Time: 3 hours $\qquad$ Marks: 100

Note: 1. All questions are compulsory.
2. Figures to right indicate full marks.
3. Use of calculator is permitted.

Q. 1. a. Write a short note on post optimality sensitivity analysis with respect to addition and deletion of a constraint in a L.P.P. $\qquad$ (10)

b. Use two-phase simplex method to solve following LP problem. $\qquad$ (10)
Minimise $Z=\frac{15}{2}x_1 -3x_2$
Subject to the constraints
$3x_1- x_2 -x_3 \geq 3$
$x_1 -x_2+x_3 \geq 2$
and $x_1, x_2, x_3 \geq 0$

OR

p. Given an optimum simplex table for a maximization type LPP, describe the procedure of checking the effect on feasibility of the current solution if an element of requirement vector is changed from b_k to $\bar{b}_k$ where $\bar{b}_k = b_k + \Delta b_k$. How is the solution modified if the change affects the feasibility of the solution? $\qquad$ (10)

q. Use dual simplex method to solve the problem: $\qquad$ (10)
Minimise: $Z=3x_1 +x_2$
Subject to the constraints:
$x_1 + x_2 \geq 1$
$2x_1 +3x_2 \geq 2$
and $x_1, x_2 \geq 0$

Q. 2. a. Find the optimum level to which the stock should be raised at the beginning of each period t (t is fixed and known). If the demand 'r' is a discrete random variable with p.m.f P(r). The per unit costs of overstock & under stock are C_1 & C_2 per unit time. Also demand occurs at a uniform rate. $\qquad$ (12)

b. Describe different costs associated with inventory system. $\qquad$ (08)

OR

p. In a certain manufacturing situation C_1 is holding per item per unit time, C_3 is the setup cost per production cycle, 'R' is the demand rate. Shortages are not allowed and the production rate is finite. 't' is the interval between the start of successive production cycles. 'q' is the number of items produced per production run. Find an expression for the optimum order quantity and the minimum cost per unit time. $\qquad$ (12)

q. Explain the problem of inventory models with price breaks. How would you obtain the EOQ in case of a problem with two price breaks? $\qquad$ (08)

Q. 3. a. Explain the concept of Individual and Group replacement Policy. (10)
Derive the condition for the replacement of item where maintenance cost increases with time and money value does not change with time where 't' is continuous random variable.

b. What is meant by Present worth factor? (10)
A firm is considering replacement of an equipment whose cost is Rs. 4000 and the scrap value is negligible at the end of any year. Based on the experience, it has been found that the maintenance cost is Rs. 1000 for the second year and it increases by Rs. 300 every year thereafter. When should the equipment be replaced?

OR

p. Derive the condition for the replacement of item where maintenance cost increases with time and money value is involved. (10)

q. A refrigerator is priced at Rs.60000 and running costs are estimated at Rs. 6000 for each (10)
of the first four years, increasing by Rs.2,000 per year in the fifth and the subsequent years. If money is worth 10% per year, when should the truck be replaced? (No scrap value)

Q. 4. a. Explain in brief the concept of reliability. Also explain series and parallel system and (10)
find expression for their reliabilities.

b. Write a short note on the Monte Carlo method used in Simulation Theory. Explain the (10)
Mid Square Method for generating random numbers. Also state its limitations with suitable examples.

OR

p. An electronic device has 15 valves, 20 resistors and 10 capacitors, all connected in (10)
series. The components in each category are identical and their failure times are found to follow exponential distribution with the following mean failure time:

Component	Valves	Resistor	Capacitor
Mean Failure time in hours	10000	20000	20000

What is the reliability of the system for 100 hours? Also find MTTF of the system.

q. What is meant by Simulation? (10)
Explain the (i) multiplicative Congruential method for generating random numbers. Also explain how generated random numbers can be used to further generate random sample from normal distribution.

Q. 5. Attempt **ANY TWO** sub-questions.

a. Use simplex method to solve the following LP problem and obtain the optimal solution: (10)
Maximize $Z=3x_1+ 5x_2$
Subject to $3x_1 +2 x_2 \leq 18$
$x_1 \leq 4$
$x_2 \leq 6$
and $x_1, x_2 \geq 0$

b. Find the optimum order level that minimizes the total expected cost for single period model with instantaneous discrete demand without set-up cost. (State clearly the assumptions you make) (10)

c. At time zero, all items in a system are new. Each item has a probability 'p' of failing immediately before the end of the first month of life and a probability q=(1-p) of failing immediately before the end of the second month. If all items are replaced as they fail. Show that the expected number of failures f(x) at the end of the month x is given by (10)

$$f(x) = \frac{N}{(1+q)}[1 - (-q)^{x_{-}+1}]$$

Where N is the number of items in the system. If the cost per item of individual replacement is C_1 and the cost per item of group replacement is C_2, find the condition under which (i)a group replacement policy at the end of each month is most profitable (ii) no group replacement policy is better than that of pure individual replacement.

d. (i) Write note on Bath-tub curve? (10)
   (ii) State advantages and disadvantages of Simulation Technique.

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