

CBCS SCHEME

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20MCM334

Third Semester M.Tech. Degree Examination, July/August 2022 Operations Research

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. A company has two plants, each of which produces and supplies two products A and B. The plants can each work up to 16 hours a day. In plant 1, it takes three hours to prepare and pack 1000 gallons of A and one hours to prepare and pack one quintal of B in plant 2, it takes two hours to prepare and pack 1000 gallons of A and 1.5 hours to prepare and pack a quintal of B. In plant 1, it costs Rs. 15000 to prepare and pack 1000 gallons of A and Rs, 28000 to prepare and pack a quintal of B, where as in plant 2 these costs are Rs. 18000 and Rs. 26000, respectively. The company is obliged to produce daily atleast 10,000 gallons of A and 8 quintals of B. (05 Marks)
- Formulate this problem as an LP model to find out as to how the company should organize its production so that the required amounts of the two products be obtained at the minimum cost.
- b. Use penalty (Big M) method to solve the following LP problem :
- Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$
Subjected to constraints $x_1 + 2x_2 + 3x_3 = 15$
 $2x_1 + x_2 + 5x_3 = 20$
 $x_1 + 2x_2 + x_3 + x_4 = 10$
and $x_1, x_2, x_3, x_4 \geq 0$. (15 Marks)

OR

- 2 a. Use two phase Simplex Method to solve the following LP problem :
- Minimize $Z = x_1 + x_2$
Subject to constraints $2x_1 + x_2 \geq 4$
 $x_1 + 7x_2 \geq 7$
and $x_1, x_2 \geq 0$. (15 Marks)
- b. The Apex television company has to decide on the number of 27 inch and 20 inch sets to be produced at one of its factories. Market research indicates that atleast 40 of the 27 inch sets and 10 of 20 inch sets can be sold per month. The maximum number of work hours available is 500 per month. A 27 inch set requires 20 work hours and 20 inch set requires 10 work hours. Each 27 inch set sold produces a profit of Rs 6000 and each 20 inch produces a profit of Rs 4000. A wholesaler agreed to purchase all the television sets produced, if the numbers do not exceed the maxima indicated by market research. Formulate this problem as an LPP. (05 Marks)

Module-2

- 3 a. Use the Graphical Method to solve the following LP problem :

$$\text{Minimize } Z = 20x_1 + 10x_2$$

$$\text{Subject to the constraints : } x_1 + 2x_2 \leq 40$$

$$3x_1 + x_2 \geq 30$$

$$4x_1 + 3x_2 \geq 60$$

$$\text{and } x_1, x_2 \geq 0.$$

(10 Marks)

- b. Use the dual simplex method to solve the following problem

$$\text{Maximize } Z = -2x_1 - 3x_2$$

$$\text{Subject to } x_1 + x_2 \geq 2$$

$$2x_1 + x_2 \leq 10$$

$$x_1 + x_2 \leq 8$$

$$\text{and } x_1, x_2 \geq 0.$$

(10 Marks)

OR

- 4 a. Use the Revised Simplex Method to solve the following LP problem

$$\text{Maximize } Z = 2x_1 + x_2$$

$$\text{Subject to constraints } 3x_1 + 4x_2 \leq 6$$

$$6x_1 + x_2 \leq 3$$

$$\text{and } x_1, x_2 \geq 0.$$

(15 Marks)

- b. Write the dual to the following LP problem

$$\text{Maximize } Z = x_1 - x_2 + 3x_3$$

$$\text{Subject to constraints } x_1 + x_2 + x_3 \leq 10$$

$$2x_1 - x_2 - x_3 \leq 2$$

$$2x_1 - x_2 - 3x_3 \leq 6$$

$$\text{and } x_1, x_2, x_3 \geq 0.$$

(05 Marks)

Module-3

- 5 a. Using Kuhn –Tucker conditions.

$$\text{Maximize } Z = 8x_1 + 10x_2 - x_1^2 - x_2^2$$

$$\text{Subject to } 3x_1 + 2x_2 \leq 6$$

$$\text{and } x_1, x_2 \geq 0.$$

(10 Marks)

- b. Consider the following project having the time estimate in weeks.

Activity	t_0	t_m	t_p	Predecessor
A	3	6	9	–
B	2	5	8	–
C	2	4	6	A
D	2	3	10	B
E	1	3	11	B
F	4	6	8	C, D
G	1	5	15	E

Draw the project network and compute the probability of completion of the project in 18 weeks.

(10 Marks)

OR

- 6 a. What are the differences between PERT and CPM. (08 Marks)
 b. A project consists of a series of tasks labeled A B - - - H, I with the following constraints /precedence relationships.

$$A < D, E ; B, D < F ; C < G ; B < H ; F, G < I$$

A < D, E means D and E cannot start until W is completed. Construct a network using this notation, also find the minimum time required for the completion of the project when the time required for the completion of each task is given below :

Task	A	B	C	D	E	F	G	H	I
Time	23	8	20	16	24	18	19	4	10

(12 Marks)

Module-4

- 7 a. The production department of a company requires 3600kg 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% 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. (08 Marks)
 b. Electro uses resin in its manufacturing process at the rate of 1000 gallons per month. It costs electro \$100 to place an order for a new shipment. The holding cost per gallon per month is \$2, and the shortage cost per gallon is \$10. Historical data show that the demand during lead time is uniform over the range (0, 100) gallons. Determine the optimal ordering policy for electro. (12 Marks)

OR

- 8 a. Lube car specializes in fast automobile oil change. The garage buys car oil in bulk at \$3 per gallon. A discount price of \$2.50 per gallon is available if Lube car purchases more than 1000 gallons. The garage services approximately 150 cars per day, and each oil change takes 1.25 gallons. Lube car stores bulk oil at the cost of \$0.02 per gallon per day. Also, the cost of placing an order for bulk oil is \$20. There is a 2 – day lead time for delivery. Determine the optimal inventory policy. (10 Marks)
 b. i) At present a company purchases an item X form outside suppliers. The consumption of this item is 10,000 units/year. The cost of the item is Rs.5 per unit and he ordering cost is estimated to be Rs. 100 per order. The cost of carrying inventory is 25%. If the consumption rate is uniform, determine the economic purchasing quantity.
 ii) In the above problem assume that company is going to manufacture the item with the equipment that is estimated to produce 100 units per day. The cost of the units thus produced is Rs. 3.50 per unit. The setup cost is Rs. 150 per setup and the inventory carrying charge is 25%. How has your answer changed? (10 Marks)

Module-5

- 9 a. A company is currently involved in negotiations with its union on the upcoming wage contract. Positive signs in table represents wage increase while negative sign represents wage reduction. What are the optimal strategies for the company as well as the union? What is the game value?

Conditional costs to the company (Rs. In lakhs)

		Union Strategies			
		u ₁	u ₂	u ₃	u ₄
Company Strategy	c ₁	0.25	0.27	0.35	-0.02
	c ₂	0.20	0.06	0.08	0.08
	c ₃	0.14	0.12	0.05	0.03
	c ₄	0.30	0.14	0.19	0.00

(10 Marks)

- b. Use dynamic programming to solve the following problem.

$$\text{Maximize } Z = x_1^2 + 2x_2^2 + 4x_3$$

$$\text{Subject to constraint } x_1 + 2x_2 + x_3 \leq 8$$

$$\text{and } x_1, x_2, x_3 \geq 0.$$

(10 Marks)

OR

- 10 a. Determine the value of u_1 , u_2 and u_3 so as to

$$\text{Maximize } Z = u_1 \cdot u_2 \cdot u_3$$

$$\text{Subject to constraints } u_1 + u_2 + u_3 = 10$$

$$\text{and } u_1, u_2, u_3 \geq 0.$$

(12 Marks)

- b. Explain the properties of a Game and mention the assumptions made in Game theory.

(08 Marks)

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