

**B.Tech 5th Semester Exam., 2019**

**ENGINEERING HYDROLOGY**

Time : 3 hours

Full Marks : 70

Instructions :

(i) All questions carry equal marks.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. 1 is compulsory.

1. Choose the correct answer from any seven of the following :

(a) Which of the following recording rain gauges does not produce the mass curve of precipitation as record?

- (i) Symon's rain gauge
- (ii) Tipping-bucket type gauge
- (iii) Weighing-bucket type gauge
- (iv) Natural siphon gauge

(b) Depth-area-duration curve of precipitation is drawn as

- (i) minimizing envelopes through the appropriate data point
- (ii) maximizing envelopes through the appropriate data point
- (iii) best-fit mean curves through the appropriate data point
- (iv) best-fit straight lines through the appropriate data point

(c) An isohyet is a line joining point having

- (i) equal evaporation line
- (ii) equal barometric line
- (iii) equal height above the MSL
- (iv) equal rainfall depth in a given duration

(d) Main annual runoff of  $1 \text{ m}^3/\text{s}$  from a catchment of area  $31.54 \text{ km}^2$  represents an effective rainfall of

- (i) 100 cm
- (ii) 1.0 cm
- (iii) 100 mm
- (iv) 3.17 cm

(e) An area is classified as a drought-prone area if the probability  $P$  of occurrence of a drought is

(i)  $0.4 < P \leq 1.0$

(ii)  $0.2 < P \leq 0.4$

(iii)  $0.1 < P \leq 0.2$

(iv)  $0.0 < P \leq 0.2$

(f) The average pan coefficient for a standard US weather bureau class A pan is

(i) 0.85

(ii) 0.70

(iii) 0.90

(iv) 0.20

(g) The chemical that is found to be most suitable as water evaporation inhibitor is

(i) ethyl alcohol

(ii) methyl alcohol

(iii) cetyl alcohol

(iv) butyl alcohol

(h) A unit hydrograph has one unit of

(i) peak discharge

(ii) rainfall duration

(iii) direct runoff

(iv) the time base of direct runoff

(i) The surface joining the static water levels in several wells penetrating a confined aquifer represents

(i) water-table surface

(ii) capillary fringe

(iii) piezometric surface of the aquifer

(iv) cone of depression

(j) The dimension of the coefficient of transmissibility  $T$  is

(i)  $L^2 / T$

(ii)  $L^3 T^2$

(iii)  $L / T^2$

(iv) dimensionless

2. (a) Discuss the hydrological water budget with the aid of examples. What are the significant features of global water-balance studies?

(b) A catchment area has seven rain gauge stations. In a year, the annual rainfall recorded by the gauges is as follows :

Station	P	Q	R	S	T	U	V
Rainfall (cm)	135.0	142.1	122.2	108.5	165.2	102.1	146.9

(i) Determine the standard error in the estimation in mean rainfall in the existing set of rain gauges.

(ii) For a 5% error in the estimation of the mean rainfall, calculate the minimum number of additional rain gauge stations to be established in the catchment.

3. (a) What are the different methods of recording of rainfall?

(b) Assuming the initial infiltration rate of 10 mm/h, final infiltration rate of 5 mm/h and the constant value (describing the rate of decay of the difference between the initial and final infiltration rates) as  $0.95 \text{ h}^{-1}$ , calculate the total infiltration depth for the storm lasting 6 h.

4. (a) Define infiltration capacity. Discuss the factors affecting the infiltration capacity of an area.

(b) Following observations were made for conducting the water budget of a reservoir over a period of one month of 30 days :

Average surface area =  $10 \text{ km}^2$ ;  
rainfall = 10 cm

Mean surface inflow rate =  $10 \text{ m}^3/\text{s}$ ;  
mean surface outflow rate =  $15 \text{ m}^3/\text{s}$

Fall of reservoir level = 1.50 m;  
pan evaporation = 20 cm

Assume pan evaporation coefficient  
= 0.70

Estimate the average seepage discharge during the month.

5. Describe briefly the surface water resources in India.

6. (a) What is meant by 75% dependable yield of a catchment? Indicate a procedure to estimate the same by using annual runoff volume time series.

- (b) For a catchment in Bihar, India, the mean monthly temperatures are given :

Month	Jan	Feb	Mar	Apr	May	Jun
Temp (°C)	10	16	22	27	34	41
Rainfall ( $P_m$ )(cm)	5	3	2	0	3	15

  

Month	Jul	Aug	Sep	Oct	Nov	Dec
Temp (°C)	39	35	30	27	17	11
Rainfall ( $P_m$ )(cm)	35	38	24	2	0	2

Estimate the annual runoff and annual runoff coefficient by Khosla's method.

7. (a) Describe the S-curve method of developing a 6 h unit hydrograph by using 12 h unit hydrograph of the catchment.
- (b) Given below are observed flows from a storm of 6 h duration on a stream with a catchment area of 500 km<sup>2</sup> :

Time (h)	0	6	12	18	24	30	36
Observed flow (m <sup>3</sup> /s)	0	100	250	200	150	100	70

  

Time (h)	42	48	54	60	66	72
Observed flow (m <sup>3</sup> /s)	50	35	25	15	5	0

Assuming the base flow to be zero, derive the ordinates of the 6 h unit hydrograph.

8. (a) Distinguish between the following :

- ~~(i)~~ Aquifer and Aquitard  
~~(ii)~~ Unconfined aquifer and a Leaky aquifer  
 (iii) Water table and Piezometric surface

- ~~(b)~~ A well is located in a 25 m confined aquifer of permeability 30 m/day and storage coefficient 0.005. If the well is being pumped at a rate of 1750 lpm, calculate the drawdown at a distance of (i) 100 m and (ii) 50 m from the well after 20 hour of pumping.

9. Write short notes on any four of the following :

- (a) Water-budget method  
 (b) Floodwater harvesting  
 (c) Artificial recharge  
 (d) Components of hydrograph  
 (e) Global freshwater resources

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