WATER RESOURCES SYSTEMS

Time : Three hours

Maximum Marks : 100

Answer FIVE *questions, taking* ANY TWO *from* **Group A,** ANY TWO *from* **Group B** and ALL *from* **Group C.**

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches. Unnecessary long answers may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification

Figures on the right-hand side margin indicate full marks.

Group A

1. (*a*) What do you mean by the 'system' ? Classify the systems and explain them. 10

   (*b*) Give your interpretation on 'water resources' as a system. 6

   (*c*) Make a detailed note on various techniques of water resources systems analysis. 4

2. (*a*) The rating curve of a current meter used for measuring velocity in a small river is given as $V = 0.62\ N + 0.032$ m/sec, where N is in rev/sec.

Velocity is measured at the mid of the sections. Calculate the discharge of the river from the following data : 8

Distance from Bank, m	0	2	5	8	12	15	18	21	23	24
Depth, m	0	0.6	1.2	1.8	2.4	1.9	1.4	1.1	0.5	0
N at 0.6 d	0	60	90	120	150	140	100	80	50	0
Time, sec	0	150	140	140	160	140	140	140	140	0

(*b*) A hilly basin of area 1200 km^2 has 7 rain-gauge stations. The annual rainfalls observed in these stations are 62, 95, 60, 49, 36, 85 and 72. Determine the optimum number of gauges required in the basin, if it is desired to limit the error in mean rainfall to 10%. Also, state the number of gauges required as per IS recommendation. 8

(*c*) State the rain-gauge network recommendations. 4

3. (*a*) The weighted catchment rainfall for the month of July along with the runoff for July at a river is given below. Develop a linear relationship between rainfall and runoff for the month of July. Also, calculate the correlation coefficient *r*. Test that it is significantly different from zero and therefore a good correlation exists. 10

S. No	Year	Rainfall, mm	Runoff, mm
1	1978	344.4	187.1
2	1979	661.2	427.8
3	1980	369.6	122.9
4	1981	297.7	80.7

S. No	Year	Rainfall, mm	Runoff, mm
5	1982	372.2	194.9
6	1983	462.6	211.3
7	1984	302.4	125.12
8	1985	656.7	309.4
9	1986	446.7	221.4
10	1987	325.7	46.8
11	1988	336.5	247.9

(*b*) What are the central tendency characteristics ? Describe them. 5

(*c*) Make a detailed note on Extreme Value Distribution and its application in water resources study. 5

4. (*a*) Solve the Linear Programming Problem using the simplex method : 8

$$\text{Maximize } z = 2x_1 + x_2$$

$$\text{subject to } x_1 + 2x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1 - 2x_2 \leq 1$$

$$x_1, x_2 \geq 0$$

(*b*) What is simulation ? Discuss its advantages and application. 8

(*c*) Write about Kuhn-Tucker conditions. 4

Group B

5. (*a*) Define and distinguish the terms 'discounting' and

'compounding'. Discuss the discounting factors. 10

(*b*) Among the following plans, identify the more economical plant at 6% interest rate. Adopt the Present Worth (PW) comparison. 6

	Plane A	Plane B
Cost of equipment	50,000/-	35,000/-
Annual O & M costs	2,000/-	2,500/-
Salvage value	7,000/-	6,000/-
Service life	30 years	15 years

(*c*) Define the following : (*i*) Amortization, and (*ii*) cash flow diagram. 4

6. (*a*) Discuss the positive and negative impacts of water resource projects. 12

(*b*) List the steps involved in environmental impact assessment of water environment. 8

7. (*a*) Explain the methods of estimating the reservoir capacity. 12

(*b*) Discuss the water resources planning methods and objectives. 8

8. (*a*) Between two reaches A and B of a river, the values of Muskingum coefficients determined are K = 24 h and $X = 0.20$. Take outflow at the beginning of routing step equal to inflow. Find the outflow hydrograph at B. 12

Time, hr	12	24	36	48	60	72	84	96	108	120	132	144	156	168
Inflow, m^3/sec	14	22	36	93	141	102	86	73	61	50	38	26	20	16

(*b*) Explain the different flood control methods. 8

Group C

9. (A) Answer the following in brief : 7×2

(*i*) What are decision variables ?

(*ii*) Brief about Gamma distribution and state its application in water resources study.

(*iii*) What is an objective function ?

(*iv*) What do you mean by feasible and infeasible solutions ?

(*v*) Define and state examples for spatial and non-spatial data of GIS.

(*vi*) Define sustainable development. List out its objectives.

(*vii*) What is meant by plan formulation ? List the methods of carrying out plan formulation.

(B) Choose the *correct* answer for the following : 6×1

(*i*) The nearest object from the rain gauge should be located at a minimum distance equal to

(*a*) height of that object.

(*b*) twice the height of that object.

(*c*) thrice the height of that object.

(*d*) four times the height of the rain gauge platform.

(*ii*) Sequent peak analysis in water resources study helps in

(*a*) cost estimation.

(*b*) finding cumulative deficit.

(*c*) flood analysis.

(*d*) evaporation losses estimation.

(*iii*) Salinity of water

(*a*) reduces the evaporation.

(*b*) increases the evaporation.

(*c*) reduces the precipitation.

(*d*) does not alter the evaporation.

(*iv*) Gumbel's distribution is best applicable for the

(*a*) rainfall at a location.

(*b*) rainfall mass curve analysis.

(*c*) flood frequency analysis.

(*d*) meteorological analysis.

(*v*) The rating curve of a stream gauging station gives the variation of discharge in the stream with the

(*a*) cross-sectional area of flow.

(*b*) stage.

(*c*) depth of flow.

(*d*) velocity of flow.

(*vi*) Which one of the following form of equation is used in Modified Pul's method of flood routing ?

(*a*) $\left(\frac{I_1 + I_2}{2}\right)\Delta t + \left(\frac{Q_1 + Q_2}{2}\right)\Delta t = S_2 - S_1$

(*b*) $\left(\frac{I_1 + I_2}{2}\right)\Delta t - \left(\frac{Q_1 + Q_2}{2}\right)\Delta t = S_2 - S_1$

(*c*) $\left(\frac{I_1 + I_2}{2}\right)\Delta t + \left(S_1 - \frac{Q_1 \Delta t}{2}\right) = \left(S_2 + \frac{Q_2 \Delta t}{2}\right)$

(*d*) $\left(\frac{I_1 + I_2}{2}\right)\Delta t + \left(S_1 + \frac{Q_1 \Delta t}{2}\right) = \left(S_2 + \frac{Q_2 \Delta t}{2}\right)$