53 (CE 711) HYDY

2019

HYDROLOGY

Paper : CE 711

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer Question No. **1** and **any four** from the rest. Each question carries **20** marks.*

1. Write short notes on **any five** of the following :   4×5=20

   (a) Methods of estimation of missing annual precipitation at a station

   (b) Assumptions of unit hydrograph theory

   (c) Rating curve and its application

   (d) Rational method of estimating peak discharge

the given month by (i) Arithmetic mean and (ii) Thiessen mean methods. 4+4=8

3. (a) Categorize different methods of measuring discharge of a river into direct and indirect methods. Describe the area velocity method of measuring discharge at a section in a river by providing a suitable sketch and relevant formulae ? 4+4=8

(b) What are the different types of current meter ? Describe the single and double point method of measuring velocity of a stream using current meter. 2+4=6

(c) In a river carrying a discharge of $60 \, m^3/s$, the stage at a station A was 2.5m and the water surface slope was 1 in 3000. If during a flood the stage at the same station was found to be same, i.e 2.5m, but the water surface slope was assessed as being 1 in 1500, then what would be the estimated value of discharge ? 6

4. (a) Define an Effective Rainfall Hydrograph (ERH), a Direct Runoff Hydrograph (DRH) and a Unit Hydrograph (UH). What is an S-curve ? 6+2=8

(e) Darcy's law for estimating groundwater discharge

(f) Reservoir routing and channel routing.

2. (a) Describe any one of Self-Recording Rainfall Gauge (SRRG) with an indicative sketch. What are the advantages of an SRRG over an Ordinary Rain Gauge (ORG) ? 4+2=6

(b) Describe the commonly used methods for estimating the data of missing annual rainfall at a raingauge station. 6

(c) A catchment has 5 raingauge stations located inside. On using Thiessen Polygon method, three more stations outside the catchment were found to contribute weights. The details of the Thiessen Polygons and the corresponding rainfalls recorded in a month are given below :

Raingauge stations	A	B	C	D	E	F	G	H
Thiessen Polygon area (km^2)	720	1380	1440	1040	900	2220	419	1456
Raifall Recorded (mm)	135	143	137	128	102	115	99	101

Stations B, D, and F are outside the catchment. Determine the average depth of rainfall on the catchment in

(b) The observed flows in m^3/s from a storm of 6-h duration at a stream gauging site having catchment area of 500 km^3 are given below. Assuming the base flow to be negligible, derive the ordinates of a 6-h unit hydrograph. 6

Time (hr)	0	6	12	18	24	30	36	42	48	54	60	66	72
Flow	0	100	250	200	150	100	70	50	35	25	15	5	0

(c) Define a Synthetic Unit Hydrograph (SUH). What Physical Catchment Descriptors would be needed for deriving an SUH for an ungauged catchment on the Gaurang River near Kokrajhar by the method recommended by the Central Water Commission in India? 4+2=6

5. (a) What are the different methods of estimating the magnitude of a flood peak? Write the Dicken's empirical formula for estimating peak discharge. 4+2=6
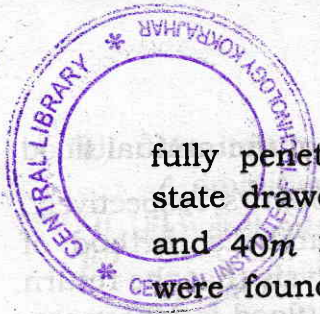
(b) The design discharge of a hydraulic structure on a river is 350m^3/s. If the available flood data for the river is for 20 years and the mean and

standard deviation of the annual flood series are 121 and 60m^3/s respectively, show by using Gumbel's method of flood frequency analysis that the return period of the design flood is 100 years. Adopt the values of the reduced mean and reduced standard deviation corresponding to a sample size of 20 as 0.5236 and 1.0628 respectively. 6

(c) What are the applications of flood routing? Starting with the continuity equation, describe the procedure of Modified-Puls method of reservoir routing. 2+6=8

6. (a) What do you mean by aquiclude, aquitard and aquifuge? Define with the help of a suitable sketch an unconfined aquifer an artesian aquifer and perched water table. 6+6=12

(b) Derive an expression for estimating steady flow into a well fully penetrating a confined aquifer. Calculate the hydraulic conductivity and transmissibility of a 10m thick confined aquifer having a 10cm diameter well

fully penetrating the aquifer. Steady state drawdowns at distances of $10m$ and $40m$ from the centre of the well were found to be $2.5m$ and $0.05m$ respectively when the well was pumped at a constant rate of $125L/min$.

4+4=8

7. (a) When is a dune formed in an alluvial river bed? Define with sketches aggrading, degrading and meandering rivers in alluvial flood plains. 2+6=8

(b) Why is training a river necessary? What are different types of river training works? What are the functions of Guide Bunds and Spurs? 4+4+4=12

8. (a) Describe various engineering measures that are adopted for reducing (i) the peak flow and (ii) peak stage for mitigating damage from flood.

6+6=12

(b) What are the likely impacts of climate change on occurrence of floods? What are likely causes of urban flooding in India. 4+4=8

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