GUJARAT TECHNOLOGICAL UNIVERSITY
MCA INTEGRATED– SEMESTER IV- EXAMINATION –SUMMER-2024

Subject Code: 2648602   **Date: 15/05/2024**
Subject Name: Operations 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)** Define Operations Research. Write down the features and advantages of it. **07**

(b) Consider the following problem faced by a production planner of a soft drink **07**
plant. He has two bottling machines A and B. A is designed for 8-ounce bottles
and B for 16-ounce bottles. However, each can also be used for both types of
bottles with some loss of efficiency. The manufacturing data is as follows:

Machine	8 - ounce Bottles	16 - ounce Bottles
A	100/minute	40/minute
B	60/minute	75/minute

The machines can be run for 8 hours per day, 5 days per week. The profit on an
8 – ounce bottle is 15 paise and on a 16 – ounce bottle is 25 paise. Weekly
production of the drink cannot exceed 3,00,000 bottles and the market can
absorb 25,000, 8 – ounce bottles and 7,000, 16 – ounce bottles per week. The
planner wishes to maximize his profit, subject to course, to all the production
and marketing restrictions. Formulate this problem as an LP model to maximize
total profit.

Q.2 **(a)** Obtain an optimal solution for the following transportation problem: **07**

	D_1	D_2	D_3	D_4	Supply
S_1	19	30	50	10	**7**
S_2	70	30	40	60	**9**
S_3	40	8	70	20	**18**
Demand	**5**	**8**	**7**	**14**	**34**

(b) A department of a company has five employees with five jobs to be performed. **07**
The time (in hours) that each man takes to perform each job is given in the
effectiveness matrix.

		Employees				
		I	**II**	**III**	**IV**	**V**
	A	10	5	13	15	16
	B	3	9	18	13	6
Jobs	**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?

OR

(b) Write down the reasons for carrying inventory. **07**

Q.3 **(a)** Machine A costs 45,000 and operating costs are estimated as 1,000 for the first year, increasing by 10,000 per year in the second and subsequent years. Machine B costs 50,000 and operating cost are 2,000 for the first year; increasing by 4,000 in the second and subsequent years. If at present we have a machine of type A, should we replace it with B? If so when? Assume that both machines have no resale value and their future costs are not discounted. **07**

(b) For what value of λ, the game with following pay-off matrix is strictly determinable? **07**

| | **Player B** | | |
Player A	**B₁**	**B₂**	**B₃**
A₁	λ	6	2
A₂	-1	λ	-7
A₃	-2	4	λ

OR

Q.3 **(a)** A Company manufactures around 200 mopeds. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is as given below: **07**

Production/Day:	196	197	198	199	200	201	202	203	204
Probability:	0.05	0.09	0.12	0.14	0.20	0.15	0.11	0.08	0.06

The finished mopeds are transported in a specially designed three storied lorry that can accommodate only 200 mopeds. Using the following 15 random numbers 82,89,78,24,53,61,18,45,04,23,50,77,27,54,10, simulate the mopeds waiting in the factory?
(i) What will be the average number of mopeds waiting in the factory?
(ii) What will be the average number of empty space in the lorry?

(b) Write down the difference between PERT and CPM. **07**

Q.4 **(a)** In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the interarrival 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) Write down the types of simulation. **07**

OR

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	A	B	C	D	E	F	G	H	I	J
Predecessor Activty	-	A	B	B	B	C	C	F, G	D, E, H	I

Draw a network diagram of activities for the project.

(b) Solve the following sequencing problem, giving an optimal solution when passing is not allowed. **07**

Machine	Job				
	A	**B**	**C**	**D**	**E**
M_1	11	13	9	16	17
M_2	4	3	5	2	6
M_3	6	7	5	8	4
M_4	15	8	13	9	11

Q.5 **(a)** Use the graphical method to solve the following LP problem.   **07**
Maximize $Z= 2x_1 + x_2$
Subject to the constraints,
(i) $x_1 + 2x_2 \leq 10$,   (ii) $x_1 + x_2 \leq 6$,   (iii) $x_1 - x_2 \leq 2$,   (iv) $x_1 - 2x_2 \leq 1$
and $x_1, x_2 \geq 0$.

(b) Use the simplex method to solve the following LP problem.   **07**
Maximize (total profit) $Z= 4x_1 + 3x_2$
Subject to the constraints,
(i) $2x_1 + x_2 \leq 1000$,   (ii) $x_1 + x_2 \leq 800$,   (iii) $x_1 \leq 400$,   (iv) $x_2 \leq 700$
and $x_1, x_2 \geq 0$.

OR

Q.5 **(a)** Write the dual of the following primal LP problem: **07**
Maximize $Z= 3x_1 + x_2 + 2x_3 - x_4$
Subject to the constraints,
(i) $2x_1 - x_2 + 3x_3 + x_4 = 1$ (ii) $x_1 + x_2 - x_3 + x_4 = 3$
and $x_1, x_2 \geq 0$ and x_3 , x_4 unrestricted in sign.

(b) Write a note on: **i)** types of failure   **ii)** behavior of arrivals   **07**

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