337714 (37)

BE (7th Semester)

Examination, Nov.-Dec., 2021

Branch : Mechanical

OPERATIONS RESEARCH

Time Allowed : Three Hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Attempt all the questions. Part (a) is compulsory and attempt any two parts from each question. Use of statistical tables permitted.

Q. 1. (a) Define linear programming. **2**

(b) A certain farming organization operates three farms of comparable productivity. The output of each farm is limited both by the usable acrege and by the amount of water available for irrigation. Following are the data for the upcoming season :

Farm	Usable Acreage	Water available in acre feet
1	400	1,500
2	600	2,000
3	300	900

The organization is considering three crops for planting which differ primarily in their expected profit per acre and in their consumption of water. Furthermore, the total acreage can be devoted to each of the crops is limited by the amount of harvesting equipment available.

Crop	Minimum Acreage	Water consumption in acre feet/acre	Expected profit/acre
A	700	5	Rs. 4,000
B	800	4	Rs. 3,000
C	300	3	Rs. 1,000

In order to maintain a uniform workload among the farms, it is the policy of the organization that the percentage of the usable acreage planted must be the same at each farm. However any combination of the crops may be grown at any of the farms. The organization wishes to know how much each of the crops may be planted at the respective farms in order to maximize the profit. Formulate this as a linear programming problem. 9

(c) Solve the following LPP by graphical method.

Objective function

Maximize, $Z = 8x_1 + 6x_2$

subject to,

$$2x_1 + x_2 \leq 1{,}000$$

$$x_1 + x_2 \leq 800$$

$$x_1 \leq 400$$

$$x_2 \leq 700$$

$$x_1 \geq 0, \quad x_2 \geq 0$$ 9

(d) Solve the following LPP by simplex method :

Maximize, $Z = 2x_1 + x_2 - x_3 + 5x_4$

subject to,

$$x_1 + 7x_2 + 3x_3 + 7x_4 \leq 46$$

$$3x_1 - x_2 + x_3 + 2x_4 \leq 8$$

$$2x_1 + 3x_2 - x_3 + x_4 \leq 10$$

$$x_1 \geq 0,\ x_2 \geq 0,\ x_3 \geq 0$$ 9

Q. 2. (a) What is an assignment problem ? Write two examples of assignment problem. 2

(b) List and explain the different methods of getting initial basic feasible solution in transportation method. **9**

(c) A product is produced by four factories A, B, C, D. The unit production cost in them are Rs. 2, 3, 1 and 5 respectively. Their production capacities are factory A → 50, B – 70, C – 30 and D – 50 units. These factories supply the product to four stores, demands of which are 25, 35, 105 and 20 units respectively. Unit transportation in rupees from each factory to each store is given below :

Stores

		1	2	3	4
	A	2	4	6	11
Factories	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each of the factories to each stores so that the total production and transportation cost is minimum. **9**

(d) There are 5 jobs and 5 m/c. The associated cost of allocating a job to the m/c is given in table below :

	M_1	M_2	M_3	M_4	M_5
J_1	11	17	8	16	20
J_2	9	7	12	6	15
J_3	13	16	15	12	16
J_4	21	24	17	28	26
J_5	14	10	12	11	15

It is required to assign one job each of 5 machines. Determine the optimal assignment of jobs, so that the total cost of processing all jobs is minimized. 9

Q. 3. (a) Explain the meaning of a 'Queue' with suitable examples. **2**

(b) Explain the basic structure and different elements of queueing system. **9**

(c) (i) Distinguish between PERT and CPM. **4**

(ii) A project is expected to take 12 months along the critical path, having standard deviation of 4 months. What is the probability of completing the project within 10 months and 16 months. **5**

(d) A small engineering project consists of six activities. The three time estimates in number of days for each activity are given below. **9**

Activity	t_o	t_m	t_p
1-2	2	5	8
2-3	2	3	4
3-5	3	6	18
5-6	7	7	7
1-4	3	3	3
4-5	2	8	14

(i) Calculate the values of expected time (t_e), standard deviation (σ_t) and variance for each activity.

(ii) Draw the network.

(iii) Identify the critical path and mark on the network diagram.

Q. 4. (a) Explain why simulation is used ? **2**

(b) A bakery keeps stock of popular brand of cake. Previous experience shows that the daily demand pattern for the item with associated probabilities is given below :

Daily Demand :	0	10	20	30	40	50
Probability :	0.01	0.2	0.15	0.5	0.12	0.02

Use the following sequence of random numbers to simulate for next 10 days. Also determine the average demand per day. **9**

(c) Explain the following terms : **9**

(i) Pure strategy

(ii) Mixed strategy

(iii) Saddle point

(iv) Pay off matrix

(v) Value of game

(d) Two companies are competing for the same product. Their different strategies are given in the following pay off matrix.

Company A

$$\begin{array}{c c} & \begin{array}{ccc} a_1 & a_2 & a_3 \end{array} \\ \begin{array}{c} b_1 \\ b_2 \end{array} & \begin{bmatrix} 4 & -1 & 0 \\ -1 & 4 & 2 \end{bmatrix} \end{array}$$

What are the best strategies for both the companies ? Find the value of game. **9**