two-phase simplex method to maximize $z = 3x_1 + 2x_2$ subject to the constraints: $2x_1 + x_2 \leq 2, \quad 3x_1 + 4x_2 \geq 12, \quad x_1, x_2 \geq 0.$ **(10)**

20(a) Check if the dual of dual is primal for the following L.P.P.:
Maximize $z = 8x_1 + 3x_2$ subject to the constraints:
$x_1 - 6x_2 \leq 2, \quad 5x_1 + 7x_2 = -4, \quad x_1, x_2 \geq 0.$ **(8)**

(b) Determine an initial feasible solution to the following transportation problem using the **north west corner rule**. Also determine the optimum solution by **MODI** method.

Origin	Destination D_1	D_2	D_3	D_4	Availability
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
Requirement	6	10	15	4	35

(12)

21(a) Use **dominance principle** to solve the following 3 x 3 game: (Player A is row player and Player B is column player)

$$\begin{bmatrix} 1 & 7 & 2 \\ 6 & 2 & 7 \\ 5 & 1 & 6 \end{bmatrix}$$ **(10)**

(b) A small project consists of seven activities, the details of which are given below:

Activity	Duration (in days) Most likely	Optimistic	Pessimistic	Immediate Predecessor
A	3	1	7	-
B	6	2	14	A
C	3	3	3	A
D	10	4	22	B, C
E	7	3	15	B
F	5	2	14	D, E
G	4	4	4	D

Draw the network, number the nodes, find the critical path and the expected project completion time. **(10)**

22. A department has four subordinates and four tasks are to be performed. The subordinates differ in efficiency and the tasks differ in their difficulties. The estimate of time (in man-hours) each man would take to perform each task is given by

		Task			
		a	b	c	d
Subordinate	1	18	26	17	11
	2	13	28	14	26
	3	38	19	18	15
	4	19	26	24	10

How should the tasks be allotted to men so as to optimize the total man-hours? **(20)**

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