

GUJARAT TECHNOLOGICAL UNIVERSITY
MCA– SEMESTER - III EXAMINATION- SUMMER-2023

Subject Code: 639406**Date: 26/06/2023****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 Explain advantage and limitation of linear programming in detail **07**

B Obtain the dual of the following primal LP problem **07**

1. Maximize $Z_x = x_1 - 2x_2 + 3x_3$
subject to the constraints

(i) $-2x_1 + x_2 + 3x_3 = 2,$

(ii) $2x_1 + 3x_2 + 4x_3 = 1$

and $x_1, x_2, x_3 \geq 0$

2. Minimize $Z_x = 3x_1 - 2x_2 + 4x_3$
subject to the constraints

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

(ii) $6x_1 + x_2 + 3x_3 \geq 4,$

(iii) $7x_1 - 2x_2 - x_3 \leq 10$

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

(v) $4x_1 + 7x_2 - 2x_3 \geq 2$

and $x_1, x_2, x_3 \geq 0$

Q.2 A A manufacturing company is engaged in producing three types of products: A, B and C. **07**
The production department produces, each day, components sufficient to make 50 units of A, 25 units of B and 30 units of C. The management is confronted with the problem of optimizing the daily production of the products in the assembly department, where only 100 man-hours are available daily for assembling the products. The following additional information is available:

Type of product	Profit contribution per unit of product (Rs)	Assembly time per product (Hrs)

A	12	0.8
B	20	1.7
C	45	2.5

The company has a daily order commitment for 20 units of products A and a total of 15 units of products B and C. Formulate this problem as an LP model so as to maximize the total profit.

- B** Write the steps of the simplex algorithm for obtaining an optimal solution to a linear programming problem. **07**

OR

- B** Explain features and application of Operations Research in detail. **07**

- Q.3 A** What do you mean by Degeneracy in transportation problem? How this can be solved? **07**

- B** A product is manufactured at four factories A, B, C and D. Their unit production costs are Rs 2, Rs 3, Re 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. **07**

	Stores			
Factories	I	II	III	IV
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 the minimum.

OR

- Q.3 A** 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. **07**

	Employee				
Job	I	II	III	IV	V
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

How should the jobs be allocated, one per employee, so as to minimize the total man-hours?

- B** State and discuss similarities and differences between Transportation problem and Assignment Problem. **07**

- Q.4 A** Listed in the table are the activities and sequencing necessary for a maintenance job on the heat exchangers in a refinery. **07**

Activity	Description	Predecessors
A	Dismantle pipe connections	-
B	Dismantle heater, closure, and floating front	A
C	Remove tube bundle	B
D	Clean bolts	B
E	Clean heater and floating head front	B
F	Clean tube bundle	C
G	Clean shell	C
H	Replace tube bundle	F,G
I	Prepare shell pressure test	D, E, H
J	Prepare tube pressure test and reassemble	I

Draw a network diagram of activities for the project.

- B** The production department of a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs 36 and the cost of carrying inventory is 25 per cent of the investment in the inventories. The price is Rs 10 per kg. Help the purchase manager to determine an ordering policy for raw material. **07**

OR

- Q.4 A** We have five jobs, each of which must be processed on the two machines A and B, in the order AB. Processing times in hours are given in the table below: **07**

JOB	1	2	3	4	5
Machine A	10	2	18	6	20
Machine B	4	12	14	16	18

Determine a sequence for the five jobs that will minimize the elapsed time T .

- B** Explain with suitable examples the different costs that are involved in the inventory problems. **07**

Q.5 A Discuss the fields of application for queuing theory. Explain queue discipline and its various forms. **07**

B The data collected in running a machine, the cost of which is Rs 60,000 are given below: **07**

YEAR	1	2	3	4	5
Resale value (Rs)	42,000	30,000	20,400	14,400	9,650
Cost of spares (Rs)	4,000	4,270	4,880	5,700	6,800
Cost of labour (Rs)	14,000	16,000	18,000	21,000	25,000

Determine the optimum period for replacement of the machine.

OR

Q.5 A In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter-arrival time follows an exponential distribution and the service time (the time taken to hump a train) distribution is also exponential with an average of 36 minutes. Calculate: **07**

- (i) expected queue size (line length)
- (ii) probability that the queue size exceeds 10

If the input of trains increases to an average of 33 per day, what will be the change in (i) and (ii)?

B What are situations that make the replacement of items necessary? Explain with example. **07**
