INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
<u>**Department of Civil Engineering (2nd Year B.Tech.)**</u>
Mid Semester Examination
<u>**Water Resources Engineering (CE20006)**</u>
Time: **2 Hrs.**   Full Marks: **40**   No. of Students: **80**

Notes: Answer all the questions. Make suitable assumptions wherever necessary and write it clearly in your answer sheet. Start the answer of each question on a new page.

1. A catchment has ten raingauge stations. In a year, the annual rainfall recorded by the gauges are as follows:

Station	A	B	C	D	E	F	G	H	I	J
Rainfall (cm)	90.6	110.9	188.3	118.3	106.8	144.7	124.6	112.6	130.4	106.4

   If it is accepted that these stations are optimum for the given area, what is the error in the estimation of the mean rainfall over the catchment.

   (10 marks)

2. Ordinates of 2 hr unit hydrograph are shown in Table 1. Compute the peak discharge for the rainfall hyetograph given in Table 2. Assume a constant loss of $0.15 \ cm/hr$.

   Table 1:

Time (hr)	0	2	4	6	8	10	12
Discharge (m^3/s)	0	540	1750	1270	580	250	0

   Table 2:

Time interval (hr)	0-1	1-2	2-3
Rainfall intensity (cm/hr)	1.25	4.15	0.65

   (10 marks)

3. The dilution technique method with sudden-injection procedure was used to measure the discharge of a hilly stream. The data of concentration measurements are given in Table 3. A fluorescent dye weighing 300 N used as a tracer was suddenly injected at station A at time $t = 0 \ h$. Concentration at station B (sufficiently downstream to ensure the complete mixing), are measured as follows:

   Table 3:

Time (h)	Concentration (in ppb by weight)
0	0.0
1	0.0
2	3.0
3	10.5
4	18.0
5	18.0
6	12.0
7	9.0
8	6.0
9	4.5
10	1.5
11	0.0

   Estimate the stream discharge.

   [10 Marks]

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4.   i) Which of he following recording raingauge does not produce the mass curve of precipitation as record:

     (a) Symon's raingauge   (b) tipping-bucket type gauge

     (c) weighing-bucket type gauge   (d) natural siphon gauge

$$[1; \text{negative marking } \frac{1}{2}]$$

ii) The mass curve of rainfall of a storm is a plot of

     (a) rainfall depths for various equal durations plotted in increasing order

     (b) rainfall intensity vs time in chronological order

     (c) accumulated rainfall intensity vs time

     (d) accumulated precipitation vs time in chronological order

$$[1; \text{negative marking } \frac{1}{2}]$$

iii) The Thiessen polygon is:

     (a) a polygon obtained by joining adjoining raingauge stations

     (b) a representative area used for weighing the observed station precipitation

     (c) an area used in construction of depth-area curves

     (d) the descriptive term for the shape of a hydrograph

$$[1; \text{negative marking } \frac{1}{2}]$$

iv) The following is *not* a direct stream flow determination technique

     (a) Dilution method   (b) Ultrasonic method

     (c) Area-velocity method   (d) Slope-area method

$$[1; \text{negative marking } \frac{1}{2}]$$

v) The flow-mass curve is an integral curve of

     (a) the hydrograph   (b) the hyetograph

     (c) the flow duration curve   (d) the S-curve

$$[1; \text{negative marking } \frac{1}{2}]$$

vi) In a flow-mass curve study, a demand line drawn from a ridge on the curve did not intersect the mass curve again. It represents that

     (a) the reservoir was not full at the beginning

     (b) the storage was not adequate

     (c) the demand can't be met by the inflow as the reservoir will not refill

     (d) the reservoir is wasting water by spill

$$[1; \text{negative marking } \frac{1}{2}]$$

vii) A storm hydrograph was due to 3h of effective rainfall. It contained 6 cm of direct runoff. The ordinates of DRH of this storm

     (a) when divided by 3 give the ordinates of a 6-h unit hydrograph

     (b) when divided by 6 give the ordinates of a 3-h unit hydrograph

     (c) when divided by 3 give the ordinates of a 3-h unit hydrograph

     (d) when divided by 6 give the ordinates of a 6-h unit hydrograph

$$[2; \text{negative marking } \frac{1}{2}]$$

viii) A triangular DRH due to a storm has a time base of 80 hrs and a peak flow of 50 m^3/s occurring at 20 hours from the start. If the catchment area is 144 km^2, the rainfall excess in the storm was

     (a) 20 cm   (b) 7.2 cm   (c) 5 cm   (d) none of these

$$[2; \text{negative marking } \frac{1}{2}]$$