2026

STATISTICS

(Major)

Paper : STA0600304

(Operation Research)

Full Marks : 60

Time : 2½ hours

The figures in the margin indicate full marks for the questions.

1. Answer the following as directed : 1×8=8

(a) A finite optimal solution cannot be unique.

(State True or False)

(b) The solution to a transportation problem with m-sources and n-destinations is feasible, if the number of allocations is _____.

(Fill in the blank)

(c) "For critical activity, the total float value is positive."

(State True or False)

(d) A feasible solution of LPP should

(i) satisfy the problem constraints

(ii) optimise the objective function

(iii) satisfy the problem constraints and non-negativity restrictions

(iv) satisfy the non-negativity restrictions

(Choose the correct option)

(e) Under what situation individual replacement policy is better than group replacement policy?

(f) Identify the type of feasible region given by the following set of inequalities :

$x - y \leq 1$

$x - y \geq 2$, $x, y > 0$

(i) A triangle

(ii) A rectangle

(iii) An unbounded region

(iv) An empty region

(Choose the correct option)

(g) What is a lead time?

(h) Economic order quantity (EOQ) results in

(i) equalisation of carrying cost and procurement cost

(ii) minimization of setup cost

(iii) reduced chances of stockouts

(iv) favourable procurement price

(Choose the correct option)

2. Answer any *six* questions from the following : 2×6=12

(a) What is a feasible solution of an LPP?

(b) What is general linear programming? Write it in equation.

(c) Write the names of different types of inventory models.

(d) State the mathematical formulation of a transportation problem.

(e) Define economic lot size problem and Economic Order Quantity (EOQ).

(f) Explain the objectives of replacement policies.

(g) Define storage cost and procurement cost.

(h) What is looping and dangling in a network?

(i) What is float? Give the names of different types of float.

(j) Write two limitations of LPP.

3. Answer any *four* from the following : 5×4=20

(a) A company has two plants, each of which produces and supplies two products : *A* and *B*. The plants can each work up to 16 hours a day. In plant 1, it takes 3 hours to prepare and pack 1000 gallons of *A* and 1 hour to prepare and pack one quintal of *B*. In plant 2, it takes 2 hours to prepare and pack 1000 gallons of *A* and 1·5 hours to prepare and pack a quintal of *B*. In plant 1, it costs ₹ 15,000 to prepare and pack 1000 gallons of *A* and ₹ 28,000 to prepare and pack a quintal of *B*, whereas these costs are ₹ 18,000 and ₹ 26,000 respectively in plant 2. The company is obliged to produce daily at least 10000 gallons of *A* and 8 quintals of *B*. Formulate this problem as an LPP.

(b) What is replacement? Describe some important replacement situations.

(c) Solve the following LPP graphically

Maximize $Z = x_1 + x_2$

subject to constrains

$$-2x_1 + x_2 \leq 1$$
$$x_1 \leq 2$$
$$x_1 + x_2 \leq 3$$
$$x_1, x_2 \geq 0$$

(d) Explain slack and float in network analysis.

(e) Explain transportation problem and show that it can be considered as an LPP.

(f) Define node and activity of a network diagram. What are the different categories of an activity? Describe the precedence network which are used in network models to show precedence requirements of the activities in the project.

(g) Discuss various costs associated with the inventory system.

(h) Explain ABC analysis.

4. Answer any *two* from the following : 10×2=20

(a) Describe the problem of replacement of items whose maintenance cost increases with time, when time is a continuous as well as discrete random variable. Assume that the value of money remains constant.

(b) Solve the following LPP by simplex method :

$$\text{Maximize } Z = 20x_1 + 10x_2 + 15x_3$$

subject to

$$3x_1 + 6x_2 + 4x_3 \leq 48$$
$$x_1 + 4x_2 \leq 18$$
$$x_2 + x_3 \leq 8$$

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

(c) Discuss north-west corner rule and least cost method of a transportation problem.

(d) Prove that in the inventory problem of economic lot size with uniform demand and unequal times of production run, the optimal lot size for each production run is given by $Q^\circ = \sqrt{\frac{2DC_0}{C_1}}$ and the optimal total cost (TC_0) is given by $TC_0 = \sqrt{2DC_0C_1}$, all the symbols have their usual meaning.

(Continued)

(e) The following maintenance job has to be performed periodically on the heat exchangers in a refinery :

Task	*Description*	*Precedence*	*Duration* (hours)
A	Dismantle pipe connections	—	14
B	Dismantle header, closure and floating head front	*A*	22
C	Remove tube bundle	*B*	10
D	Clean bolts	*B*	16
E	Clean header and floating head front	*B*	12
F	Clean tube bundle	*C*	10
G	Clean shell	*C*	6
H	Replace tube bundle	*F, G*	8
I	Prepare shell pressure test	*D, E, H*	24
J	Prepare tube pressure test and make the final reassembly	*I*	16

Draw the network diagram and obtain the critical path. Also determine the total float and free float.

★★★