53 (CE 711) HDLG

2017

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) Thiessen Polygon method of rainfall averaging

   (b) Instantaneous Unit Hydrograph

   (c) Rating Curve

   (d) Return period of a hydrological event

   (e) Hydraulic conductivity and transmissibility of an aquifer

   (f) Muskingum method of flood routing

(g) Flood Insurance.

2. (a) Describe an Ordinary Rain Gauge (ORG) as specified in Indian Standard Code IS : 4986-2002, and *any one* type of Self Recording Rain Gauge (SRRG). What are the advantages of an SRRG over an ORG ? 3+3+2=8

(b) Describe *three* commonly used methods of estimating average rainfall over a catchment with suitable sketches wherever necessary. 6

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

Isohyet Interval in *cm*	15–12	12–9	9–6	6–3	3–1
Inter-Isohyet area in km^2	86	165	230	154	75

Estimate the average depth of precipitation over the catchment. 6

3. (a) What is the usefulness of measuring the stage at a gauging site ? Describe *any one* type of automatic stage recorder by providing a suitable sketch. Define a rating curve. 4+4=8

(b) What are the different types of current meter ? Describe different procedures for measuring the velocity of a stream using a current meter. 3+3=6

(c) From the following table of data for measuring the discharge at a gauging site, estimate the discharge :

Distance from left water edge (m)	0	1	3	5	7	9	11	12
Flow depth (m)	0	1·1	2·0	2·5	2·0	1·7	1·0	0
Velocity (m/s)	—	0·23	0·33	0·41	0·34	0·26	0·18	—

6

4. (a) What are the assumptions made in the Unit Hydrograph Theory ? Describe the method of deriving a new Unit Hydrograph of duration that is a non-integer multiple of the duration of an already available Unit Hydrograph. 4+4=8

(b) What is a synthetic Unit Hydrograph ? Regression equations of a synthetic Unit Hydrograph of 1-day duration for the hydrometeorologically homogeneous subzone 2(a) of India as given in the Flood Estimation Report of the Central Water Commission are reproduced

below. Evaluate the parameters of the synthetic Unit Hydrograph at a weir site on a river in that subzone using relevant catchment parameters provided below and by following the usual convention. Sketch the resulting Unit Hydrograph. If the depth of effective rainfall of a design storm of 1-day duration is 2·2*cm*, what would be the peak flow of the resulting direct runoff hydrograph at the weir site ?

Synthetic Unit Hydrograph parameters	**Regression Equation (t_r = 1 hour)**
$q_p\,(m^3/s)$	$2{\cdot}272\ (LL_C/S)^{-0{\cdot}409}$
t_p(hour)	$2{\cdot}164\ (q_p)^{-0{\cdot}940}$
W_{50}(hour)	$2{\cdot}084\ (q_p)^{-1{\cdot}065}$
W_{75}(hour)	$1{\cdot}028\ (q_p)^{-1{\cdot}071}$
W_{R50}(hour)	$0{\cdot}856\ (q_p)^{-0{\cdot}865}$
W_{R75}(hour)	$0{\cdot}440\ (q_p)^{-0{\cdot}918}$
T_B(hour)	$5{\cdot}428\ (t_p)^{0{\cdot}852}$
T_m(hour)	$t_p + t_r/2$
Q_p(hour)	q_pA

Catchment Parameter	Value
Area, $A(km^2)$	120
Length of longest stream, $L(km)$	18·19
Length of the stream from CG of the catchment up to the weir site, $Lc(km)$	10·05
Stream slope, $S(m/km)$	64·6

2+4+3+3=12

5. *(a)* Describe the procedure for estimating the design flood of a specified return period for practical application using Gumbel's method. 6

(b) What is Probable Maximum Flood (PMF)? Peak floods of return periods 50 and 100 years in a river were estimated as being $40{,}809 m^3/s$ and $46{,}300 m^3/s$ respectively. Estimate the peak flood with a return period of 300 years. 2+6=8

(c) What is flood routing ? Starting with the storage-continuity equation, describe the procedure of Modified Pul's method of reservoir routing. 2+4=6

6. (a) Define with the help of suitable sketches, *(i)* an aquifer, *(ii)* an aquitard, *(iii)* an aquiclude, *(iv)* an aquifuge, *(v)* a perched aquifer and *(vi)* a leaky aquifer. Write the expression for estimating ground water discharge using Darcy's equation. 6+4=10

(b) Calculate the hydraulic conductivity and transmissibility of a 10*m* thick confined aquifer having a 10*cm* dia well fully-penetrating the aquifer. Steady state draw downs at distances of 10*m* and 40*m* from the centre of the well were found to be 2·5*m* and 0·05*m* respectively when the well was pumped at a constant rate of 125 litre/min. 10

7. (a) Describe with sketches the formation of different bed-forms during sediment transport with increasing Froude Number. 6

53

(b) Define with sketches the aggrading, the degrading and the meandering rivers in alluvial flood plains. 6

(c) What objectives are met by training a river ? Classify different river training works on the basis of the purpose of construction. Provide a list of the methods of training rivers generally adopted. 2+3+3=8

8. (a) Describe various engineering measures for reducing *(i)* peak flow, *(ii)* peak stage, and *(iii)* flood runoff for flood damage mitigation. 12

(b) What are the likely causes of urban flooding in India ? Write a note on Catchment Flood Risk Assessment and Management (CFRAM) studies of a river. 4+4=8
