

**B.Tech 5th Semester Exam., 2020**  
**(New Course)**

**HYDROLOGY AND WATER RESOURCES**  
**ENGINEERING**

**Time : 3 hours**

**Full Marks : 70**

**Instructions :**

- (i) The marks are indicated in the right-hand margin.
- (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 the following  
(any seven) : 2×7=14

- (a) The area below a direct runoff graph is
- (i) always greater than that below the corresponding rainfall histogram
  - (ii) always less than that below the corresponding rainfall histogram
  - (iii) always equal to that below the corresponding rainfall histogram
  - (iv) sometimes greater and sometimes less than that below the corresponding rainfall histogram

- (b) A confined aquifer is one in which
- (i) water surface under the ground is at atmospheric pressure
  - (ii) water is confined under pressure less than the atmospheric pressure between impermeable strata
  - (iii) water is confined at atmospheric pressure between impermeable strata
  - (iv) water is confined under pressure greater than the atmospheric pressure between impermeable strata

- (c) An unconfined aquifer is one in which
- (i) water surface under the ground is at atmospheric pressure
  - (ii) water is under pressure greater than the atmospheric pressure between impervious strata
  - (iii) water is at pressure below the atmospheric pressure between impervious strata
  - (iv) water is either below or above atmospheric pressure between impervious strata

- (d) For a well penetrating an unconfined aquifer having permeability  $k = 4 \times 10^{-4}$  m/s, the radius of influence for a drawdown of 5 m is approximately
- 100 m
  - 200 m
  - 300 m
  - 400 m
- (e) If it rains between 2 p.m. and 3 p.m. and the entire basin area just starts contributing water at 3 p.m. to the outlet, then time of concentration will be
- 15 minutes
  - 20 minutes
  - 30 minutes
  - 60 minutes
- (f) The area between the isohyets 45 cm and 55 cm is 100 square km and between 55 cm and 65 cm is 150 square km. The average depth of annual precipitation over the above basin of 250 square km will be
- 50 cm
  - 55 cm
  - 56 cm
  - 60 cm

- (g) S-hydrograph is used to obtain unit hydrograph of
- shorter duration from longer duration
  - longer duration from shorter duration
  - Both (i) and (ii)
  - Not used for unit hydrograph
- (h) The runoff increases with
- increase in intensity of rain
  - increase in infiltration capacity
  - increase in permeability of soil
  - Does not depend on intensity of rain
- (i) Infiltration rate is always
- more than the infiltration capacity
  - less than the infiltration capacity
  - equal to or less than the infiltration capacity
  - equal to or more than the infiltration capacity
- (j) A rain gauge should preferably be fixed
- near the building
  - under the tree
  - in an open space
  - in a closed space

2. (a) Discuss different infiltration indices. 6
- (b) The mass curve of rainfall of duration 180 minutes on a catchment is given below in the table. The catchment had an initial loss of 0.5 cm, the phi-index ( $\phi$ -index) of the catchment is known to be 0.4 cm/hr. Calculate the total surface runoff due to this storm. 8

Time (minute)	0	30	60	80	100	120	150	180
Cumulative rainfall (cm)	0	0.6	1.3	2.6	2.8	3.0	3.2	3.3

3. A small tube with a cross-sectional area of  $40 \text{ cm}^2$  is filled with soil and laid horizontally. The open end of the tube is saturated, and after 15 minutes,  $100 \text{ cm}^3$  of water have infiltrated into the tube. If the saturated hydraulic conductivity of the soil is 0.4 cm/hr, determine how much infiltration would have taken place in 30 minutes if the soil column had initially been placed upright with its upper surface saturated. [Use Philip's equation.] 14
4. The peak of flood hydrograph due to a 3-h duration isolated storm in a catchment is 270 cumecs. Total depth of rainfall is 5.9 cm. Assuming an average infiltration loss of 0.3 cm/h and a constant base flow of 20 cumecs, estimate the peak of 3-h unit

hydrograph. If the area of catchment is given as 567 sq.km, determine the base width of 3-h unit hydrograph assuming it to be triangular in shape. 14

5. At a certain point in an unconfined aquifer of  $3 \text{ km}^2$  area, the water table was at an elevation of 102.00 m. Due to natural recharge in a wet season, its level rose to 103.20 m. A volume of  $1.5 \text{ mm}^3$  of water was then pumped out of the aquifer causing the water table to reach to a level of 101.20 m. Assuming the water table in the entire aquifer to respond to a similar way, estimate (i) the specific yield of the aquifer and (ii) the volume of recharge during wet season. 14
6. Find the probable life of a reservoir with initial capacity of 4000 ha-m if the average annual inflow is 8000 ha-m and the average annual sediment inflow is  $2 \times 10^5$  tons. Assume a specific weight of sediment as  $1120 \text{ kg/m}^3$ . The useful life of reservoir is terminated when 80% of its initial capacity is filled with sediment. The values of trap efficiency for different values of capacity inflow ratio is given in the table below : 14

Capacity inflow ratio	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Trap efficiency, %	87	93	95	95.5	96	96.5	97	97.3	97.4	97.5

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7. A 12-hectare land is to be irrigated by a pump working for 12 hours a day. Root zone depth is 0.9 m and the field capacity of the soil is 28% while permanent wilting point is 17%. Density of soil is  $1.36 \text{ gm/cm}^3$  and the water application efficiency is 70%. The soil is to be irrigated when 50% of the available water has depleted. The peak evapotranspiration is 5.0 mm/day and the system is to run for 10 hours a day. Determine (a) net irrigation depth, (b) gross irrigation depth, (c) irrigation period, (d) area to be irrigated per day and (e) the system capacity.

3-3-2-3+3=14

8. Use the information from the table given below to find moisture content in the root zone at different depths, depth of water available in the root zone at different depths, total depth of water available in the root zone and the soil moisture deficit. Assuming peak rate of consumptive use as 8 mm/day, also find the irrigation interval :

14

Depth of sampling (m)	Wt. of moist soil sample (gm)	Oven dry wt (gm)
0-0.30	98.80	94.60
0.30-0.60	96.60	92.10
0.60-0.90	95.00	90.60
0.90-1.20	94.00	89.40

The bulk density of the soil in the root zone was  $1.60 \text{ gm/cc}$ . The moisture holding capacity of the soil at field capacity was  $19.60 \text{ cm/m}$  depth.

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9. Write short notes on the following :  $3\frac{1}{2} \times 4 = 14$

- (a) Depth-area-duration relationship
- (b) Methods of base flow separation
- (c) Regime channels
- (d) Sprinkler irrigation system

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