0411E1027 Candidate's Seat No :________

B.Sc. Sem.-5 Examination

CC - 304

Mathematics

November-2025

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

Instructions : (1) All questions are compulsory.
(2) Right side indicates marks of that question.

Q-1 (A) Let $K \subset R^n$. Prove that K is convex set if and only if every finite convex linear combination of elements in K is also belongs to K. [7]

(B) A firm manufactures headache pills in two sizes A and B. Size A contains 2 grain of aspirin, 5 grain of bicarbonate and 1 grain of codeine. Size B contains 1 grain of aspirin, 8 grain of bicarbonate and6 grain of codeine. It is found by users that it requires at least 12 grains of aspirin, 74 grains of bicarbonate and 24 grain of codeine for providing immediate effect. It is required to determine the least number of pills a patient should take to get immediate relief. Formulate the problem as a standard LPP. [7]

OR

Q-1 (A) Define convex set. Prove that $X = \{(x_1, x_2) / 9x_1^2 + 4x_2^2 \le 36\}$ is a convex set. [7]

(B) A company produces three products A,B and C. These products require three ores O_1,O_2 and O_3. The maximum quantities of the ores O_1,O_2 and O_3available are 22 tonnes , 14 tonnes and 14 tonnes respectively. For one tonne of each of these products, the ore requirements are :

	A	B	C
O_1	3	-	3
O_2	1	2	3
O_3	3	2	3
Profit per tonne (Rs in thousand)	1	4	5

The company makes a profit of Rs. 1000, 4000 and 5000 on each tonne of the products A,B and C respectively. Forumulate this problem as a linear programming model. [7]

Q-2 (A) Explain Simplex algorithm for solving linear programming problem. [7]

(B) Solve the following LPP by simplex method.
Use the two-phase method to
Max. Z= $3x_1 + 2x_2 + 5x_3$
Subject to $x_1 + 2x_2 + x_3 \le 430$; $3x_1 + 2x_3 \le 460$; $x_1 + 4x_2 \le 420$
$x_1, x_2, x_3 \ge 0$ [7]

OR

Q-2 (A) Explain Gomory'scutting plane method for solving Integer programming [7]

(B) Using appropriate simplex method to solve : [7]
Max Z= $3x_1 + 2x_2$
Subject to the constraint $2x_1 + x_2 \le 2$; $3x_1 + 4x_2 \ge 12$; $x_1, x_2 \ge 0$

Q-3 (A) Prove that the value of the objective function f(x) for any feasible solution of the primal is not less than the value of the objective function g(y) for any feasible solution of the dual. [7]

(B) Apply the principle of duality to solve the following LPP. [7]
Min Z= $2x_1 + 2x_2$
Subject to the constraint
$2x_1 + 4x_2 \ge 1$; $x_1 + 2x_2 \ge 1$; $2x_1 + x_2 \ge 1$; $x_1, x_2 \ge 0$

P.T.O

OR

E 1027-2

Q-3 (A) Explain Primal-Dual Relationship. Prove that Dual of the Dual is Primal. [7]

(B) Using dual simplex method to solve the following Linear Programming Problem. [7]

Max $Z=-3x_1-2x_2$

$x_1+x_2\ge 1$; $x_1+x_2\le 7$; $x_1+2x_2\ge 10$; $x_2\le 3$; $x_1,x_2\ge 0$

Q-4 (A) Explain : (1) Loop in transportation problem (2) Degeneracy in transportation problem. [7]

(B) Using MODI method to solve the following Transportation problem.

	DESTINATION				
SOURCE		D1	D2	D3	SUPPLY
	S1	2	7	4	5
	S2	3	3	7	8
	S3	5	7	1	7
	S4	1	6	2	14
	DEMAND	7	9	18	34

[7]

OR

Q-4 (A) Explain Hungarian method to solve Assignment Problem. [7]

(B) A product is manufactured by four factories A,B,C and D. The unit production costs in them are Rs. 2,Rs. 3, Rs. 1 and Rs. 5 respectively. Their production capacities are 50,70,30 and 50 units respectively. These factories supply the product to four stores, demands of which are 25,35,105 and 20 units respectively. Unit transportation cost in rupees from each factory to each store is given in the table below. [7]

	STORES				
FACTORIES		1	2	3	4
	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is minimum

Q-5 Answer in Short : **(Attempt any SEVEN)** [14]

(1) Define extreme point.

(2) Give two examples of non-convex set.

(3) Define convex linear combination.

(4) Define Artificial variable.

(5) How we solve any Linear Programming Problem using Two-Phase simplex method ?

(6) When we say any Linear Programming Problem has Unbounded solution ?

(7) Give one advantage of duality.

(8) Obtain dual problem of the following LPP.

Min. $Z=x_1+2x_2$ Subject to the constraints $2x_1+4x_2\le 160$; $x_1-x_2=30$; $x_1\ge 10$ $x_1,x_2\ge 0$

(9) How we get Primal solution without solve it ?

(10) Explain North-West Corner Rule.

(11) How we solve unbalanced transportation problem ?

(12) How we solve unbalanced Assignment Problem ?

-------------------- *Best of Luck* --