K23U 0549

Reg. No. : ....

Name : ....

VI Semester B.Sc. Honours in Mathematics Degree (CBCSS – Regular/ Supplementary/Improvement) Examination, April 2023
(2016 Syllabus)
BHM 603 : OPERATIONS RESEARCH

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **any 4** questions out of 5 questions. **Each** question carries **1** mark.

1. Define slack variable.
2. Explain unbounded solution in simplex method.
3. Define node and arc in a transportation model.
4. Define a spanning tree.
5. Define cut in a network.

(4×1=4)

SECTION – B

Answer **any 6** questions out of 9 questions. **Each** question carries **2** marks.

6. Obtain the optimum solution of LPP using graphical method :
   Maximize $f = 2x_1 + 3x_2$
   Subject to $2x_1 + x_2 \le 4$
   $x_1 + 2x_2 \le 5$
   $x_1, x_2 \ge 0$
7. Explain M-method.
8. Explain optimality condition and feasibility condition in a simplex method.
9. Write the dual problem of the primal :
   Maximize $f = 5x_1 + 12x_2 + 4x_3$
   Subject to $x_1 + 2x_2 + x_3 \le 10$
   $2x_1 - x_2 + 3x_3 = 8$
   $x_1, x_2, x_3 \ge 0.$

P.T.O.

10. Write a note on economic interpretation of dual variables.
11. Obtain the initial basic solution using North-West corner rule or least cost method.

Destination

	A	B	C	D	Supply
Source I	10	2	20	11	15
Source II	12	7	9	20	25
Source III	4	14	16	18	10
Demand	5	15	15	15	

12. Draw the network defined by (N, A) where N = {a, b, c, d, e}, A = {(a, b), (a, c), (b, c), (b, e), (c, d), (c, e), (d, b), (d, e)}.
13. Explain the forward pass and backward pass in critical path calculation.
14. Explain the Bridges of Königsberg problem.

(6×2=12)

SECTION – C

Answer **any 8** questions out of 12 questions. **Each** question carries **4** marks.

15. Explain earliest occurrence times and latest occurrence times in CPM computations.
16. Describe PERT network. How it differ from CPM ?
17. Explain Floyd's algorithm.
18. Write the algorithm for North-West corner rule and least cost method.
19. Write the mathematical formulation of assignment problem. Compare assignment problem with transportation problem.
20. The assignment cost of any one operator to any one machine is given in the table :

Operators

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

   Find the optimal assignment using Hungarian method.
21. Write the rules for constructing the dual problem.
22. Describe how to solve an LPP using M-Method.

23. Use simplex method to solve the LPP :
   Maximize $f = 4x_1 + 10x_2$
   Subject to $2x_1 + x_2 \le 50$
   $2x_1 + 5x_2 \le 100$
   $2x_1 + 3x_2 \le 90$
   $x_1, x_2 \ge 0$
24. Use dual simplex method to solve :
   Minimize $f = 2x_1 + x_2$
   Subject to $3x_1 + x_2 \ge 3$
   $4x_1 + 3x_2 \ge 6$
   $x_1 + 2x_2 \ge 3$
   $x_1, x_2 \ge 0.$
25. Consider the following LPP :
   Maximize $f = 4x_1 + 14x_2$
   Subject to $2x_1 + 7x_2 + x_3 = 21$
   $7x_1 + 2x_2 + x_4 = 21$
   $x_1, x_2, x_3, x_4 \ge 0$

   Check the optimality and feasibility of LPP with basic variables (x_2, x_4) and

   $$\text{inverse} = \begin{pmatrix} \frac{1}{7} & 0 \\ \frac{-2}{7} & 1 \end{pmatrix}.$$
26. Write a note on sensitivity analysis and post optimal analysis.

(8×4=32)

SECTION – D

Answer **any 2** questions out of 4 questions. **Each** question carries **6** marks.

27. Use duality to solve the LPP :
   Maximize $f = 3x_1 + 2x_2$
   Subject to $x_1 + x_2 \ge 1$
   $x_1 + x_2 \le 7$
   $x_1 + 2x_2 \le 10$
   $x_2 \le 3$
   $x_1, x_2 \ge 0.$

28. Solve the LPP using M-method :
   Minimize $f = 4x_1 + 3x_2$
   Subject to $2x_1 + x_2 \ge 10$
   $-3x_1 + 2x_2 \le 6$
   $x_1 + x_2 \ge 6$
   $x_1, x_2 \ge 0.$
29. Find the optimum transportation cost of the following transportation problem :

Market

	A	B	C	D	E	Available
Factory P	4	1	2	6	9	100
Factory Q	6	4	3	5	7	120
Factory R	5	2	6	4	8	120
Demand	40	50	70	90	90	

30. A project consists of 12 activities with the three time estimates of these activities (in weeks) are given below :

Activity	Optimistic Time	Most likely Time	Pessimistic Time
1 – 2	3	4	5
2 – 3	1	2	3
2 – 4	2	3	4
3 – 5	3	4	5
4 – 5	1	3	5
4 – 6	3	5	7
5 – 7	4	5	6
6 – 7	6	7	8
7 – 8	2	4	6
7 – 9	1	2	3
8 – 10	4	6	8
9 – 10	3	5	7

   a) Draw the PERT network.
   b) Compute expected project completion time.
   c) Find expected variance of the project length.

(2×6=12)

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