Reg. No. : .....

Code No. : 20439 E **Sub. Code : CEMA 54**

B.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2023.

Fifth Semester

Mathematics

Major Elective — OPERATIONS RESEARCH — I

(For those who joined in July 2021-2022)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. What is an unbounded solution?

   (a) Finite number of solutions

   (b) Infinite number of solutions

   (c) Feasible solution

   (d) Infeasible solution

2. A necessary and sufficient condition for a basic feasible solution to a maximization LPP to be an optimum is that (for all j) ————————.

(a) $z_j - c_j \geq 0$

(b) $z_j - c_j \leq 0$

(c) $z_j - c_j = 0$

(d) $z_j - c_j > 0$ or $z_j - c_j < 0$

3. There is a dual constraint for every ————————.

(a) dual variable

(b) primal variable

(c) primal constraint

(d) feasible solution

4. Dual simplex method is applicable to the LPP having

(a) an optimum solution

(b) an infeasible solution

(c) an optimum and feasible solution

(d) an optimum and infeasible solution

5. A transportation problem is said to be balance if ————————.

(a) Total Supply > Total Demand

(b) Total Supply < Total Demand

(c) Total Supply = Total Demand = 0

(d) Total Supply = Total Demand

6. The current basic feasible solution of the transportation problem is optimal if ————————.

(a) one $Z_{ij} - C_{ij} \leq 0$ (b) all $Z_{ij} - C_{ij} \leq 0$

(c) one $Z_{ij} - C_{ij} > 0$ (d) all $Z_{ij} - C_{ij} > 0$

7. In the optimum solution of the assignment problem, a given row or column of the cost matrix have ————————.

(a) no assignment (b) < 0 assignment

(c) ≥ 2 assignment (d) one assignment

8. If $C_{ij} > 0$ such that minimum $\sum_{i=1}^{n}\sum_{j=1}^{n} C_{ij} = 0$, then x_{ij} provides

(a) optimum solution

(b) feasible solution

(c) infeasible solution

(d) unbounded solution

9. The sequence of jobs and the order of completion of jobs are

(a) dependent (b) independent

(c) minimum (d) maximum

10. In graphical method the diagonal live segment shows that

(a) no job is under process

(b) first job is under process

(c) second job is under process

(d) both jobs are under process

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Discuss the standard form of the linear programming problem.

Or

(b) Solve graphically :

Max $z = 3x_1 + 2x_2$

Subject to

$2x_1 + x_2 \leq 40$

$x_1 + x_2 \leq 24$

$2x_1 + 3x_2 \leq 60$

$x_1, x_2 \geq 0$.

12. (a) Write the dual of

Maximize : $z = 2x_1 + x_2$

Subject to

$x_1 + 2x_2 \leq 10$

$x_1 + x_2 \leq 6$

$x_1 - x_2 \leq 2$

$x_1 - 2x_2 \leq 1$

$x_1, x_2 \geq 0$.

Or

(b) Prove that the dual of the dual is primal.

13. (a) Obtain an initial basis feasible solution to the following transportation problem using the matrix minima method.

	D_1	D_2	D_3	D_4	
O_1	1	2	3	4	6
O_2	4	3	2	0	8
O_3	0	2	2	1	10
	4	6	8	6	

Or

(b) Explain Vogel's Approximation Method.

14. (a) Write Hungarian assignment algorithm.

Or

(b) Solve the following assignment problem.

	1	2	3	4
A	10	12	19	11
B	5	10	7	8
C	12	14	13	11
D	8	15	11	9

15. (a) Determine the sequence for 6 jobs 2 machines that will minimize the total elapsed time T.

Processing time (in hours)

Job :	J_1	J_2	J_3	J_4	J_5	J_6
M_1 :	1	3	8	5	6	3
M_2 :	5	6	3	2	2	10

Or

(b) Using graphical method determine the minimum elapsed time sequence of 2 jobs 4 machines.

Machines

Job 1	Sequence	A	B	C	D
	Time	2	4	5	1
Job 2	Sequence	D	B	A	C
	Time	6	4	2	3

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) Use Simplex method to

Maximize $z = 5x_1 + 4x_2$

Subject to the constraints

$4x_1 + 5x_2 \leq 10$

$3x_1 + 2x_2 \leq 9$

$8x_1 + 3x_2 \leq 12$

$x_1, x_2 \geq 0$.

Or

(b) Use Simplex method to

Maximize $z = 107x_1 + x_2 + 2x_3$

Subject to the constraints

$14x_1 + x_2 - 6x_2 + 3x_4 = 7$

$16x_1 + x_2 - 6x_3 \leq 5$

$3x_1 - x_2 - x_3 \leq 0$

$x_1, x_2, x_3, x_4 \geq 0$.

17. (a) Use Dual Simplex method to solve

Minimize $z = 3x_1 + x_2$

Subject to

$x_1 + x_2 \geq 1$

$2x_1 + 3x_2 \geq 2$

$x_1, x_2 \geq 0$.

Or

(b) Find the optimum integer solution to

Maximize $z = x_1 + x_2$

Subject to

$3x_1 + 2x_2 \leq 5$

$x_2 \leq 2$

$x_1, x_2 \geq 0$ and are integers.

18. (a) Solve the following transportation problem.

	A	B	C	D	Stock
1	10	0	20	11	15
2	12	7	9	20	25
3	0	14	16	18	5
Demand	5	15	15	10	

Or

(b) Solve the following transportation problem.

	D_1	D_2	D_3	D_4	D_5	Available
O_1	4	7	3	8	2	
O_2	1	4	7	3	8	
O_3	7	2	4	7	7	
O_4	4	8	2	4	7	
Demand	8	3	7	2	2	

19. (a) Solve the following assignment problem.

	A	B	C	D	E
I	3	8	2	10	3
II	8	7	2	9	7
III	6	4	2	7	5
IV	8	4	2	3	5
V	9	10	6	9	10

Or

(b) Find the optimum assignment and the maximum profit for the following :

	I	II	III	IV	V
1	32	38	40	28	40
2	40	24	28	21	36
3	41	27	33	30	37
4	22	38	41	36	36
5	29	33	40	35	39

20. (a) Solve the following sequencing problem.

	Job					
	1	2	3	4	5	6
M_1 :	8	10	6	7	11	3
M_2 :	5	6	2	3	4	4
M_3 :	4	9	8	6	5	5

Or

(b) Using graphical method, determine the minimum elapsed time sequence of 2 jobs 4 machines.

Job 1	Sequence	A	B	C	D	E
	Time	3	4	2	6	2
Job 2	Sequence	B	C	A	D	E
	Time	5	4	3	2	6
