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B.C.A. - IV Sem.

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B.C.A. Examination, June-2023
OPTIMIZATION TECHNIQUES
(BCA-404)

Time : 3 Hours]

[Maximum Marks : 75

Section-A

Note: Attempt all the five questions. Each question carries 3 marks. $5 \times 3 = 15$

1. What is the central problem of linear programming?
2. What are the characteristics of a queuing system?
3. What is the objective of replacement theory?
4. What is a deterministic inventory model?
5. What are the different types of job sequencing problems?

Section-B

Note: Attempt any two questions from this section. Each carry 7.5 marks.

6. Explain the simplex method in linear programming, including its basic steps and how it is used to solve optimization problems.

7. Explain the basic economic order quantity (EOQ) model and its assumptions.
8. Explain the concept of "time to failure" and "time to repair" in replacement theory.

Section-C

Note: Attempt any three questions out of five. Each carry 15 marks.

9. A company produces two products, A and B, which have profit margins of \$3 and \$5 per unit, respectively. The company has a limited production capacity of 1000 hours per week and a limited raw material supply of 1500 units per week. Product A requires 2 hours of production time and 1 unit of raw material, while product B requires 3 hours of production time and 2 units of raw material. Formulate the linear programming problem to maximize the total profit for the company and solve it graphically.
10. Discuss the central problem of linear programming in detail, including the various definitions, basic theorems, and properties associated with it.
11. A company uses a machine for production that has a useful life of 4 years. The cost of the machine is Rs. 20,000 and the annual maintenance cost for the machine is Rs. 2,500. The company estimates that the salvage value of the machine at the end of

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4 years will be Rs. 2,000. The company is considering two replacement policies:

- (i) Replace the machine at the end of year 4;
- (ii) Replace the machine as soon as it fails.

The company has collected data on the probability distribution of the machine's failure time. The probability that the machine fails in the first year is 0.1, in the second year is 0.2, in the third year is 0.3, and in the fourth year is 0.4.

- (a) Calculate the expected cost for each of the two replacement policies.
- (b) Which policy should the company choose?
- (c) What is the probability that the machine will fail during the third year?
- (d) What is the expected number of years until the machine is replaced under policy (ii)?

Note: Assume that the company operates the machine for 4 years only.

12. A retailer sells a particular product at a constant rate of 200 units per week. The product has a fixed ordering cost of Rs. 500 per order, and a variable holding cost of Rs. 2 per unit per week. The lead time for an order is 2 weeks, and the demand during this period is normally distributed with a mean of 400 units and a standard deviation of 50 units.

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Determine the optimal order quantity, reorder point, and the total annual inventory cost assuming 50 working weeks in a year.

13. A supermarket has two checkout counters to serve customers. The customers arrive at the checkout counters according to a Poisson process with an arrival rate of 20 customers per hour. The service time of each checkout counter follows an exponential distribution with a mean of 2.5 minutes per customer. The management of the supermarket is interested in improving the service by reducing the average waiting time in the queue.
- (a) Determine the utilization rate of each checkout counter.
 - (b) Determine the probability of having zero customers in the system.
 - (c) Determine the average number of customers waiting in the queue.
 - (d) Determine the average waiting time in the queue.
 - (e) Suppose the management decides to add a third checkout counter. Determine the utilization rate of each checkout counter and the average waiting time in the queue for each customer.