

Enrolment No. /Seat No.: \_\_\_\_\_

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**MCA – SEMESTER III- EXAMINATION –SUMMER-2025**

**Subject Code: 639406**

**Date: 05/06/2025**

**Subject Name: Operation Research**

**Time:02:30 PM TO 05:00 PM**

**Total Marks: 70**

**Instructions:**

1. Attempt all questions.
2. Make Suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of simple calculators and non-programmable scientific calculators are permitted.

- Q.1 (a)** Define the following terms **07**
1. Operation research
  2. Gradual failure
  3. Inventory
  4. Carrying (Holding) cost of an inventory
  5. Dummy activity
  6. Optimistic time in PERT
  7. Balking
- (b)** State advantages and applications of operation research **07**

- Q.2 (a)** Explain the procedure to solve a Linear programming problem using the simplex method. **07**
- (b)** Write a dual of the following LP problem. **07**

Minimize  $Z_x = 3x_1 - 2x_2 + 4x_3$

subject to,

$$3x_1 + 5x_2 + 4x_3 \geq 7,$$

$$6x_1 + x_2 + 3x_3 \geq 4,$$

$$7x_1 - 2x_2 - x_3 \leq 10,$$

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

$$4x_1 + 7x_2 - 2x_3 \geq 2$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

**OR**

- (b)** For the given LP model, find the solution using the simplex method. **07**

Maximize  $Z=80x_1+70x_2$

Subjected to

$$4x_1+6x_2 \leq 120,$$

$$8x_1+6x_2 \leq 192,$$

$$x_1, x_2 \geq 0$$

- Q.3 (a)** Find the initial basic feasible solution for the transportation problem given in the table using Vogel's approximation method. **07**

		Distribution centers				Supply
		D1	D2	D3	D4	
Production plant (Sources)	S1	22	26	34	28	500
	S2	32	36	28	20	600
	S3	42	48	26	20	800
Requirement (Demand)		400	450	550	500	

(b) Explain in detail the Hungarian method to solve an assignment problem. 07

**OR**

**Q.3 (a)** Explain the MODI method (u, v method) to solve a transportation problem. 07

(b) A pharmaceutical company producing a single product sold it through five agencies situated in different cities. As a result of increased demand for the product in another five cities that didn't have any agency of the company. The company is now facing the problem of deciding how to assign the existing agencies to dispatch the product to needy cities so that the travelling distance is minimized. The distance between the surplus and deficit cities (in km) is given in the following table. Solve the assignment problem. 07

		Deficit cities				
		A	B	C	D	E
Surplus cities	C1	160	130	115	190	200
	C2	135	120	130	160	175
	C3	140	110	125	170	185
	C4	50	50	80	80	110
	C5	55	35	80	80	105

**Q.4 (a)** The cost of a laser printing machine is Rs. 45000 and its scrap value is Rs. 3000. The maintenance and refilling costs (in Rs.) for each year are as given below: 07

Year	1	2	3	4	5	6	7
Maintenance and refilling cost	2000	4000	7000	10000	16000	22000	32000

When should the printer be replaced?

(b) What is Economic Order quantity (EOQ)? A manufacturing company purchases raw materials at a cost of 16 rupees per unit. The annual demand is 25,000 units. The cost associated with the storage per unit is 6.40 rupees and the cost of placing an order is 32 rupees. Calculate all the inventory costs and economic order quantity. 07

**OR**

**Q.4 (a)** Explain various inventory cost components with suitable examples. 07

(b) What is Replacement? Explain the types of failures with suitable examples. 07

**Q.5 (a)** Compare PERT and CPM. 07

(b) Explain Kendall's notation to represent a queuing system in detail. 07

**OR**

**Q.5 (a)** An established company has decided to add a new product to its line. It will buy the product from a manufacturing concern, package it, and sell it to several distributors that have been selected on a geographical basis. Market research has already indicated the expected volume and the required size of the sales force. The steps shown in the following table are to be planned. Draw a network diagram for the following project and find its critical path. 07

<i>Activity</i>	<i>Description</i>	<i>Predecessors</i>	<i>Duration (days)</i>
<i>A</i>	Organize sales office	–	6
<i>B</i>	Hire salesmen	<i>A</i>	4
<i>C</i>	Train salesmen	<i>B</i>	7
<i>D</i>	Select advertising agency	<i>A</i>	2
<i>E</i>	Plan advertising campaign	<i>D</i>	4
<i>F</i>	Conduct advertising campaign	<i>E</i>	10
<i>G</i>	Design package	–	2
<i>H</i>	Setup packaging facilities	<i>G</i>	10
<i>I</i>	Package initial stocks	<i>J, H</i>	6
<i>J</i>	Order stock from manufacturer	–	13
<i>K</i>	Select distributors	<i>A</i>	9
<i>L</i>	Sell to distributors	<i>C, K</i>	3
<i>M</i>	Ship stocks to distributors	<i>I, L</i>	5

(b) Explain Johnson's procedure(steps) to process n jobs through two machines.

07

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