(Please write your Exam Roll No.) Exam Roll No. .....

END TERM EXAMINATION

FIFTH SEMESTER [B.TECH] DECEMBER 2015-JANUARY 2016

Paper Code: ETCE-307 **Subject: Engineering Hydrology**

Time: 3 Hours **Maximum Marks: 75**

Note: Attempt any five questions including Q.no.1 which is compulsory. Select one question from each unit.

Q1 Answer **any five** questions providing sketches wherever applicable: **(5x5=25)**

(a) Describe the hydrologic cycle, and explain the water budget equation.

(b) Define Evapotranspiration and name different methods of estimating evapotranspiration of a catchment.

(c) Describe Slope-Area method for estimating discharge through a channel.

(d) What are the factors affecting a flood hydrograph? Define a Unit Hydrograph.

(e) Starting with the continuity equation, describe the modified Pul's method of reservoir routing.

(f) Why is separation of baseflow required from a flood hydrograph? Describe three methods of baseflow separation.

(g) Derive an expression for steady-state radial flow into a well fully penetrating an unconfined aquifer.

Unit-I

Q2 (a) Describe either the Thiessen polygon or the Isohyetal method of estimating the mean areal rainfall over a catchment. Write an expression for determining the optimum number of rain gauge stations in a catchment for a specified allowable degree of error. **(4+1)**

(b) On the basis of isopluvial maps, the 50 year-24 hour maximum rainfall at a place is found to be 17 cm. Determine the probability of a 24 hour rainfall of magnitude equal to or greater than 17 cm occurring at that place (i) once in 25 successive years. **(2+2)**

(c) Describe the Intensity-Duration-Frequency relationship of storms over a catchment providing a general form of the relationship. Define 'Return Period' of a hydrological event. **(2.5+1)**

Q3 (a) Write Horton's expression of decay of infiltration capacity with time explaining each term of the expression. Hence, find the infiltration capacity of a catchment (i) at the 6th hour (hr) from the start and (ii) the total volume of infiltration over the 6 hour period if the initial rate of infiltration is 5.3 hr^{-1}, the final capacity is 0.5 cm hr^{-1}, and the time constant is 0.4 hr^{-1}. **(2+2+3)**

(b) Define Φ-index. For a 12-hour (hr) storm rainfall over a catchment with the hourly distribution of rainfall in cm given by 2.0, 2.5, 7.6, 3.8, 10.6, 5.0, 7.0, 10.0, 6.4, 3.8, 1.4 and 1.4 and estimated direct runoff 25.5 cm, show that the average Φ-index for the catchment would be 3.5875 cm hr^{-1}. **(2+3.5)**

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Unit-II

Q4 (a) What is the usefulness of measuring the state at a gauging site? Describe any one type of automatic stage recorder by providing a suitable sketch.

(b) What are the different types of current meter? Describe different procedure of measuring the velocity of a stream using a current meter. **(1+3)**

(c) From the following data for measuring discharge of a river at a gauging site, estimate the discharge by calculating by the mid-section method. **(4.5)**

Distance from the 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	–

Q5 (a) What are the uses of a flow duration curve and a flow-mass curve in water resource planning and development? **(3+2)**

(b) Estimate the storage required in a proposed reservoir to meet variable monthly demands in Million Cubic Metre (Mm^3) as tabulated below. The table also includes data of mandatory release (Mm^3) to be made on the downstream of the reservoir and the net evaporation (Mm^3) after according for rainfall over the reservoir's area. **(7.5)**

Month	J	F	M	A	M	J	J	A	S	O	N	D
Inflow	50	40	30	25	30	40	200	250	175	100	70	60
Demand	60	80	80	90	120	130	40	30	50	50	50	50
Mandatory Release	11	9	11	10	11	10	11	11	10	11	10	11
Evaporation	2	3	3	4	4	2	0	1	1	3	2	3

Unit-III

Q6 (a) What are the assumption made in the Unit Hydrograph (UH) theory? Name the methods of deriving a new UH of duration different form the duration of a UH that is already available. Describe the method in the case of the required duration being fraction of the duration for which a UH is available. **(2.5+2+3)**

(b) The observe flow in m^3s^{-1} from a storm of 6-hour duration at a stream gauging site having catchment area of 500 km^2 are given below. Assuming the base flow to be negligible, derive the ordinates of a 6-hour unit hydrograph. **(5)**

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

Q7 (a) Describe a procedure for deriving UH from a complex storm. **(4)**

(b) Regression equations of a Synthetic Unit Hydrograph (SUH) of 1-day duration for hydrometeorologically homogeneous subzone 2(a) of India as given in the Flood Estimation Report of the Central Water Communication are reproduced below. Evaluate the parameters of the **P.T.O.**

SUH at a weir site on a river in that subzone using relevant catchment parameters provide below, and by following the usual convention. Sketch the resulting SUH. How is such an SUH finalized for practical application? 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? **(4+2.5+2)**

SUH Parameters	**Regression Equation**
t_p (hour)	$2.272\ (LLc/S)^{-0.409}$
$q_p (m^3s^{-1})$	$2.164\ (q_p)^{-0.940}$
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 (hour)	$q_p A$

Catchment parameter	**Value**
Area 'A' (km^2)	120
Length of longest stream 'L' (km)	18.19
Length of the stream from CG to dam site 'L_c' (km)	10.05
Stream slope 'S' (m/km)	64.6

Unit-IV

Q8 (a) Write the general equation of hydrologic frequency analysis? Describe procedure for estimating the design flood of a specified return period for practical application using Gumbel's method? **(1+4)**

(b) Peak floods of return periods 50 and 100 year in a river were estimated as being 40809 m^3s^{-1} and 46300 m^3s^{-1} respectively. Estimate the peak flood with a return period of 300 years. **(4.5)**

(c) Define Standard Project Flood (SPF) and Probable Maximum Flood (PMF). **(3)**

Q9 (a) Define with the help of suitable sketches: (i) an aquifer, (ii) an aquitard, (iii) an aquiclude, (iv) an aquifuge, and (v) a leaky aquifer giving examples. **(5)**

(b) A 10 cm diameter well penetrates a 10 m thick confined aquifer. The steady state drawdowns were found to be 2.5 m and 0.05 m at distances of 10 m and 40 m respectively from the centre of the wall when the well was pumped at a constant rate of 125 litre/min. Calculate the transmissibility and hydraulic conductivity of the aquifer. **(4)**

(c) What purposes does artificial recharge serve? Describe any one method of artificial recharge by providing a sketch. **(2+1.5)**

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