53 (CE 711) HDLG

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.*

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

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

   (b) Assumptions of Unit Hydrograph theory

   (c) Rating Curve

   (d) Rational method of estimating peak discharge

Contd.

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

(f) A Synthetic Unit Hydrograph

(g) Method of reduction of volume of flood.

2. (a) Describe with sketch an Ordinary Rain Gauge (ORG) specified in relevant Indian Standard Code. What are the advantages of a Self-Recording Rainfall Gauge (SRRG) over an ORG? 4+2=6

(b) A catchment has an area of 250 *Ha*. The runoff/rainfall ratio for this catchment during the monsoon season is assessed as being 0.6. If a rainfall of 12 *cm* over the catchment results in a stream flow that lasts for 6 hours at the outlet of the catchment, compute the average stream flow during the period. (1 $Ha = 10_4\ m^2$). 4

(c) Describe with a sketch the Thiessen Polygons method of estimating average rainfall over a catchment. 4

(d) From Isohyetals drawn for a storm over a catchment of area 710 km^2, the following precipitation data were obtained :

Isohyetals (interval) (*cm*)	15-12	12-9	9-6	6-3	3-1
Inter-isohyetal area (km^2)	86	165	230	154	75

Estimate the average depth of precipitation over the catchment. 6

3. (a) List the important direct and indirect methods of measuring discharge in a river. Describe with a sketch and suitable expressions the Area-Velocity method of measuring discharge. 4+4+2=10

(b) Describe the single and double-point method of measuring velocity of a stream using current meter. 4

(c) In a river carrying a discharge of $60 m^3 s^{-1}$, the stage at a station A was 2.5 *m* and the water surface slope was 1 in 3000. If during a flood, the stage at the same station was found to be the same, i.e., 2.5 *m*, 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 a Unit Hydrograph (UH). What is an S-curve? Provide suitable sketches. Describe *three* methods for separating baseflow from a flood hydrograph. 4+4+4=12

(b) Derive a 12-hour UH from the following ordinates of a 4-hour UH for the same catchment. 8

Time (hour)	0	4	8	12	16	20	24	28	32	36	40	44
Ordinates (m^3/s)	0	20	80	130	150	130	90	52	27	15	5	0

5. (a) What are the different methods of estimating the magnitude of a flood peak? Describe Dicken's empirical formula for estimating the peak discharge. 2+4=6

(b) What is flood routing and what are its applications? At any given instant the storage of water in a reach of a river passing a flood wave was found to be 16.112 *ha.m.* If the average inflow and outflow during a 3 hour period were 14.2 m^3s^{-1} and 10.6 m^3s^{-1} respectively, what would be the storage in the reach after 3 hours? 2+2+4=8

(c) Regression equations of a Synthetic Unit Hydrograph (SUH) of 1-hour duration in the Hydrometeorologically homogeneous region No. 2 *(a)* for the North Brahmaputra Basin of India are given in the table below. Estimate the parameters of the SUH at a proposed site on a river in this region using the relevant catchment parameters given in

the following table and show that the peak discharge of the SUH for the catchment would be about 60 m^3s^{-1}. Sketch the SUH using the SUH parameters thus estimated. 6

SUH	Regression Equation
q_p (m^3s^{-1})	$2.272*(L*Lc/S)^{-0.409}$
t_p (hour)	$2.164*(q_p)^{-0.940}$
W_{50} (hour)	$2.084*(q_p)^{-1.065}$
W_{75} (hour)	$1.028*(q_p)^{-1.071}$
W_{R50} (hour)	$0.856*(q_p)^{-0.865}$
W_{R75} (hour)	$0.440*(q_p)^{-0.918}$
T_B (hour)	$5.428*(t_p)^{0.852}$
T_m (hour)	$t_p + t_r/2$
Q_p (m^3s^{-1})	q_p*A

Catchment parameter	Value
Area 'A' (km^2)	596
Length of longest stream 'L' (km)	75.6
Length of the longest stream from CG to dam site 'L_c' (km)	47.5
Stream slope 'S' (m/km)	1.7

6. *(a)* Define with the help of suitable sketches

(i) an unconfined aquifer

(ii) an artesian aquifer and

(iii) perched water table. 8

(b) Define :

(i) porosity

(ii) transmissibility and

(iii) Specific Yield of an aquifer. 6

(c) Starting with Dupuit's assumptions, derive an expression of steady radial flow into a well penetrating the full length of an unconfined aquifer. Under steady state of pumping from a 30 *cm* diameter well completely penetrating a confined aquifer 15 *m* thick, the drawdown in the well was observed as 2.5 *m* and the radius of influence was found to be 280 *m*. Estimate the discharge from the well. 6

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? Describe with sketches the layouts of *any one* type of river training works. 4+4=8

8. *(a)* Describe various engineering measures that may be adopted for reducing the peak discharge from floods in a flood prone area. 8

(b) What are prevalent causes of urban flooding in India ? 4

(c) What data would you look for in order to plan a water resources project for supplying drinking water to a rural community and providing irrigation to a large command area ? 4+4=8