Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - V EXAMINATION - WINTER 2025

Subject Code: 3151910 **Date: 29-11-2025**

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. Simple and non-programmable scientific calculators are allowed.

			Marks
Q.1	**(a)**	Explain limitations of operation research.	**03**
	(b)	Discuss Various phases in solving an OR problems.	**04**
	(c)	Use graphical method to solve the following LPP: Maximize $Z = 20x1 + 10x2$ Subject to $x1 + 2x2 \leq 40$ $3x1 + x2 = 30$ $4x1 + 3x2 \geq 60$ and $x1, x2 \geq 0$	**07**
Q.2	**(a)**	Discuss relationship regarding primal and dual solution.	**03**
	(b)	A firm manufactures two product A & B on which the profit earned per unit are Rs. 3 and Rs. 4, respectively. Each product is processed on two machines M1 and M2. Product A requires one minute of processing time on M1and two minutes on M2, while product B requires one minute of processing time on M1 and one minute on M2. Machine M1 is available for not more than 7 hours and 30 minutes while machine M2 is available for 10 hours during any working day. Formulate the problem as LPP.	**04**
	(c)	Solve the following LPP by Big-M method: Minimize $Z = -3x1 + x2 - 2x3$ Subject to $x1 + 3x2 + x3 \leq 5$ $2x1 - x2 + x3 \geq 2$ $4x1 + 3x2 - 2x3 = 5$ And $x1, x2, x3 \geq 0$	**07**

OR

(c) Solve the following problem using Simplex Method: **07**

Maximize Z = 10x1 + 15x2

Subject to $2x1 + x2 \leq 26$

$2x1 + 4x2 \leq 56$

$X1 - x2 \geq -5$

And $x1, x2 \geq 0$

Q.3 (a) How profit maximization problem can be solved in assignment technique? **03**

(b) Consider the transportation problem shown in table below. Find the initial basic feasible solution using Northwest corner method. **04**

	1	2	3	4	5	Supply
1	20	4	32	28	20	3000
2	12	36	24	26	32	5000
3	16	8	28	24	20	8250
4	28	44	40	16	36	3750
Demand	3500	4000	2500	1500	4000	

(c) Solve the following assignment problem by minimization method **07**

	I	II	III	IV	V
M1	12	5	9	18	11
M2	13	7	6	12	14
M3	3	2	3	4	5
M4	18	9	12	16	15
M5	12	6	14	19	10

OR

(a) What is degeneracy in transportation problem? **03**

(b) A chemical company distributes its products by trucks loaded at its only loading station and loading station is working 24 hours, continuously. Both company's trucks and contractor's trucks are used for this purpose. It was find out that on an average 10 minutes one truck arrived and average loading time is 6 minutes. If 50% trucks are contractor's trucks find: **04**

1. Traffic intensity factor;
2. Waiting time of trucks in system;

The expected waiting time of contractor's trucks per day.

(c) A transportation company has 5, 10, 7 and 3 trucks available at four different sites A, B, C and D. Its customers have requirement of 5, 8 and 10 trucks at the three different destinations X, Y and Z respectively. The distance (in kms.) from an origin to destination is summarized in the following table. Formulate above problem as transportation problem and determine strategy for a company using VAM. Test the optimality of VAM solution and determine optimum strategy for the transport company. **07**

	X	Y	Z
A	70	30	60
B	40	60	80
C	50	80	40
D	80	40	30

Q.4 **(a)** What do you understand by zero sum with reference to game theory? Explain saddle point in brief. **03**

(b) A copy maker has one copy making machine and he operates as the order comes. The order arrival is poison distribution having interval time of 0.5 min. The average time to serve a copy is distributed with mean of 0.3 min. Determine the following: **04**

1. Utilization factor of the machine
2. Idle time for machine in a day having working hours of 10 hours
3. No. of persons waiting in the system
4. No. of persons waiting in the queue

Average waiting time in the queue

(c) Company has purchased machine A costing Rs. 4500 and it has estimated operating cost of Rs. 100 for the first year increasing by Rs. 1000 per year in the second and subsequent years. Now, after six months due to technological advancement machine B was introduced costing Rs. 5000. Its operating cost is Rs. 200 for the first year, increasing by Rs. 400 in second year and subsequent years. Now, company is thinking to buy the machine B. Suggest him optimal time. Consider resale value as zero for both machines. **07**

OR

(a) What is strategy? Explain the difference between pure and mixed strategy. **03**

(b) Draw algorithm to solve the assignment problem. **04**

(c) Explain briefly the difference in replacement of items which deteriorates gradually and items which fails completely that too suddenly. **07**

Q.5 **(a)** Mention any two limitations of critical path. **03**

(b) What is EMV? How is it computed to be used a criterion of decision making and when? **04**

(c) The following table give the duration in days and the predecessor for the various tasks. Draw the network diagram and find the minimum time for completion of the project. **07**

Task	A	B	C	D	E	F	G	H	I
Time(Days)	8	10	8	10	16	17	18	14	9
Predecessor	-	-	-	A	A	B,D	C	C	F,G

OR

(a) Explain predecessor, successor and dummy activity with diagram. **03**

(b) What do you mean by saddle point? How it is found out? **04**

(c) A small project is composed of 7 activities whose time estimates are listed in the table below. Activities are identified by their beginning and ending node numbers: **07**

A small project is composed of 7 activities whose time estimates are listed in the table below. Activities are identified by their beginning and ending node numbers:

Activity	t_0	t_m	t_p	Activity	t_0	t_m	t_p
1-2	1	1	7	3-5	2	5	14
1-3	1	4	7	4-6	2	5	8
1-4	2	2	8	5-6	3	6	15
2-5	1	1	1				

i. *Draw the project network.*

ii. *Find the expected duration and variance of each activity.*

iii. *What is the expected project length and standard deviation?*

iv. *What is the probability that the project will be completed 3 weeks later than expected time?*

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