

Roll No. 

Total No. of Pages : 03

Total No. of Questions : 09

**B.Tech.(ME) (Sem.-7)**  
**OPERATION RESEARCH**  
Subject Code : ME-406  
Paper ID : [A0840]

Time : 3 Hrs.

Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

**SECTION-A****I. Answer briefly :**

- (a) Discuss two merits of O.R.
- (b) Write one comprehensive definition of O.R.
- (c) What is the importance of constraints in optimization?
- (d) When shall an L.P.P. have multiple optimal solutions? What is their importance?
- (e) Explain significance of surplus variables.
- (f) What is identified cell? How is it important?
- (g) Define no passing rule in sequencing problems.
- (h) Explain the terms 'stage' and 'state' in dynamic programming.
- (i) Explain conditions of certainty and uncertainty in decision-making.
- (j) Briefly explain the costs which are relevant to decisions for replacement of depreciable assets.

**SECTION-B**

- II. What is an Operations Research problem? Describe briefly the applications of O.R.
- III. A company has a team of four salesmen and there are four districts where the company wants to start its business. After taking into account the capabilities of salesmen and the nature of districts, the company estimates that the profit per day in rupees for each salesman in each district is as below :

		District			
		1	2	3	4
Salesman	A	16	10	14	11
	B	14	11	15	15
	C	15	15	13	12
	D	13	12	14	15

Find the assignment of salesmen to various districts which will yield maximum profit.

- IV.** A dairy firm wants to determine the quantity of butter it should produce to meet the demand. Past records have shown the following patterns :
- |                               |    |    |    |    |    |    |    |
|-------------------------------|----|----|----|----|----|----|----|
| Quantity required (kg) :      | 15 | 20 | 25 | 30 | 35 | 40 | 50 |
| No. of days demand occurred : | 5  | 15 | 25 | 75 | 40 | 30 | 10 |
- The stock levels are restricted to the range 15 to 50 kg due to inadequate storing facilities. Butter costs Rs. 40 per kg and is sold at Rs. 50 per kg.
- V.** A bakery keeps stock of a popular brand of cake. Daily demand based on past experience is given below :
- |                |      |      |      |      |      |      |
|----------------|------|------|------|------|------|------|
| Daily demand : | 0    | 15   | 25   | 35   | 45   | 50   |
| Probability :  | 0.01 | 0.15 | 0.20 | 0.50 | 0.12 | 0.02 |
- Consider the following sequencing of random numbers :
- 48, 78, 09, 51, 56, 77, 15, 14, 19, 52
- (i) Using the sequence, simulate the demand for the next 10 days.  
 (ii) Find the stock situation if the owner of the bakery decides to make 35 cakes every day. Also simulate the daily average demand for the cakes on the basis of the simulated data.
- VI.** A Xerox machine in an office is operated by a person who does other jobs also. The average service time for a job is 6 minutes per customer. On an average, every 12 minutes, one customer arrives for xeroxing. Find
- (i) the Xerox machine utilization  
 (ii) percentage of time that an arrival has not to wait.  
 (iii) average time spent by a customer  
 (iv) average queue length.  
 (v) the arrival rate if the management is willing to deploy the person exclusively for xeroxing when the average time spent by a customer exceeds 15 minutes.

### SECTION-C

- VII.** Solve the following L.P. problem by the simplex method :
- Maximize  $Z = 3x_1 - x_2$   
 Subject to  $2x_1 + x_2 \leq 2$   
 $x_1 + 3x_2 \geq 3$   
 $x_2 \leq 4$   
 $x_1, x_2 \geq 0$
- VIII.** (a) The data on the operating costs per year and resale price of equipment A whose purchase price is Rs. 10,000 are given below :
- |                         |       |       |       |       |       |       |       |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|
| Year :                  | 1     | 2     | 3     | 4     | 5     | 6     | 7     |
| Operating Costs (Rs.) : | 1,500 | 1,900 | 2,300 | 2,900 | 3,600 | 4,500 | 5,500 |
| Resale Value (Rs.) :    | 5,000 | 2,500 | 1,250 | 600   | 400   | 400   | 400   |
- (i) What is the optimum period of replacement?

(ii) When equipment A is 2 years old, equipment B which is a new model for the same usage is available. The optimum period for replacement is 4 years with an average cost of Rs. 3,600. Should equipment A be replaced by B and if so, when?

(b) Some of the spare parts of a ship cost Rs. 45,000 each. These spare parts can only be ordered together with the ship. If not ordered at the time the ship is constructed, these parts cannot be available on need. Suppose that a loss of Rs. 5,000,000 is suffered for each spare that is needed when none is available in stock. Further suppose that the probabilities that the spares will be needed as replacement during the life term of the class of the ship discussed are :

Spares required :	0	1	2	3	4	5	6 or more
Probability :	0.9000	0.040	0.025	0.020	0.010	0.005	0.000

How many spare parts should be procured?

**IX.** In the PERT network shown in the figure below, the activity time estimates (in weeks) are given along the arrows. If the scheduled completion time is 23 weeks, calculate the latest possible occurrence times of the events. Calculate the stock for each event and identify the critical path. What is the probability that the project will be completed on the scheduled date?

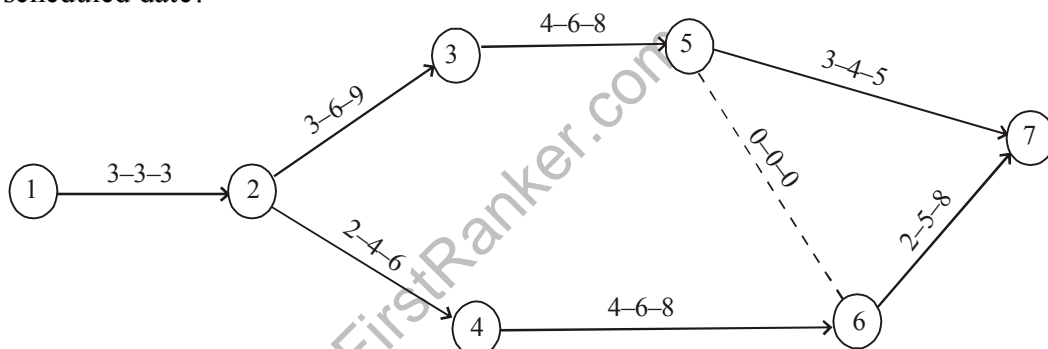


Fig.1