Reg. No ..... Name **26U680**

B.Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2026

SEMESTER 6 : MATHEMATICS

COURSE : **19U6CRMAT13 : OPERATIONS RESEARCH (EL)**

(For Regular - 2023 Admission and Supplementary 2022/2021/2020/2019 Admissions)

Time : Three Hours Max. Marks: 75

PART A

Answer any 10 (2 marks each)

1. Differentiate between unbounded solution and infeasible solution.
2. Assign programs 1, 2, 3 to the programers A , B, C such that minimum time is utilised for completion of programs. Time required by each programmers to complete each program are as follows:

	A	B	C
1	120	100	80
2	80	90	110
3	110	140	120

3. Find an initial solution using NWCR

	A	B	C	
1	2	1	3	10
2	4	5	7	25
3	6	0	9	25
4	1	3	5	30
	20	20	15	

4. Define Surplus variable.
5. Define Pure Strategy.
6. Obtain the dual of

$$\begin{aligned} \text{Maximize} \quad & z = -160y_1 + 30y_2 + 10y_3 \\ \text{Subject to} \quad & -2y_1 + y_2 + y_3 \leq 1 \\ & -4y_1 - y_2 \leq 2. \end{aligned}$$

y_1, y_3 are non negative and y_2 unrestricted in sign.

7. What is the standard form of LPP
8. Define Basic feasible solution.
9. Define Maximin principle.
10. Consider an LPP with m constraints and n variables, then what is the number of non - basic variable.

11. Find an initial solution of the transportation problem.

	A	B	C	D	Supply
U	19	30	50	10	7
V	70	30	40	60	9
W	40	8	70	20	18
Demand	5	8	7	14	

12. Define unbalanced transportation problem with example.

(2 x 10 = 20)

PART B

Answer any 5 (5 marks each)

13. Find the optimal solution of the transportation problem

	A	B	C	Supply
P	4	8	8	76
Q	16	24	16	82
R	8	16	24	77
Demand	72	102	41	

14. Solve

$$\begin{aligned} \text{Max} \quad & 40x_1 + 30x_2 \\ \text{subject to} \quad & x_1 + x_2 \leq 12 \\ & 2x_1 + 1x_2 \leq 16 \\ & x_1, x_2 \geq 0 \end{aligned}$$

using graphical method.

15. If the i^{th} constraint of the primal is equality then prove that i^{th} variable of the dual is unrestricted in sign.

16. Write the standard form of primal and dual.

17. Solve graphically and find value of the game and optimum strategies for the payoff matrix;

$$\begin{bmatrix} 3 & -4 \\ 2 & 5 \\ -2 & 8 \end{bmatrix}$$

18. Find the initial basic feasible solution using a)NWCR b)LCM c)VAM

	A	B	C	Supply
P	4	8	8	76
Q	16	24	16	82
R	8	16	24	77
Demand	72	102	41	

19. Use two phase method to solve
Max $z = x_1 + x_2$ subject to
$7x_1 - 6x_2 \leq 5,$
$6x_1 + 3x_2 \geq 7$
$-3x_1 + 8x_2 \leq 6$
x_1, x_2 are non negative .

20. Construct the initial simplex table and calculate the first pivoting.

$$\begin{aligned} \text{Max} \quad & 40x_1 + 30x_2 \\ \text{subject to} \quad & x_1 + x_2 \leq 12 \\ & 2x_1 + 1x_2 \leq 16 \\ & x_1, x_2 \geq 0 \end{aligned}$$

(5 x 5 = 25)

PART C
Answer any 3 (10 marks each)

21. Use graphical method to solve
Max $z = x_1 + x_2$ subject to
$7x_1 - 6x_2 \leq 5,$
$6x_1 + 3x_2 \geq 7$
$-3x_1 + 8x_2 \leq 6$
x_1, x_2 are non negative .

22. Use Principle of Dominance to find value of the game and optimum strategies for the payoff matrix;

$$\begin{bmatrix} 4 & 6 & 5 & 10 & 6 \\ 7 & 8 & 5 & 9 & 10 \\ 8 & 9 & 11 & 10 & 9 \\ 6 & 4 & 10 & 6 & 4 \end{bmatrix}$$

23. Assign the following jobs (rows) to the employees (columns) so as to minimise the total man - hours with the following time schedule.

Employees→ / Jobs	1	2	3	4	5
A	10	5	13	15	16
B	3	9	18	13	6
C	10	7	2	2	2
D	7	11	9	7	12
E	7	9	10	4	12

24. Solve using VAM

	A	B	C	
1	2	1	3	10
2	4	5	7	25
3	6	0	9	25
4	1	3	5	30
	20	20	15	

(10 x 3 = 30)