Hall Ticket Number :										

R-14

Code: 4G571

IV B.Tech. I Semester Supplementary Examinations August 2020

Operations Research

(Mechanical Engineering)

Max. Marks: 70 Time: 3 Hours

Answer *all five* units by choosing one question from each unit (5 x 14 = 70 Marks)

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UNIT–I

1. Solve the following LPP by Big-M method.

$$\begin{aligned} Maximize \quad & Z = 2x_1 + 4x_2 \\ subject\ to \quad & 2x_1 + x_2 \leq 18 \\ & 3x_1 + 2x_2 \geq 30 \\ & x_1 + 2x_2 = 26 \\ & x_1, x_2 \geq 0 \end{aligned}$$

OR

2. Solve the following problem graphically:

$$\begin{aligned} Maximize \quad & Z = 5x_1 + 6x_2 \\ subject\ to \quad & x_1 - 2x_2 \geq 2 \\ & -2x_1 + 3x_2 \geq 2 \end{aligned}$$

x_1, x_2 *unrestricted in sign*

UNIT–II

3. The Captain of a cricket team has to allot the first five batting positions to the five batsmen. The average runs scored by each batsman at these positions are as follows:

Batsman	Batting Positions				
	1	2	3	4	5
P	40	40	35	25	50
Q	42	30	16	25	27
R	50	48	40	60	50
S	20	19	20	18	25
T	58	60	59	55	53

Find the assignment of batsmen to positions, which would give the maximum number of runs.

OR

4. The MJK Manufacturing Company must produce two products in sufficient quantity to meet contracted sales in each of the next three months. The two products share the same production facilities, and each unit of both products requires the same amount of production capacity. The available production and storage facilities are changing month by month, so the production capacities, unit production costs, and unit storage costs vary by month. Therefore, it may be worthwhile to overproduce one or both products in some months and store them until needed.

   For each of the three months, the second column of the following table gives the maximum number of units of the two products combined that can be produced on Regular Tome (RT) and on Overtime (OT). For each of the two products, the subsequent columns give (1) the number of units needed for the contracted sales, (2) the cost (in thousands of dollars) per unit produced on Regular Time, (3) the cost (in thousands of dollars) per unit produced on Overtime, and (4) the cost (in thousands of dollars) of storing each extra unit that is held over into the next month. In each case, the numbers for the two products are separated by a slash /, with the number for Product 1 on the left and the number for Product 2 on the right.

	Maximum Combined Production		**Product 1 / Product 2**			
				Unit Cost of Production ($1,000's)		**Unit Cost of Storage ($1,000's)**
Month	**RT**	**OT**	**Sales**	**RT**	**OT**	
1	10	3	5/3	15/16	18/20	1/2
2	8	2	3/5	17/15	20/18	2/1
3	10	3	4/4	19/17	22/22	

   The production manager wants a schedule developed for the number of units of each of the two products to be produced on Regular Time and (if Regular Time production capacity is used up) on Overtime in each of the three months. The objective is to minimize the total of the production and storage costs while meeting the contracted sales for each month. There is no initial inventory, and no final inventory is desired after the three months.

   (a) Formulate this problem as a transportation problem by constructing the appropriate parameter table.

   (b) Obtain an initial solution using Vogel Approximation Method (VAM) and obtain an optimal solution.

   Find the assignment of batsmen to positions, which would give the maximum number of runs.

UNIT–III

5. A machine owner finds from his past records that the costs per year of maintaining a machine whose purchase price is Rs. 8000 are as given below:

Year	1	2	3	4	5	6	7	8
Maintenance Cost (Rs.)	1000	1300	1700	2200	2900	3800	4800	6000
Resale Price (Rs.)	4000	2000	1200	600	500	400	400	400

Determine at what age a replacement is due?

OR

6. Two players A and B play a game in which each has three coins: a Rs. 5, a Rs. 10, and a Rs. 20. Each selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount, A wins B's coin; if the sum is even, B wins A's coin. Find the best strategy for each player and the value of game.

UNIT–I

7. An airline company has one reservation clerk on duty in its local branch at any given time. The clerk handles information regarding passenger reservation and flight timings. Assume that the number of customers arriving during any given period is Poisson distributed with an arrival rate of eight per hour and that the reservation clerk can serve a customer in six minutes on an average, with an exponentially distributed service time.
   (a) What is the probability that the system is busy?
   (b) What is the average time a customer spends in the system?
   (c) What is the average length of the queue and what is the number of customers in the system?

OR

8. A company can produce an item or buy it from a contractor. If it is produced, it will cost $20 each time the machines are set up. The production rate is 100 units per day. If it is bought from a contractor, it will cost $15 each time an order is placed. The cost of maintaining the item in stock, whether bought or produced, is $.02 per unit per day. The company's usage of the item is estimated at 26,000 units annually. Assuming that no shortage is allowed, should the company buy or produce?

UNIT–V

9. A 4-ton vessel can be loaded with one or more of three items. The following table gives the unit weight, w_i, in tons and the unit revenue in thousands of rupees, r_i, for item i. How should be the vessel be loaded to maximize the total return? Solve this problem by dynamic programming.

Item	w_i	r_i
1	2	31
2	3	47
3	1	14

OR

10. A bookstore wishes to carry 'Ramayana' in stock. Demand is probabilistic and replenishment of stock takes 2 days (i.e., if an order is placed on March 1, it will be delivered at the end of the day on March 3). The probabilities of demand are given below:

Demand (daily)	0	1	2	3	4
Probability	0.05	0.10	0.30	0.45	0.10

Each time an order is placed, the store incurs an ordering cost of Rs. 10 per order. The store also incurs a carrying cost of Rs. 0.50 per book per day. The inventory carrying cost is calculated on the basis of stock at the end of each day.

The manager of the bookstore wishes to compare two options for his inventory decision.

Option A: Order 5 books when the inventory at the beginning of the day plus orders outstanding is less than 8 books.

Option B: Order 8 books when the inventory at the beginning of the day plus orders outstanding is less than 8 books.

Currently (beginning of the 1st day) the store has stock of 8 books plus 6 books ordered 2 days ago (say, on day '-1') and expected to arrive end of today (on day 1). Using Monte-Carlo simulation for 10 cycles, recommend which option the manager should choose.

The two-digit random numbers are given as:

89, 34, 78, 63, 61, 81, 39, 16, 13, 73.