

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**MCA– SEMESTER III- EXAMINATION –WINTER-2023**

**Subject Code:639406****Date: 05/12/2023****Subject Name: Operation Research****Time: 10:30 AM TO 01:00 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)** (1) Obtain the dual of the following primal LP problem. **04**  
 Maximize  $Z_x = x_1 + 2x_2 + x_3$   
 Subject to constraints  
 (1)  $2x_1 + x_2 - x_3 \leq 2$   
 (2)  $-2x_1 + x_2 - 5x_3 \geq -6$   
 (3)  $4x_1 + x_2 + x_3 \leq 6$   
 $x_1, x_2, x_3 \geq 0$
- (2) Explain the following terms with respect to PERT / CPM. **03**  
 i. Dangling  
 ii. Merge event  
 iii. Dummy activity
- (b)** Define Operation Research. Discuss the features of Operation Research. **07**
- Q.2 (a)** Use the graphical method to solve the following LP problem. **07**  
 Maximize  $Z = 15x_1 + 10x_2$   
 Subject to constraints,  
 (1)  $4x_1 + 6x_2 \leq 360$   
 (2)  $3x_1 + 0x_2 \leq 180$   
 (3)  $0x_1 + 5x_2 \leq 200$   
 $x_1, x_2 \geq 0$ .
- (b)** Discuss the general structure and assumptions of an LP Model. **07**
- OR**
- (b)** Solve using Simplex method: **07**  
 max  $Z = 5x_1 + 10x_2 + 8x_3$   
 subject to  
 $3x_1 + 5x_2 + 2x_3 \leq 60$   
 $4x_1 + 4x_2 + 4x_3 \leq 72$   
 $2x_1 + 4x_2 + 5x_3 \leq 100$   
 and  $x_1, x_2, x_3 \geq 0$
- Q.3 (a)** Determine the initial feasible solution for the following transportation problem **07**  
 using (1) NWCM, (2) LCM, and (3) VAM

	D1	D2	D3	D4	Supply
S1	19	30	50	10	7
S2	70	30	40	60	9
S3	40	8	70	20	18
Demand	5	8	7	14	

- (b) A department of a company has five employees with five jobs to be performed. The time (in hours) that each man takes to perform each job is given in the effectiveness matrix. How should the job be allocated, one per employee, so as to minimize the total man-hours? **07**

		Employees				
		I	II	III	IV	V
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

**OR**

- Q.3** (a) Describe the transportation problem with its general mathematical formulation, and Also define the following terms with reference to a transportation problem: (i) Feasible solution (ii) Basic feasible solution (iii) Optimal solution (iv) Non-degenerate basic feasible solution. **07**
- (b) Explain in brief what is assignment problem? Enlist the steps of Hungarian method to solve an assignment problem. **07**
- Q.4** (a) What is the meaning of Inventory management and control? Explain the different inventory cost components. **07**
- (b) Define job sequencing. Explain Johnson's procedure (steps) for processing n jobs through two machines. **07**

**OR**

- Q.4** (a) A project schedule has the following characteristics. **07**

Activity	Time (days)
1 – 2	4
1 – 3	1
2 – 4	1
3 – 4	1
3 – 5	6
4 – 9	5
5 – 6	4
5 – 7	8
6 – 8	1
7 – 8	2
8 – 10	5
9 – 10	7

- (a) Construct the Network Model.  
 (b) Compute the earliest event time and latest event time.  
 (c) Determine the critical path and total project duration.
- (b) What is 'Inventory'? List and explain the different types of Inventories. **07**
- Q.5** (a) Which are the patterns of customer arrivals in a Queuing system? For a queuing system, define (i) Traffic intensity (server utilization factor) (ii) Customer arrival rate (iii) Reneging (iv) Jockeying **07**
- (b) A firm is considering the replacement of a machine, whose cost price is Rs 12,200, and its scrap value is Rs 200. From the experience the running costs are found to be as follows: **07**

Year	1	2	3	4	5	6	7	8
Running Cost(Rs.)	200	500	800	1,200	1,800	2,500	3,200	4,000

When should the machine be replaced?

**OR**

- Q.5 (a)** Determine the sequence that will minimize the total elapsed time, also find idle time of all machines. **07**

Job	1	2	3	4	5	6
Machine 1	3	12	5	2	9	11
Machine 2	8	6	4	6	3	1
Machine 3	13	14	9	12	8	13

- (b)** Describe the PERT/CPM network components and rules for network construction. **07**

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