FOURTH YEAR FIRST SEMESTER EXAMINATIONS
FOR
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: **CSE 451**
COURSE NAME: **WATER RESOURCES ENGINEERING I**

Instructions to candidates

- This paper consists of **FIVE (5)** questions
- Answer Question **ONE** and **ANY OTHER THREE (3)** questions
- You require **ONE** Cartesian graph paper
- All symbols have their usual meanings unless otherwise stated
- Time allowed is **THREE (3)** hours

Question ONE (40 marks)

a) Climate change has had an adverse effect on water resource management. Highlight on the action plans on sustainable water management (3 marks)

b) Table Q1(b) presents hydrological data of a country X with regard to her water resources

Table Q1 (b)

Description	**Quantity (km^3/yr)**
Surface water entering the country	1.700
Accounted flow of border rivers	0.060
Accounted part of shared lakes	0.050
Groundwater entering the country	0.250
Total volume of the long term average annual flow of surface water produced by direct runoff from endogenous precipitation	4.600
Groundwater recharge generated from precipitation within the country	1.300
Groundwater drainage into rivers	0.850
Seepage from rivers into aquifers	0.150
Volume of surface water entering the country which is not submitted to treaties	0.400
Volume of surface water entering the country which is secured through treaties	0.400

Using the data, calculate the following:

i. The natural external renewable water resource (ERWR) (3 marks)
ii. Total volume of incoming water resources from neighbouring countries (IWR) (3 marks)
iii. The internal renewable water resources (IWR) (3 marks)
iv. The total natural renewable water resources (TRWR) (3 marks)
v. The dependency ratio (DR) (3 marks)

c) The details of a gauging carried out by the velocity-area method at a gauging station X on River Y are as shown in Table Q1 (c). Estimate the discharge using the mid-section method (10 marks)

Table Q1 (c)

Chainage (m)	0	50	100	150	200	250	300	350	400	450	500
Depth(m)	0	1.5	2.3	3.0	3.7	4.0	3.2	2.2	1.4	1.4	0.0
Mean Velocity (m/s)	0	0.24	0.36	0.34	0.46	0.49	0.47	0.38	0.34	0.23	0.0

d) A fish industry on the banks of a small lake discharges a pollutant into the lake. The river flow into the lake is 10 m^3/s. The waste flow (from the industry) into the lake is 0.5 m^3/s. The pollutant concentration in the river is 30 mg/l and in waste flow is 4000 mg/l. Determine the following:

i. The flow rate into the lake (2 marks)
ii. The concentration of pollutant into the lake (2 marks)
iii. If the pollutant from the factory has a rate coefficient of 2 x $10^{-5}/s$ and the lake volume is 3 x 10^6 m^3, determine the steady state of the concentration of the pollutant in the outflow from the lake (3 marks)
iv. Suppose the factory discharging the pollutant gets shut down by the government, what will be the concentration of the pollutant in the outflow from the lake three (3) days after the discharge stops (5 marks)

Question TWO (20 marks)

A community of 60,000 people is increasing in size of 10% per annum (Geometric). Average demand per capita for all purposes is presently 0.2 m^3/day and rising at a rate of 5% per annum (Geometric). The existing water supply has a safe yield of 0.5 m^3/s. A river is to be used as an additional source of supply. The mean daily discharges for the river for each month of the water-year are listed in Table Q2 (x 1000m^3)

Table Q2

Apri	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
198	225	333	603	779	1467	603	477	243	270	252	252

Allowing for compensation water release of 3 m^3/s from October-March inclusive and 5 m^3/s from April-September inclusive and assuming present trends continue and that the reservoir would be full at the end of November, determine the storage capacity required on the river to ensure the community's water supply 18 years from now. (20 marks)

Question THREE (20 marks)

a) What do you understand by Integrated Water Resource Management (2 marks)
b) What is a Network? What are the uses for the Network Data in Water Resources Management (4 marks)
c) Briefly discuss the three principles of the National Water Act, 2002 (6 marks)
d) Describe briefly the contents of the four principles of the Dublin statement (1992) (8 marks)

Question FOUR (20marks)

a) Why is water resources management critical? (4 marks)
b) Highlight on the basic principles of regulatory instruments in IWRM (2 marks)
c) Explain the terms 'point source and non-point source pollutants'. What are the effects of pollutants in rivers and lakes? (4 marks)
d) State and briefly explain the tenets (five 'Cs') to be accounted for in developing water management policies (10 marks)

Question FIVE (20 marks)

Table Q5 presents monthly flows, pan evaporation, and demand rates for a critical 12 month period at a proposed reservoir site. The local regulations require the release of 0.23m^3 s^{-1} for environmental purposes. Assume that the average reservoir area is 6.071 km^2 and that the runoff coefficient for the land that will be flooded is 0.3. Determine the required reservoir capacity assuming an average of 30 days in each month (20 marks)

Table Q5

Month	Q (m^3)	Demand (m^3)	Evaporation (m)	Rainfall (m)
January	8735247	1356830	0.0533	0.1346
February	7854382	2035245	0.0686	0.0762
March	9616113	2713660	0.0813	0.0406
April	3817083	4070490	0.0914	0.0254
May	1468109	4884588	0.1397	0.0051
June	660649	4946262	0.2007	0.0000
July	513838	5057276	0.2108	0.0000
August	367027	5057276	0.2032	0.0000
September	1835136	4872253	0.1981	0.0000
October	3083028	2713660	0.1549	0.0000
November	6973517	2442294	0.0864	0.1194
December	7560760	1480178	0.0533	0.1600