

Answer all six questions. Part 'a' of each question is compulsory.

Answer either part 'b' or part 'c' of each question

Module 1

- 1a** Briefly describe the different types of problems in system analysis **4**

Answer b or c

- 1b** What are the steps involved in system approach? Explain by citing a water resources problem **5**

- 1c** Explain the different techniques used in water resources system analysis? **5**

Module 2

- 2a** What is meant by optimisation? What is the relevance of simulation in optimisation **4**

Answer b or c

- 2b** On the basis of a typical water resources decision making problem explain mathematical modelling and how do you set the objective function and constraints **5**

- 2c** Domestic water supply standards require that total dissolved solids (TDS) shall not exceed 800 ppm, sulphate content shall not be more than 250 ppm and chloride content shall not exceed 1000 ppm. The total water requirement of the area is 2 lakh lit/day. Water diverted from the dam through the canal cannot exceed 50,000 lit/day. As per the stipulations of govt. at least 30% of the total water consumed should be reclaimed from the waste water. Formulate the problem as LPP to optimize the cost using the following data. **5**

Details	Sources of water			
	Canal	Reclaimed waste	Desalinized water	Local Source
Cost (Rs/lit/day)	0.2	0.5	0.9	0.1
TDS (ppm)	720	610	500	630
Sulphate (ppm)	320	340	28	160
Chloride (ppm)	120	25	20	50

Module 3

- 3a** Define (i) global & local maxima/minima and saddle point. (ii) concave functions **4**

Answer b or c

- 3b** Using the method of Lagrangian multipliers, solve $Max Z = 6x_1 + 8x_2 - x_1^2 - x_2^2$ subject to $4x_1 + 3x_2 = 16$, $3x_1 + 5x_2 = 15$ **5**

- 3c** Examine the following functions for convexity/concavity and determine the extreme values and their nature **5**

(i) $f(x) = 3x^2 - 3x + 6$

(ii) $f(x) = 4x_1^2 + x_2^2 - 2x_1x_2$

Module 4

- 4a** Write the steps involved in solving a linear programming problem using simplex method **4**

Answer b or c

- 4b** Solve the following LPP by Simplex method $Min Z = -6x_1 - 4x_2$ **5**

subject to $2x_1 - x_2 \geq -2$, $x_1 - x_2 \leq 2$, $3x_1 + 2x_2 \leq 9$, $x_1 \geq 0, x_2 \geq 0$

- 4c** Using Big M Simplex method $Min Z = 4x_1 + 3x_2$, **5**

subject to $2x_1 + x_2 \geq 10$, $-3x_1 + 2x_2 \leq 6$, $x_1 + x_2 \geq 6$, $x_1 \geq 0, x_2 \geq 0$

Module 5

- 5a** Write short note on (i) stage and state (ii) Bellman's principle of optimality **5**

Answer b or c

- 5b** A subsystem of Godavari river basin has one existing reservoir and two others are proposed on the main stream. The available total resource is 800 units after tribunal award. Minimum of 200 units are to be allocated to the existing reservoir to satisfy riparian rights. The net benefits for different levels of supply to the three reservoirs are given below. Determine the optimum allocation and benefit. **7**

Supply (Units)	Net benefits in lakh of rupees/year		
	No. 1 (existing)	No.2	No.3
100	150	180	210
200	350	380	450
300	480	550	580
400	600	720	700
500	700	870	810
600	790	1000	920
700	750	-	-

- 5c** Find the minimum value of the function $x^5 - 5x^3 - 20x + 5$ in the interval (0, 3) by Fibonacci Method. Do 5 iterations, $\epsilon = 0.1$ **7**

Module 6

- 6a** Write short note on (i) Amortisation (ii) Depreciation (iii) sinking fund **5**

Answer b or c

- 6b** Using the equivalent annual worth method, compare and select from the following machines which are having different life spans at an interest rate of 9.25% per year. **7**

Particulars	Machine 1	Machine 2
Initial purchase price (Rs.)	10,00,000/-	13,50,000/-
Annual operating cost for the first five years (Rs.)	25,000/-	28,000/-
Annual operating cost for the remaining useful life (Rs.)		32,500/-
Expected salvage value	20,000/-	30,000/-
Annual Revenue	40,000/-	65,000/-
Useful life	5 years	10 years

- 6c** Find the amount credited towards loan repayment in the 5th year if a person borrows 10 lakh at 10.23% interest rate for 10 years. What is the percentage of repayment done towards capital by the end of fifth year. If he is able to repay an additional amount of Rs.50,000/- from the sixth year onwards, what is his savings in the total interest to be paid? **7**