

**Operations Research**

P. Pages : 4

Time : Three Hours

**NKT/KS/17/7397**

Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
  2. Solve Question 1 OR Questions No. 2.
  3. Solve Question 3 OR Questions No. 4.
  4. Solve Question 5 OR Questions No. 6.
  5. Solve Question 7 OR Questions No. 8.
  6. Solve Question 9 OR Questions No. 10.
  7. Solve Question 11 OR Questions No. 12.
  8. Assume suitable data whenever necessary.
  9. Use of normal distribution table is permitted.
  10. Use of Random-number table is permitted.

1. a) Define operation research. Explain the importance of operation research in the decision making process. **4**
- b) A firm makes two products X and Y and has a total production capacity of 9 tonnes per day. X and Y requiring the same production capacity. The firm has a permanent contract to supply at least 2 tonnes of X and at least 3 tonnes of Y per day to another company. Each tonne of X requires 20 machine hours of production time and each tonnes of Y requires 50 machine hours of production time. The daily possible number of machine hours is 360. All the firm's output can be sold, and the profit made is Rs. 80 per tonne of X and Rs. 120 per tonnes of Y. It is required to determine the production schedule for maximum profit and calculate this profit. **9**

**OR**

2. Solve by simplex method **13**  
 Minimize  $Z = 5x_1 + 3x_2$   
 subject to constraints  
 $2x_1 + 4x_2 \leq 12$   
 $2x_1 + 2x_2 = 10$   
 $5x_1 + 2x_2 \geq 10$   
 $x_1, x_2 \geq 0$
3. A solicitors firm employ typist on hourly piece rate basis for their daily work. There are fine typists and their charges and speed are different. According to an earlier understanding only one job is given to one typist and he is paid for full hour even if he work for a fraction of an hour. Find the least cost allocation for the following data : **13**

| Typist | R/Hour | No. of pages typed/hour | Job | No. of pages |
|--------|--------|-------------------------|-----|--------------|
| A      | 5      | 12                      | P   | 199          |
| B      | 6      | 14                      | Q   | 175          |
| C      | 3      | 8                       | R   | 145          |
| D      | 4      | 10                      | S   | 298          |
| E      | 4      | 11                      | T   | 178          |

**OR**

4. A manufacturer has distribution centers located at Agra, Allahabad, and Mumbai. These centers have 40, 20 and 40 units of product available with them. The retail outlets require following number of units A-25, B-10, C-20 and D-30. The transportation cost per unit in Rs. Between each centre and outlet is as follows. Find out the optional transportation program. 13

| Distribution Centre | Retail outlets |    |     |    |
|---------------------|----------------|----|-----|----|
|                     | A              | B  | C   | D  |
| Agra                | 50             | 30 | 40  | 50 |
| Allahabad           | 35             | 30 | 100 | 45 |
| Mumbai              | 40             | 60 | 95  | 35 |

5. a) An automobile manufacturer needs 50 piston per day in his assembly shop. The cost of ordering is Rs. 700/- order. The inventory holding cost is Rs. 0.15/unit/day. If the piston cost Rs. 160 and no shortages are permitted. 8

- i) Find optimal order quantity
- ii) What is optimal total expected system cost ?
- iii) Find minimum cost procurement level if lead time is 4 days.
- iv) Sketch the inventory model.

- b) Write short notes on **any two**. 6

- i) ABC analysis.
- ii) Cost Associated with Inventory.
- iii) Pure strategy, mixed strategy, saddle point.
- iv) Sequencing with proper example.

**OR**

6. a) In a machine shop 8 different products are being manufactured, each requiring time on two machines  $M_1$  and  $M_2$  as given below : 7

| Machines         | Product |    |     |    |    |     |     |      |
|------------------|---------|----|-----|----|----|-----|-----|------|
|                  | I       | II | III | IV | V  | VI  | VII | VIII |
| M1 (Time in min) | 30      | 45 | 15  | 20 | 80 | 120 | 65  | 10   |
| M2 (Time in min) | 20      | 30 | 50  | 35 | 36 | 40  | 50  | 20   |

- i) Decide the optimum sequence of processing of different products in order to minimize the total manufacturing time for all the products.
- ii) The total minimum elapsed time.
- iii) Idle time for machine  $M_1$  and Machine  $M_2$ .
- iv) Name the scheduling model used.

- b) The labour contract between your management and the union will terminate in the near future. A new contract must be negotiated preferably before the old one expires. You are a member of management group charged with selecting a strategy for them during the coming negotiations. After a consideration of past experience, the group agrees that feasible strategies for the company and union are :

- i) All out attack, hard aggressive bargaining
- ii) A reasonably logical approach.
- iii) A legalistic strategy

iv) An agreeable conciliatory approach. The pay off table is given below :

|                    |     |                  |    |     |    |
|--------------------|-----|------------------|----|-----|----|
|                    |     | Union Strategies |    |     |    |
|                    |     | I                | II | III | IV |
| Company Strategies | I   | 20               | 15 | 12  | 35 |
|                    | II  | 25               | 14 | 8   | 10 |
|                    | III | 40               | 2  | 19  | 5  |
|                    | IV  | 5                | 4  | 11  | 0  |

Find optimal strategy for the company. Determine the worth of your negotiation.

7. a) A small project consist of eight activities whose time estimates are given below :

14

| Activity | Preceding Activity | Time Estimates (in weeks) |       |       |
|----------|--------------------|---------------------------|-------|-------|
|          |                    | $t_o$                     | $t_m$ | $t_p$ |
| A        | -                  | 12                        | 4     | 12    |
| B        | -                  | 10                        | 12    | 26    |
| C        | A                  | 8                         | 9     | 10    |
| D        | A                  | 10                        | 15    | 20    |
| E        | A                  | 7                         | 7.5   | 11    |
| F        | B, C               | 9                         | 9     | 9     |
| G        | D                  | 3                         | 3.5   | 7     |
| H        | E, F, G            | 5                         | 5     | 5     |

- i) Draw a PERT Network for the project.
- ii) Determine the critical path
- iii) If a 30 week deadline is imposed what is the probability that the project will be finished within the time limit ?
- iv) If the project manager want to be 99% sure that the project is completed on the scheduled date, how many week before that date should be start the project ?

**OR**

8. A small project consist of seven activities. The normal and crash cost and time is given in the table. If indirect cost is Rs. 160/- per day find optimum project duration.

14

| Activity | Normal         |               | Crash          |               |
|----------|----------------|---------------|----------------|---------------|
|          | Time (in days) | Cost in (Rs.) | Time (in days) | Cost in (Rs.) |
| 1 - 2    | 3              | 360           | 2              | 400           |
| 2 - 3    | 6              | 1440          | 4              | 1620          |
| 2 - 4    | 9              | 2160          | 5              | 2380          |
| 2 - 5    | 7              | 1120          | 5              | 1600          |
| 3 - 4    | 8              | 400           | 4              | 800           |
| 4 - 5    | 5              | 1600          | 3              | 1770          |
| 5 - 6    | 3              | 480           | 2              | 760           |

9. A computer has a large number of electronic tubes. They are subjected to a mortality as given below : 13

| Period | Age of failure<br>(Internal time period) | Probability of failure |
|--------|--|------------------------|
| 1      | 0 - 200                                  | 0.10                   |
| 2      | 201 - 400                                | 0.26                   |
| 3      | 401 - 600                                | 0.35                   |
| 4      | 601 - 800                                | 0.22                   |
| 5      | 801 - 1000                               | 0.07                   |

If the tubes are group replaced, the cost of replacement is Rs. 15 per tube. Group replacement can be done at a fixed interval in the night shift when the computer is not normally used. Replacement of individual tube which fail in service cost Rs. 60/- tube. How frequently should the tube be replaced ?

**OR**

10. A mini truck owner estimates that the running cost and salvage value of truck for various years as tabulated below. If purchase price of truck is Rs. 1,60,000, estimate optimal replacement age. Assume a rate of return on capital invested to 25% per year. Also assume running cost incurred in the beginning of the year. 13

| Year (k)                               | 1      | 2     | 3     | 4     | 5     | 6     | 7     | 8     |
|--|--------|-------|-------|-------|-------|-------|-------|-------|
| Running cost (R <sub>k</sub> ) in Rs.  | 12000  | 15000 | 18000 | 24000 | 30000 | 40000 | 55000 | 75000 |
| Salvage value (S <sub>k</sub> ) in Rs. | 120000 | 80000 | 60000 | 60000 | 50000 | 40000 | 40000 | 4000  |

11. a) Define simulation. Give one application area where this technique used in practice. 4
- b) A company manufactures around 200 vehicles. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 vehicles to 204 vehicles whose probability distribution is as given below : 9

|                    |      |      |      |      |      |      |      |      |      |
|--------------------|------|------|------|------|------|------|------|------|------|
| Production per day | 196  | 197  | 198  | 199  | 200  | 201  | 202  | 203  | 204  |
| Probability        | 0.05 | 0.09 | 0.12 | 0.14 | 0.20 | 0.15 | 0.11 | 0.08 | 0.06 |

The finished vehicles are transported in a specially designed three storeyed lorry that can accommodate only 200 vehicles. Using the given 15 random numbers, 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54, 10. Simulate the process to find out.

- i) What will be the average number of vehicles waiting in the factory ?  
 ii) What will be the average number of empty space on the lorry ?

**OR**

12. a) Patron arrive at a reception counter at an average inter arrival rate of 2 min. The receptionist in duty takes an average of one minute per patron. 9
- i) What is the chance that a patron will straight way meet the receptionist.  
 ii) For what portion of time the receptionist is busy ?  
 iii) What is the average queue length ?  
 iv) What is the average number of patrons in the system ?  
 v) What is the average waiting time of a patron ?  
 vi) What average time patron spends in the system ?
- b) What is queuing theory? What information can be obtained by analyzing a queuing system? 4

\*\*\*\*\*