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B TECH
(SEM IV) THEORY EXAMINATION 2017-18
WATERSHED HYDROLOGY

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. What are the necessary conditions for the formation of precipitation?
b. What is an isohyet?
c. What are the precautions to be taken in selecting a site for the location of a raingauge?
d. Define φ_{index} and W_{index}.
e. What is basin yield?
f. What are the uses of a flow duration curve?
g. Why baseflow separated from total runoff?
h. What does the word unit refer to in the unit hydrograph?
i. Differentiate between prism storage and wedge storage.
j. What is the differential equation of storage?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. What is the basis for measurement of precipitation? What are the difficulties that come in the way of accurate measurement of precipitation?
b. List out the various climatic factors affecting runoff. Specifically discuss the effect of the direction of storm movement and the antecedent precipitation on the peak discharge.
c. Define unit hydrograph. What are the assumptions underlying the unit hydrograph theory? How do they limit the applicability of unit hydrograph?
d. Explain the terms risk, reliability and safety factor. A factory is proposed to be located on the edge of the 50 year flood plain of a river. If design life of factory is 25 years, what is the reliability that it will not be flooded during its design life?
e. On the basis of isopluvial maps the 50 year 24 h maximum rainfall at a city is found to be 16 cm. Determine the probability of 24 h rainfall of magnitude equal to or greater than 16 cm occurring at the city:
   i. once in 10 successive years
   ii. two times in 10 successive years
   iii. at least once in 10 successive years

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Describe the principle of working of a tipping bucket type recording rain gauge with a neat sketch. What are its advantages and disadvantages?

(b) The average annual rainfalls in cm at 4 existing rain gauge stations in basins are 105, 79, 70 and 66. If the average depth of rainfall over the basin is to be estimated within 10% error, determine the additional number of gauges needed.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) One drainage area 500 ha, an intense rain falls at uniform a rate of 6 cm/h for a period of 69 min. the average infiltration capacity during the entire rain period has been work out as 1.5 cm/h. if the peak discharge based on 10 min interval from the distribution graph for the basin is 18% determine the maximum run off rate.

(b) Describe how the total precipitation is transformed into the total runoff.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Explain with the help of neat sketches, the flow duration curve method and mass curve method to measure the runoff.

(b) Write in brief the SCS-CN method for estimating the runoff volume. The peak of flood hydrograph due to a 3-h duration isolated storm in a catchment is 270 m^3 /s. The 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 m^3 /s, estimate the peak of the 3-h hydrograph (UH) of this catchment. If the area of the catchment is 567 km^2; determine the base width of the 3-h unit hydrograph by assuming it to be triangular in shape.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) What do you mean by design flood? What are the factors affecting the flood hydrograph? Explain the procedure of using a unit hydrograph to develop the flood hydrograph due to a storm in a catchment.

(b) What is flood frequency analysis? How flood frequency analysis at a project site is conducted? What are the data requirements?

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) The following are the rates of rainfall for successive 20 minutes period of a 140 minutes storm: 2.5, 2.5, 10.0, 7.5, 1.25, 1.25, 5.0 cm/hr. Taking the value of ϕ_{index} as 3.2 cm/ hr, find out the net runoff in cm, the total rainfall and value of W_{index}.

(b) Distinguish between:

i. Rainfall excess and effective rainfall
ii. Depression storage and detention storage
iii. Direct runoff and baseflow