53 (CE 711) HYLG

2021

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 by providing sketches
   wherever applicable on **any four** of the
   following : 5×4=20

   (a) Methods of estimating the average
   precipitation over a catchment.

   (b) Unit Hydrograph, Synthetic Unit
   Hydrograph, Instantaneous Unit
   Hydrograph and Dimensionless Unit
   Hydrograph.

(c) Stage of a river, a rating curve and applications of a rating curve.

(d) Categories of methods for flood estimation with advantages and disadvantages of each method.

(e) Darcy's law for estimation ground water discharge.

(f) Modified Puls' method for reservoir routing.

2. (a) The annual precipitation of a year over a catchment having an area of $3850 km^2$ was estimated using Thiesen polygon method as being $119 cm$. The average discharge during the year in the river draining that catchment at the catchment's outlet worked out to $56 cumec$. Show that —

(i) the river carried 1766 Million Cubic Metre (MCM) of water from that catchment in that year.

2

(ii) 2815·5 MCM of water was lost from the precipitation by the combined effect of evapotranspiration and infiltration into ground.

2

(iii) the runoff co-efficient for the catchment is 38·5%.   2

(iv) the amount of ground water recharge would be 813·5 MCM if the evapotranspiration of 52 cm is estimated over the catchment for the year.   2

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

(c) Describe the commonly used methods of estimating the data of missing annual rainfall at a rain gauge station.   6

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 metre ? Describe the single- and double-point methods of measuring velocity of a stream using a current meter.   2+4=6

(c) From the following data for measuring discharge of a river at a gauging station, estimate the discharge by using the area velocity method. 6

Distance from left water edge (m)	0	1	3	5	7	9	11	12
Depth of flow (m)	0·0	1·1	2·0	2·5	2·0	1·7	1·0	0·0
Velocity (ms^{-1})	–	0·229	0·326	0·411	0·336	0·260	0·183	–

4. (a) Define ϕ index and baseflow. What do you mean by terms ERH and DRH ? 4+4=8

(b) The observed flow in *Cumec* from a storm of 6-hour duration at a stream gauging site having catchment area of $500\,km^2$ are given below. Assuming the baseflow to be negligible, derive the ordinates of a 6-hour 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) Describe with suitable sketches, the two methods for deriving unit hydrographs (UH) of different durations from a UH of a given duration. 6

5.　(a)　Write the Dicken's empirical formula for estimating peak discharge. Write the general equation of hydrologic frequency analysis. What physical catchment descriptors would be needed for deriving a Synthetic Unit Hydrograph for an ungauged catchment on the Gaurang River near Kokrajhar by the method recommended by the Central Water Commission in India ?

2+2+2=6

(b)　The design discharge of a hydraulic structure on a river is 350 *cumec*. 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 60 *cumec* 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 ? What are reservoir and channel routing ?　　2+6=8

6. *(a)* What do you mean by aquifer, aquiclude, aquitard and aquifuge by giving an example of a geological or lithological formation for each of the four ? Define with the help of a suitable sketch an unconfined aquifer, an artesian aquifer and a 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 will fully penetrating the aquifer. Steady state drawdowns at distances of $10m$ and $40m$ from the centre of the well were found to be $2 \cdot 5m$ and $0 \cdot 05m$ respectively when the well was pumped at a constant rate of 125litre/min. 4+4=8

7. *(a)* Describe the 'bed formations' that are created in an alluvial river bed with increasing Froude Number. Define with sketches aggrading, degrading and meandering rivers in alluvial flood plains. 4+6=10

(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+2+4=10

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 flood ? What are the likely causes of urban flooding in India ?   4+4=8

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

(a) Optimum number of raingauge stations in a catchment

(b) Return period of a storm

(c) Pan Evaporimeter as per Indian Standard

(d) Lysimeters

(e) Potential evapotranspiration

(f) Horton's equation for measuring infiltration capacity

(g) Constant rate injection method of dilution technique of discharge measurement

(h) Form constants of an aquifer.