

B.A. (Prog.) / II

A

(T)

OPERATIONAL RESEARCH  
Paper II— Operational Research – I  
(Admissions of 2004 and onwards)

Time : 3 hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer six questions in all, selecting at least one question from each Section. All questions carry equal marks.

SECTION — I

Linear Programming

- (a) If a linear programming problem possesses (i) unbounded solution, (ii) multiple solutions, or (iii) infeasible solution, how can you detect it in course of simplex computations?
- (b) Use two-phase simplex method to solve the following L.P.P.

$$\begin{aligned} \text{Maximize } Z &= 5x_1 - 4x_2 + 3x_3 \\ \text{subject to } 2x_1 + x_2 - 6x_3 &= 20 \\ 6x_1 + 5x_2 + 10x_3 &\leq 76 \\ 8x_1 - 3x_2 + 6x_3 &\leq 50 \\ x_1, x_2, x_3 &\geq 0 \end{aligned}$$

- (a) Write a note on sensitivity analysis in Linear Programming.
- (b) Obtain the dual of the following L.P.P.

$$\begin{aligned} \text{Minimise } Z &= x_1 + x_2 + x_3 \\ \text{subject to } x_1 - 3x_2 + 4x_3 &= 5 \\ x_1 - 2x_2 &\leq 3 \\ 2x_2 - 3x_3 &\geq 5 \\ x_1, x_2 &\geq 0 \text{ and } x_3 \text{ unrestricted} \end{aligned}$$

3. (a) Two leading firms are competing for the market share for a particular product. Each firm is considering what promotional strategy to employ for the coming period. The following pay-off matrix describes the increase in market share for firm A and decrease in market share for firm B.

Firm A's strategy	Firm B's strategy		
	No promotion	Moderate promotion	Heavy promotion
No promotion	0	2	-15
Moderate promotion	12	8	-4
Price cut	20	15	6

Find the optimum strategies and the worth of such strategies for the two firms.

- (b) A company has factories at  $F_1$ ,  $F_2$ , and  $F_3$ , which supply warehouses at  $W_1$ ,  $W_2$  and  $W_3$ . Weekly factory capacities are 150, 175 and 275 units respectively. Weekly warehouse requirements are 200, 100 and 300 units respectively. Unit shipping costs (in rupees) are as follows:

From \ To	$W_1$	$W_2$	$W_3$	Supply
$F_1$	6	8	10	150
$F_2$	7	11	11	175
$F_3$	4	5	12	275
	200	100	300	600

Determine the optimum distribution plan for this company to minimize shipping cost.

## SECTION – II

### Inventory Management

4. (a) What is meant by Inventory Control? What are the various techniques for classification of inventory? Describe ABC analysis in detail.

- (b) An aircraft uses rivets at an approximately constant rate of 5,000 kg. per year. The rivets cost Rs. 20 per kg. and the company personnel estimate that it costs Rs. 200 to place an order, the carrying cost of inventory is 10% of cost of rivets per year. How frequently should orders for rivets be placed and what quantity should be ordered?
5. (a) The demand for certain item is 16 units per period. Unsatisfied demand causes a shortage cost of Rs. 0.75 per unit per period. The ordering cost is Rs. 15 per order and the holding cost is 15% of average inventory valuation per period. Item cost is Rs. 8 per unit. Assuming that shortages are backlogged, find the economic order quantity.
- (b) Formulate an inventory model to determine EOQ with finite replenishment rate. Shortages are not allowed.
6. (a) A newspaper boy buys paper for 60 paise each and sells them for Rs. 1.40 each. He cannot return unsold newspapers. Daily demand has the following distribution:

No. of customers	23	24	25	26	27	28	29	30	31	32
probability	0.01	0.03	0.06	0.01	0.20	0.25	0.15	0.10	0.05	0.05

If each day's demand is independent of the previous days, how many papers should be ordered each day?

- (b) Discusses the different types of costs involved in inventory system.

### SECTION – III Queueing Theory

7. (a) With respect to queueing system, explain the following:
- i. Arrival process
  - ii. Queue discipline
  - iii. Balking
  - iv. Jockeying
- (b) Show that inter-arrival times are distributed exponentially if arrivals follow Poisson process.
8. For a  $(M/M/1):(\infty/FIFO)$  queueing model, derive the steady state expressions for:

- (i) Probability that a customer will not have to wait
- (ii) Expected number of customers in the queue given that the queue is not empty.
- (iii) Expected waiting time of a customer in the system.

9. (a) A television repairman finds that the time spent on his jobs has an exponential distribution with average 30 minutes. If he repairs sets in the order in which they came in, and if the arrival of sets follows Poisson distribution with an average rate of 10 per 8-hour day, what is repairman's expected idle time each day? How many jobs on an average are ahead of the set just brought in?
- (b) A petrol pump station has two pumps. The vehicles arrive in a Poisson process at the rate of 10 per hour. The service time follows exponential distribution, with mean time of 4 minutes. Find the probability that an arriving customer has to wait for the service. What proportion of time the pumps remain idle?