(8 pages) Reg. No. :.....

Code No. : 20085 E **Sub. Code : SEMA 5 D/ AEMA 54**

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

Fifth Semester

Mathematics

Major Elective — OPERATIONS RESEARCH — I

(For those who joined in July 2017-2020)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL the questions.

Choose the correct answer :

1. Graphical method can be used to solve the LPP if the number of decision variable is ————————.
   (a) Equal to two
   (b) Atmost two
   (c) Atleast two
   (d) Not equal to two

2. A maximization problem $Max\, z$ can be converted by using ————————.
   (a) $\min(-z)$ (b) $-\min(z)$
   (c) $-\min(-z)$ (d) none

3. The cost of slack variable is ————————.
   (a) 1 (b) -1
   (c) M (d) 0

4. If all the constraints of the dual problem in equations of $\leq$ type then the constraints in the primal problem ———————— type.
   (a) $\leq$ (b) $=$
   (c) $\geq$ (d) $\neq$

5. The constants $b_1, b_2, \ldots, b_n$ in the constraints of the primal will appear in the ———————— of the dual.
   (a) constraints
   (b) objective function
   (c) both constraints and objective function
   (d) none

6. When demand $\neq$ supply the transportation is called
   (a) Unbalanced (b) Balanced
   (c) Degenerate (d) None of these

7. If the number of rows and columns are not equal in the assignment problem, then it is called ————————.
   (a) bounded (b) balanced
   (c) unbounded (d) unbalanced

8. The set of feasible solutions to LPP is ————————.
   (a) Convex (b) Polygon
   (c) Triangle (d) Bounded

9. Sequence problem involving processing of two job on 'n' machines ————————.
   (a) can be solved graphically
   (b) can't be solved graphically
   (c) two jobs must be in the same order
   (d) none of these

10. ———————— method explains n jobs on two machines.
    (a) NLPP
    (b) LPP
    (c) Johnson's method
    (d) Graphical method

PART B — (5 × 5 = 25 marks)

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

11. (a) Solve graphically :

Maximize $z = -x_1 + 4x_2$

Subject to the constraints :

$$-3x_1 + x_2 \leq 6$$
$$x_1 + 2x_2 \leq 4$$
$$x_2 \leq -3$$

no lower bound constraint for x_1.

Or

(b) Define slack variable and surplus variable.

12. (a) Obtain the dual of the following LPP :

Maximize $z = 3x_1 + 10x_2 + 2x_3$

Subject to the constraints :

$$2x_1 + 3x_2 + 2x_3 \leq 7$$
$$3x_1 - 2x_2 + 4x_3 = 3$$
and $x_1, x_2, x_3 \geq 0$.

Or

(b) Write down the primal and dual problems in canonical form.

13. (a) Determine an initial basic feasible solution to the following transportation problem using North West Corner Rule :

	A	B	C	D	E	Supply
P	2	11	10	3	7	4
Q	1	4	7	2	1	8
R	3	9	4	8	12	9
Demand	3	3	4	5	6	

Or

(b) Explain the method of solving a unbalanced transportation problem.

14. (a) Give the mathematical formulation of the assignment problem.

Or

(b) Solve the following assignment problem.

	I	II	III	IV
A	10	5	13	15
B	3	9	18	3
C	10	7	3	2
D	5	11	9	7

15. (a) Solve the following sequencing problem :

Job (Time in hrs) :	A	B	C	D	E	F
Machine 1 :	8	3	7	2	5	1
Machine 2 :	3	4	5	2	1	6
Machine 3 :	8	7	6	9	10	9

Or

(b) We have 5 jobs, each of which must through A, B in the order AB processing time (in hours) are given in the following table. Find the sequence that minimizes the total elapsed time.

Job :	1	2	3	4	5
Machine A :	10	2	18	6	20
Machine B :	4	12	14	16	8

PART C — ($5 \times 8 = 40$ marks)

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

16. (a) Use Simplex method to solve the following LPP.

Maximize $z = 4x_1 + 10x_2$

Subject to the constraints

$2x_1 + x_2 \le 50$

$2x_1 + 5x_2 \le 100$

$2x_1 + 3x_2 \le 90$ and $x_1, x_2 \ge 0$.

Or

(b) Use Big-M method and solve :

Maximize $z = 3x_1 + 2x_2$

Subject to

$2x_1 + x_2 \le 2$

$3x_1 + 4x_2 \ge 12$ and $x_1, x_2 \ge 0$.

17. (a) Use duality to solve the following LPP.

Minimize $z = 2x_1 + 2x_2$

Subject to

$2x_1 + 4x_2 \ge 1$

$-x_1 - 2x_2 \le -1$

$2x_1 + x_2 \ge 1$ and $x_1, x_2 \ge 0$.

Or

(b) Use dual simplex method to solve.

Maximize $z = -3x_1 - 2x_2$

Subject to

$x_1 + x_2 \ge 1$

$x_1 + x_2 \le 7$

$x_1 + 2x_2 \ge 10$

$x_2 \le 3$ and $x_1, x_2 \ge 0$.

18. (a) Solve the following transportation problem.

4	1	2	6	9	100
6	4	3	5	7	120
5	2	6	4	8	120
40	50	70	90	90	

Or

(b) Solve the following transportation problem.

1	2	0	30
2	3	4	35
1	5	6	35
30	40	30	

19. (a) Obtain an optimum solution using the following assignment problem.

9	22	58	11	19
43	78	72	50	63
41	28	91	37	45
74	42	27	49	39
36	11	57	22	25

Or

(b) Solve the assignment problem.

4	7	3	7
8	2	5	5
4	9	6	9
7	5	4	8
6	3	5	4
6	8	7	3

20. (a) State the Algorithm for processing 'n' jobs on 2 machines.

Or

(b) Use graphical method to minimize the time added to process the following jobs on the machines shown below. Also calculate the total elapsed time to complete the jobs.

Job 1	Sequence :	A	B	C	D	E
	Time (hours) :	6	8	4	12	4
Job 2	Sequence :	B	C	A	D	E
	Time (hours) :	10	8	6	4	12