

Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 7 – EXAMINATION – SUMMER 2026

Subject Code: 2171901

Date: 05/06/2026

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. Simple and non-programmable scientific calculators are allowed.

- Q.1**
- (a) Discuss various areas for the application of operations research techniques. **03**
- (b) Explain different phases of OR. **04**
- (c) Using graphical method to solve the LPP **07**
Maximize $Z=8x_1+6x_2$
Subjected to,
 $20x_1+10x_2 \leq 200,$
 $9x_1+5x_2 \leq 100,$
 $10x_1+20x_2 \geq 200$
 $x_1 \text{ \& } x_2 \geq 0$
- Q.2**
- (a) Construct the dual of following primal problem **03**
Minimize $Z = 3x_1 - x_2 + x_3$
Subject to,
 $4x_1 - x_2 \geq 8,$
 $8x_1 + x_2 + 3x_3 \geq 8,$
 $5x_1 - 6x_3 \geq 12,$
 $x_1, x_2, x_3 \geq 0$
- (b) A company is manufacturing two different types of products, A and B. Each product has to be processed on two machines M_1 and M_2 . Product A requires 3 hours on machine M_1 and 2 hours on machine M_2 , Product B requires 2 hours on machine M_1 and 4 hours on machine M_2 . The available capacity of machine M_1 is 200 hours and that of machine M_2 is 150 hours. Profit per unit for product A is Rs.8 and that for B is Rs.15. Formulate the problem. **04**
- (c) Solve the following LPP by simplex method. **07**
Maximize $Z= 30x_1 + 20x_2$
Subjected to,
 $2x_1+3x_2 \leq 50$
 $4x_1+3x_2 \leq 60$
 $x_1, x_2 \geq 0$

OR

- (c) Solve the following LPP by simplex method

07

$$\text{Minimize } Z = 6x_1 + 5x_2$$

Subject to,

$$2x_1 + x_2 \geq 5,$$

$$x_1 + 2x_2 \geq 4,$$

$$x_1, x_2 \geq 0$$

- Q.3 (a) Define degeneracy in transportation problem. 03

- (b) Explain Transshipment concept in Transportation problem with suitable example. 04

- (c) Find out optimal cost for following transportation problem using Least cost method. 07

	D1	D2	D3	D4	Supply
S1	8	10	12	9	50
S2	10	11	11	10	60
S3	9	9	10	10	70
Demand	40	40	60	40	

OR

- Q.3 (a) Discuss Characteristics of two-person zero sum games. 03

- (b) For what value of λ , the game with following pay-off matrix is strictly determinable? 04

Player B

Player A	B_1	B_2	B_3
A_1	λ	6	2
A_2	-1	λ	-7
A_3	-2	4	λ

- (c) Find the minimal assignment cost of following matrix 07

	1	2	3	4
A	7	8	9	8
B	6	8	8	6
C	12	11	10	9
D	10	12	14	16

- Q.4 (a) Distinguish forward pass and backward pass calculation in context of critical path method. 03

- (b) Differentiate Individual and Group Replacement Policy. 04

- (c) The running cost per year and resale price of the Grinding machine is given below. The purchase price is Rs. 9000/-. What is the optimum period of replacement? 07

Year	1	2	3	4	5	6	7
Running Cost (Rs.)	200	2200	4200	6200	8200	10200	12200
Resale value (Rs.)	0	0	0	0	0	0	0

OR

- Q.4 (a) Define the following terms relating the customer's behavior in Queue. (A) Balking (B) Jockeying (C) Reneging. 03

- (b) Explain Kendall's notation for queuing system. 04

- (c) In Workshop vehicle arrive at the time interval of 50 minutes and departures at on an average at 26 minutes after service. Calculate: 1) Expected system length, 2) waiting time of customer when 3rd customer arrives at the same time. **07**

- Q.5** (a) Discuss various costs involved in an Inventory model. **03**
 (b) Write a short note on “ABC analysis” of inventory control technique. **04**
 (c) Consider the following given data and based on that find out the number of path available in network, project completed time and critical path for the given project: **07**

Activity	Predecessor	Weeks
A	-	3
B	-	4
C	A	5
D	B	6
E	C	4
F	B, C	8
G	F	9
H	E	8

OR

- Q.5** (a) Define the term decision-making under certainty, under uncertainty and under risk. **03**
 (b) Discuss, Why replacement of old parts or machinery is important in Industry? **04**
 (c) The demand for a part is 100 units per day. The incurred fixed cost is Rs 400 for every time order. The holding cost is 80 paisa per unit per day. If lead time is 5 days, calculate the economic lot size and reorder point. **07**
