GUJARAT TECHNOLOGICAL UNIVERSITY
MCA INTEGRATED– SEMESTER IV- EXAMINATION –WINTER-2023

Subject Code:2648602   **Date: 04/01/2024**
Subject Name: Operations 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. Use of simple calculators and non-programmable scientific calculators are permitted.

Q.1 (a) What is Operations Research (OR)? What are the significant features of OR? State **07** any four application of OR.

(b) An electronic company is engaged in the production of two components C_1 and C_2 **07** that are used in radio sets. Each unit of C_1 costs the company Rs. 5 in wages and Rs. 5 in material, while each of C_2 costs the company Rs. 25 in wages and Rs. 15 in material. The company sells both products on one-period credit terms, but the company's labour and material expenses must be paid in cash. The selling price of C_1 is Rs. 30 per unit and of C_2 it is Rs. 70 per unit. Because of the company's strong monopoly in these components, it is assumed that the company can sell, at the prevailing prices, as many units as it produces. The company's production capacity is, however, limited by two considerations. First, at the beginning of period 1, the company has an initial balance of Rs. 4000. Second, the company has available in each period 2000 hours of machine time and 1400 hours of assembly time. The production of each C_1 requires 3 hours of machine time and 2 hours of assembly time, whereas, the production of each C_2 requires 2 hours of machine time and 3 hours of assembly time.Formulate this problem as an LP model so as to maximize the total profit to the company.(DO NOT SOLVE)

Q.2 (a) Construct the dual of the problem. **07**
    Max $z = 6x_1 + 4x_2 + 6x_3 + x_4$
    subject to the constraints
    (i) $4x_1 + 4x_2 + 4x_3 + 8x_4 = 21$
    (ii) $3x_1 + 17x_2 + 80x_3 + 2x_4 \leq 48$
    Where $x_1, x_2 \geq 0$ and x_3, x_4 are unrestricted.

(b) Solve the following LP problem using Simplex method: **07**
    Maximize $Z = x_1 - x_2 + 3x_3$
    subject to the constraints
    $x_1 + x_2 + x_3 \leq 10$
    $2x_1 - x_3 \leq 2$
    $2x_1 - 2x_2 + 3x_3 \leq 0$
    and $x_1, x_2, x_3 \geq 0$.

OR

(b) Use penalty (Big-M) method to solve the following LPP **07**

    Maximize $Z = 2x_1 + 4x_2$

    Subject to $2x_1 + x_2 \leq 18$

        $3x_1 + 2x_2 \geq 30$

        $x_1 + 2x_2 = 26$ and $x_1, x_2 \geq 0$.

Q.3 **(a)** Solve the following assignment problem: 07

	1	2	3	4	5
A	41	72	39	52	25
B	22	29	49	65	81
C	27	39	60	51	40
D	45	50	48	52	37
E	29	40	45	26	30

Minimize the total cost.

(b) Determine an initial basic feasible solution to the following transportation problem using (i) Least Cost Method and (ii) Vogel's Approximation Method: 07

Origins	Destinations				Availability
	D_1	D_2	D_3	D_4	
O_1	5	3	6	2	19
O_2	4	7	9	1	37
O_3	3	4	7	5	34
Demand	16	18	31	25	90

OR

Q.3 **(a)** Define: Simulation. State the advantages and disadvantages of simulation. 07

(b) Define: Two- person zero- sum game, Saddle point. For the game with payoff matrix: 07

Player A	Player B			
	B_1	B_2	B_3	B_4
A_1	3	−5	0	6
A_2	−4	−2	1	2
A_3	5	4	2	3

Determine the best strategies for players A and B and the value of the game. Is this game (i) fair? (ii) strictly determinable?

Q.4 **(a)** Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially, with mean 3 minutes. Find: 07
   1. The probability that an arrival finds that four persons are waiting for their turn.
   2. The average number of persons waiting and making telephone calls.
   3. The average length of the queue that is formed time to time.

(b) Describe the characteristics of Calling Population (input source) of a Queuing System. What do you understand by Queue Discipline? 07

OR

Q.4 **(a)** 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 of replacement of the machine.

(b) An engineering company is offered a material handling equipment A. It is priced at Rs. 60,000 including cost of installation. The costs for operation and maintenance are estimated to be Rs. 10,000 for each of the first five years, increasing every year by Rs. 3,000 in the sixth and subsequent years. The company expects a return of 10% on all its investment. What is the optimal replacement period? **07**

Q.5 (a) Explain different type of Inventory Cost. **07**

(b) precedence relationships of the activities, and activity time estimates of a project is as follows **07**

Task	A	B	C	D	E	F	G	H	I	J
Precedence	-	A	-	C	B,C	C	F	D,E,G	D,E	H,I
Time	10	5	15	11	10	5	5	10	10	15

    1. Draw the network of the project.
    2. Obtain the total, free and independent float values for non-critical activities.

OR

Q.5 (a) A machine operator has to perform three operations, turning, threading **07** and knurling on a number of different jobs. The time required to perform these operations (in minutes) for each job is known and is given below: **07**

Job	Time for turning	Time for threading	Time for knurling
1	3	8	13
2	12	6	14
3	5	4	9
4	2	6	12
5	9	3	8
6	11	1	13

Determine the order in which the jobs should be processed in order to minimize the total time required to turn out all the jobs.

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

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