

2018

HYDROLOGY

Paper : CE 711

Full Marks : 100

Time : Three hours

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

Answer Q. No. 1 and any four from the rest.

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

- (a) Optimal number of rain gauge stations in a catchment for an allowable degree of error
- (b) Assumptions of unit of hydrograph theory
- (c) Rating Curve
- (d) Rational method of estimating peak discharge

Contd.

(e) Darcy's formula for estimating ground water discharge

(f) Modified Pul's method of reservoir routing

(g) Methods of reduction of flood run off for flood impact mitigation.

2. (a) Describe with a sketch, the non-recording type rain gauge as specified in IS : 5225-1992 and the method of its installation and measurement of rainfall as specified in IS : 4986-2002. 6

(b) Describe the methods for estimating missing annual precipitation at a station. Describe with the aid of a sketch the Thiessen polygon method of estimating average rainfall over a catchment. 4+4=8

(c) Show that the average precipitation over a catchment of area 600 km^2 calculated from the following data for a storm would be 7.41 cm . 6

Isohyets (cm)	:	15-12	12-9	9-6	6-3	3-1
Inter - Isohyetal area (km^2)	:	92	128	120	175	85

3. (a) Describe with sketches *any one* method each of (i) direct and (ii) indirect determination of stream discharge. Describe *three* simplified methods of measuring velocity of a stream using current meter. 4+4+4=12

(b) The data from a stream gauging operation at a gauging site are given below. The rating equation of the current meter used for this purpose is $V = 0.51 N_s + 0.03 \text{ m/s}$, V being the velocity of flow, and N_s being the number of revolution/sec recorded by the current meter.

Distance from left water edge (m)	:	0.0	1.0	3.0	5.0	7.0	9.0	11.0	12.0
Depth	:	0.0	1.1	2.0	2.5	2.0	1.7	1.0	0.0
Revolutions of the current meter held at 60% depth	:	—	39	58	112	90	45	30	—
Duration of observations (s)	:	—	100	100	150	100	100	100	—

Show that the discharge in the stream would be $6.457 \text{ m}^3/\text{s}$. 8

4. (a) Define a Unit Hydrograph. What is an S-curve? What is the use of an S-curve? 3+3+2=8

- (b) A 2-hour unit hydrograph for a river catchment has the ordinates 0, 3, 11, 35, 55, 66, 63, 40, 22, 9 and $2 \text{ m}^3/\text{s}$. Assuming that the baseflow at time $t = 0$ hour is $20 \text{ m}^3/\text{s}$ increasing linearly to $44 \text{ m}^3/\text{s}$ at $t = 24$ hour, show that the peak flow of a hydrograph resulting from two successive 2-hour periods of effective rainfall of 2.0 cm and 1.5 cm would be $257 \text{ m}^3/\text{s}$ occurring at $t = 12 \text{ hrs}$. 6

- (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 flood peak? Describe Dicken's empirical formula for estimating the peak discharge. 4+2=6

- (b) The magnitudes of flood having return periods 100 and 50 years at a river station having 30 years of data were estimated by Gumbel's method as 1200 and $1060 \text{ m}^3/\text{s}$ respectively. Show that (i) the mean and standard deviation of the data are 385 and $223 \text{ m}^3/\text{s}$ respectively and (ii) a flood of 500 years return period would have magnitude of $1525 \text{ m}^3/\text{s}$. For sample size of 30, adopt reduced mean = 0.5362 and reduced standard deviation = 1.1124. 5+5=10

- (c) What is flood routing and what are its application? 4

6. (a) Define and provide examples of aquifer, aquitard, aquiclude and aquifuge. Describe with sketches (i) unconfined aquifer, (ii) artesian aquifer and (iii) perched water table. 6+6=12

- (b) Derive an expression for estimating steady flow into well fully penetrating a confined aquifer. Assuming the radius of influence as 300 m , show that the steady discharge from a 30 cm diameter aquifer of depth 20 and permeability 45 m day^{-1} would be 1550 lpm when the drawdown at the well is 3.0 m . 4+4=8

7. (a) Describe with sketches the formation of different bed-forms during sediment transport with increasing Froude number. Define aggrading, degrading and meandering rivers in alluvial flood plains. 6+6=12

- (b) Why is training a river necessary? What are the functions of Guide bunds and spurs? 4+4=8

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

- (b) What are likely causes of urban flooding in India? Write a note on the flood event in the state of Kerala that occurred during this year's monsoon season. 6+6=12