2803N1148

M.Sc. Sem.-3 Examination

504

Mathematics

March-2025

Candidate's Seat No :_____

Time : 2-30 Hours] **[Max. Marks : 70**

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 **(a)** Solve given LPP: **(07)**

Maximize $z = x_1 - x_2 + 3x_3$

Subject to constraints, $x_1 + x_2 + x_3 \leq 10$

$2x_1 - x_3 \leq 2$

$2x_1 - 2x_2 + 3x_3 \leq 0;\ x_1, x_2, x_3 \geq 0$

(b) Find the optimum integer solution of LPP: **(07)**

$$Max\ Z = 4x_1 + 3x_2$$

Subject to constraints, $x_1 + 2x_2 \leq 4$;

$2x_1 + x_2 \leq 6;\ x_1, x_2 \geq 0$

OR

Q.1 **(a)** Solve given LPP using dual simplex method: **(07)**

Minimize $Z = x_1 + x_2$

Subject to $2x_1 + x_2 \geq 2$

$-x_1 - x_2 \geq 1;\ x_1, x_2 \geq 0$

(b) Solve the given LPP by using Big-M Method: **(07)**

Maximize $z = 2x_1 + x_2 + x_3$

subject to $4x_1 + 6x_2 + 3x_3 \leq 8$

$3x_1 - 6x_2 - 4x_3 \leq 1$

$2x_1 + 3x_2 - 5x_3 \geq 4;\ x_1, x_2, x_3 \geq 0$

Q.2 **(a)** Adirondack Paper Mills, Inc., operates paper plants in Augusta, Maine, and Tupper Lake, New York. Warehouse facilities are located in Albany, New York, and Portsmouth, New Hampshire. Distributors are located in Boston, New York, and Philadelphia. The plant capacities and distributor demand for the next month and the unit transportation costs (in dollars) for shipments from the two plants to the two warehouses and from the two warehouses to the three distributors are as follows: **(07)**

	Warehouse		
Plant	**Albany**	**Portsmouth**	**Capacity**
Augusta	7	5	300
Tupper Lake	3	4	100

	Distributor		
Warehouse	**Boston**	**New York**	**Philadelphia**
Albany	8	5	7
Portsmouth	5	6	10
Demand	150	100	150

(P.T.O)

a. Develop a network representation of the Adirondack Paper Mills problem.
b. Formulate the Adirondack Paper Mills problem as a linear programming problem.

(b) The project has the following activities: **(07)**

Activity	Immediate Predecessor	Time (weeks)
A	-	3
B	-	1
C	-	2
D	A, B, C	4
E	C, D	5
F	A	3
G	D, F	6
H	E	4

a. Draw a project network.
b. What are the critical activities?
c. What activity has the most slack time?

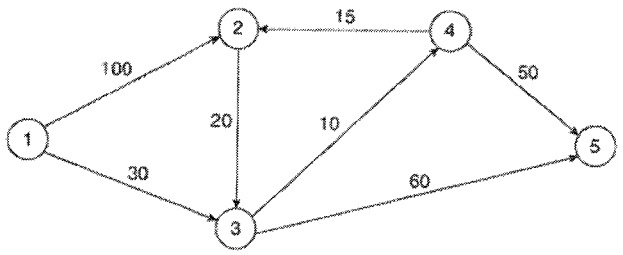
OR

Q.2 **(a)** A project has the following activities and other characteristics: **(07)**

Activity	Immediate Predecessor	Time (weeks)		
		Optimistic	Most Probable	Pessimistic
A	-	4	7	16
B	-	1	5	15
C	A	6	12	30
D	A	2	5	8
E	C	5	11	17
F	D	3	6	15
G	B	3	9	27
H	E, F	1	4	7
I	G	4	19	28

a. Draw a project network.
b. Identify the critical path.
c. Prepare the activity schedule for the project.
d. Determine the mean project completion time.

(b) Find the shortest path from source 1 to destination 5, through the network given below. **(07)**



Q.3 **(a)** Find the optimal solution using Lagrange's multiplier method **(07)**

$$\min z = x_1^2 + x_2^2 + x_3^2$$

Subject to constraint: $4x_1 + x_2^2 + 2x_3 = 14$

(b) Find the optimal solution using Kuhn – Tucker condition **(07)**

$$\max z = x_1 - x_2$$

$$s.to.c: x_1^2 + x_2^2 \leq 1$$

OR

Q.3 **(a)** Find the optimal solution using Kuhn – Tucker condition **(07)**

$$\min x^3 - 3x^2 + 2x - 1$$

$$s.to.c: -2 \leq x \leq 4$$

(b) Use Wolfe's method to solve the following QPP: **(07)**

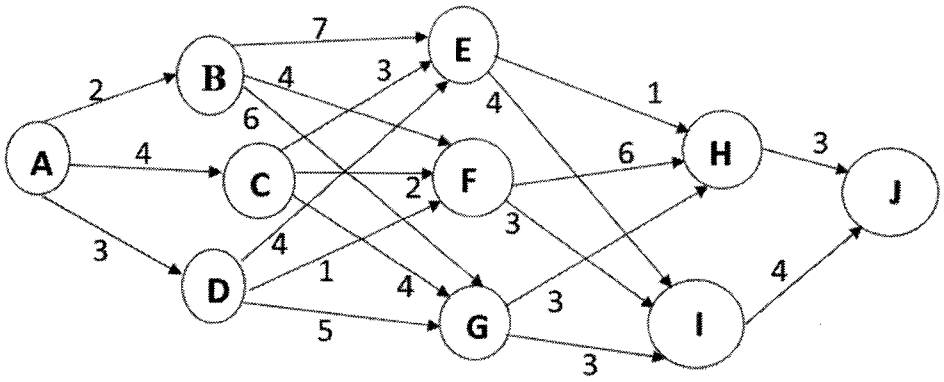
$$\min z = 2x_1 + 3x_2 - 2x_1^2$$

$$s.to.c: x_1 + 4x_2 \leq 4$$

$$x_1 + x_2 \leq 2$$

$$x_1, x_2 \geq 0$$

Q.4 **(a)** Find the shortest path of the following network using backward approach. **(07)**



(b) Solve the LPP by Dynamic Programming. **(07)**

Max Z = $3x_1 + 4x_2$

Subject to constraints, $2x_1 + x_2 \leq 40$

$$2x_1 + 5x_2 \leq 180$$

$x_1, x_2 \geq 0$

OR

Q.4 **(a)** A 6-ton vessel is loaded with one or more of the three items. The following table gives the unit weight w_i in tons and the unit revenue in thousands of rupees r_i, for item i. How should the vessel be loaded to maximize the total return? **(07)**

Item i	w_i	r_i
1	4	70
2	1	20
3	2	40

(P.T.O)

(b) Determine the value of u_1 , u_2 and u_3 as to **(07)**

Maximize $Z = u_1 \cdot u_2 \cdot u_3$

Subject to constraint: $u_1 + u_2 + u_3 = 10$ and $u_1 , u_2, u_3 \geq 0$

Q.5 Attempt any **SEVEN** out of **TWELVE:** **(14)**

(1) Define feasible solution for linear programming problems.

(2) Write the dual of the following LPP:

Maximize $Z = -2x_1 - x_2$

Subject to $3x_1 + x_2 \geq 3$

$4x_1 + 3x_2 \geq 6$

$x_1 + 2x_2 \geq 3$ $\qquad x_1, x_2 \geq 0$

(3) Write down the general formulation of Linear Programming Problems.

(4) Write down the difference between CPM and PERT.

(5) Explain Normal and Crash time.

(6) Define expected time and variance in PERT.

(7) Explain convex and concave function.

(8) Check definiteness of function: $f(x) = {x_1}^2 + 2{x_2}^2 - 7{x_3}^2 - 4x_1x_2 + 8x_1x_3$

(9) Write down necessary and sufficient conditions for Kuhn Tucker Method.

(10) Define Recursive relationship in dynamic programming.

(11) Define states and stages in dynamic programming.

(12) Write down the difference between linear programming and dynamic programming.

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