

**BTECH**  
**(SEM VII) THEORY EXAMINATION 2018-19**  
**OPERATIONS RESEARCH**

*Time: 3 Hours*

*Total Marks:100*

*Notes: Assume any Missing Data.*

**SECTION - A**

1. **Attempt all questions in brief.** **2 x 10 = 20**
- a. What is the role of operations research in decision making?
  - b. "Dual of a dual is it's primal." Explain.
  - c. Degeneracy in a transportation problem.
  - d. What are assignment problems? Give two examples.
  - e. What is float? What are the different types of float?
  - f. What is looping and dangling in network diagram?
  - g. What is two person zero-sum games?
  - h. Characteristics of M/M/1 queue model.
  - i. Discuss the various costs involved in an inventory model
  - j. Write a lucid note on replacement problem.

**SECTION - B**

2. **Attempt any three of the following:** **10 x 3 = 30**
- a. Three machine shops A, B, C produces three types of products X, Y, Z respectively. Each product involves operation of each of the machine shops. The time required for each operation on various products is given as follows:

| Products        | Machine Shops |    |    | Profit per unit |
|-----------------|---------------|----|----|-----------------|
|                 | A             | B  | C  |                 |
| X               | 10            | 7  | 2  | \$12            |
| Y               | 2             | 3  | 4  | \$3             |
| Z               | 1             | 2  | 1  | \$1             |
| Available Hours | 100           | 77 | 80 |                 |

The available hours at the machine shops A, B, C are 100, 77, and 80 only. The profit per unit of products X, Y, and Z is \$12, \$3, and \$1 respectively.

- b. Find the optimal solution of the following transportation problem in which cell entries represent unit costs.

| Ware House  | Market |    |     |    | Supply |
|-------------|--------|----|-----|----|--------|
|             | I      | II | III |    |        |
| A           | 4      | 14 | 8   | 10 |        |
| B           | 6      | 6  | 2   | 16 |        |
| C           | 10     | 8  | 14  | 14 |        |
| D           | 2      | 12 | 4   | 28 |        |
| Requirement | 14     | 18 | 36  | 68 |        |

- c. The following table shows the various jobs of a network along with their time estimates:

| Activity | Estimated Duration work |             |             |
|----------|-------------------------|-------------|-------------|
|          | Optimistic              | Most Likely | Pessimistic |
| 1-2      | 1                       | 1           | 7           |
| 1-3      | 1                       | 4           | 7           |
| 2-4      | 2                       | 2           | 8           |
| 2-5      | 1                       | 1           | 1           |
| 3-5      | 2                       | 5           | 14          |
| 4-6      | 2                       | 5           | 8           |
| 5-6      | 3                       | 6           | 15          |
| 6-7      | 2                       | 4           | 8           |

Draw a network diagram and determine the critical path. What is the minimum time for completion of projects?

- d. What do you understand by queuing model? Why do arrivals and services follow the Poisson and Exponential distribution respectively?
- e. The demand for an inventory item each costing Re5, is 20000 units per year. The ordering cost is Rs.10. The inventory carrying cost is 30% based on the average inventory per year. Stock out cost is Rs.5 per unit of shortage incurred. Find out various parameters.

### SECTION - C

3. Attempt any one part of the following:

10 x 1 = 10

- a. Solve the following LPP

$$\text{Maximize } Z = 5X_1 + 10X_2 + 8X_3$$

Subject to the following constraints :

$$3X_1 + 5X_2 + 2X_3 \leq 60$$

$$4X_1 + 4X_2 + 4X_3 \leq 72$$

$$2X_1 + 4X_2 + 5X_3 \leq 100$$

- b. What is sensitivity analysis? Discuss its significance from managerial viewpoint.

Write the dual of the following primal problem:

$$\text{Maximize } Z = -5x_1 + 2x_2$$

$$\text{Subject to : } X_1 - X_2 \geq 2$$

$$2X_1 + 3X_2 \leq 5$$

$$X_1, X_2 \geq 0$$

4. Attempt any one part of the following:

10 x 1 = 10

- a. A wholesale company has three warehouses from which retail customers. The company deals in a single product, the supply of which at each warehouse are

| Warehouse No. | Supply units | Customer No. | Demand units |
|---------------|--------------|--------------|--------------|
| I             | 20           | A            | 15           |
| II            | 28           | B            | 19           |
| III           | 17           | C            | 13           |
|               |              | D            | 18           |

Conveniently, total supply at the warehouses is equal to customers. The following table gives the transportation cost per unit shipment from each warehouse to each customer :

| Warehouse | Customer |   |   |   |
|-----------|----------|---|---|---|
|           | A        | B | C | D |
| I         | 3        | 6 | 8 | 5 |
| II        | 6        | 1 | 2 | 5 |
| III       | 7        | 8 | 3 | 9 |

Determine what supplies to dispatch from each of the warehouses to each customer so as to minimize overall transportation cost.

- b. A trip from Chennai to Coimbatore takes six hours by bus. A typical time table of the bus service in both the direction is given in the Table 1. The cost of providing this service by the company based on the time spent by the bus crew i.e. driver and conductor away from their places in addition to service times. The company has five crews. The condition here is that every crew should be provided with more than 4 hours of rest before the return trip again and should not wait for more than 24 hours for the return trip. Also the company has guest house facilities for the crew of Chennai as well as at Coimbatore. Find which line of service is connected with which other line so as to reduce the waiting time to the minimum.

| Departure from Chennai | Route Number | Arrival at Coimbatore | Arrival at Chennai | Route Number | Departure from Coimbatore |
|------------------------|--------------|-----------------------|--------------------|--------------|---------------------------|
| 06.00                  | 1            | 12.00                 | 11.30              | a            | 05.30                     |
| 07.30                  | 2            | 13.30                 | 15.00              | b            | 09.00                     |
| 11.30                  | 3            | 17.30                 | 21.00              | c            | 15.00                     |
| 19.00                  | 4            | 01.00                 | 00.30              | d            | 18.30                     |
| 00.30                  | 5            | 06.30                 | 06.00              | e            | 00.00                     |

5. Attempt any one part of the following:

10 x 1 = 10

- a. There are six jobs which must go through two machines A and B in the order AB. Processing time in hours is given below processing.

| Job              | 1 | 2  | 3  | 4  | 5  | 6  |
|------------------|---|----|----|----|----|----|
| <b>Machine A</b> | 8 | 10 | 11 | 12 | 16 | 20 |
| <b>Machine B</b> | 7 | 5  | 0  | 14 | 3  | 9  |

Determine the optimal sequence and the elapsed time.

- b. A project has activities with the following normal and crash times and cost:

| Activity | Predecessor Activity | Normal Time (Weeks) | Crash Time (Weeks) | Normal Cost (Rs.) | Crash Cost (Rs.) |
|----------|----------------------|---------------------|--------------------|-------------------|------------------|
| A        | -                    | 4                   | 3                  | 8,000             | 9,000            |
| B        | A                    | 5                   | 3                  | 16,000            | 20,000           |
| C        | A                    | 4                   | 3                  | 12,000            | 13,000           |
| D        | B                    | 6                   | 5                  | 34,000            | 35,000           |
| E        | C                    | 6                   | 4                  | 42,000            | 44,000           |
| F        | D                    | 5                   | 4                  | 16,000            | 16,500           |
| G        | E                    | 7                   | 4                  | 66,000            | 72,000           |
| H        | G                    | 4                   | 3                  | 2,000             | 5,000            |

Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks.

**6. Attempt any one part of the following:**

**10 x 1 = 10**

- a. Solve the game with the following pay-off matrix.

|                     |   | Player B   |    |     |    |   |
|---------------------|---|------------|----|-----|----|---|
|                     |   | Strategies |    |     |    |   |
|                     |   | I          | II | III | IV | V |
| Player A Strategies | 1 | 7          | 5  | 2   | 3  | 9 |
|                     | 2 | 10         | 8  | 7   | 4  | 5 |
|                     | 3 | 9          | 12 | 0   | 2  | 1 |
|                     | 4 | 11         | -2 | -1  | 3  | 4 |

- b. Customers arrive at the first class ticket counter of a theater at the rate of 12 per hour. There is one clerk serving the customers at the rate of 30 per hour.
- What is the probability that there is no customer in the counter?
  - What is the probability that there are more than two customers in the counter?
  - What is the probability that there is no customer waiting to be served?
  - What is type probability that a customer's being served and nobody is waiting?

**7. Attempt any one part of the following:**

**10 x 1 = 10**

- a. A manufacturer uses an item at a uniform rate of 25,000 units per year. Assume that no shortage is allowed and delivery is at an infinite rate. The ordering, receiving and hauling cost is Rs.23 per order, while inspection cost is Rs.22 per order. Interest costs is Rs.0.056 and deterioration and obsolescence cost is Rs.0.004 respectively per year for each item actually held in inventory plus Rs.0.02 per year per unit based on the maximum number of units in inventory. Determine the EOQ. If lead time is 40 days, find reorder level.
- b. A firm is considering replacement of a machine whose cost price is Rs 12,200 and the scrap value Rs 200. The running cost (maintenance and operating) in rupees are found from experience to be as follows

| Year         | 1   | 2   | 3   | 4    | 5    | 6    | 7    | 8    |
|--------------|-----|-----|-----|------|------|------|------|------|
| Running Cost | 200 | 500 | 800 | 1200 | 1800 | 2500 | 3200 | 4000 |

When should the machine be replaced?