Code : 101307

2012 (A)

WATER RESOURCES ENGINEERING—I

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **TEN** questions in the paper.*

*(iii) Attempt **FIVE** questions, **TWO** from each Group is compulsory.*

(iv) Assume any suitable data, if required.

GROUP—A

1. *(a)* Describe the Symon's rain gauge used in India with neat sketches. 6

(b) For a drainage basin of 600 km^2, isohyetals drawn for a storm gave the following data :

Isohyetals (interval, cm)	15–12	12–9	9–6	6–3	3–1
Inter-isohyetal area (km^2)	92	128	120	175	85

Estimate the average depth of precipitation over the catchment. 8

2. *(a)* Distinguish between the following : 6

(i) Potential and Actual evapo-transpiration

(ii) Infiltration capacity and Infiltration rate

(iii) ϕ_{index} and W_{index}

(iv) Land Pan and Infiltrometer

(b) A reservoir had an average surface area of 20 km^2 during June 1982. In that month the mean rate of inflow = 10 m^3/s, outflow = 15 m^3/s, monthly rainfall = 10 cm and change in storage = 16 million m^3. Assuming the seepage losses to be 1·8 cm, estimate the evaporation in that month. 8

3. *(a)* Discuss the Horton equation of infiltration. Describe briefly the experimental method of determination of infiltration rate using double ring infiltrometer. 6

(b) The mass curve of an isolated storm over a watershed is given below :

Time from start (h)	3·0	3·5	4·0	4·5	5·0
Cumulative rainfall (cm)	3·50	5·70	6·50	7·30	7·70

If the storm produced a direct runoff of 3·5 cm at the outlet of the watershed, estimate the ϕ_{index} of the storm and duration of rainfall excess. 8

4. *(a)* Define unit hydrograph. Write the uses and limitations of UH. 5

(b) The ordinates of the 2 hr unit hydrograph of a basin are given below. Derive the 6 hr Unit Hydrograph for the basin : 9

Time (hr)	0	2	4	6	8	10
Ordinate of 2 hr UH (m^3/s)	0	25	100	160	190	170
Time (hr)	12	14	16	18	20	22
Ordinate of 2 hr UH (m^3/s)	110	70	30	20	6	0

5. Write short notes on any *three* of the following : 14

(a) Hydrologic cycle

(b) Salient features of streams

(c) Gumbel's equations for practical use

(d) Rating curve

(e) S curve

GROUP—B

6. *(a)* Differentiate between the following : 6

(i) Pipe flow and Open channel flow

(ii) Steady and Unsteady flow

(iii) Uniform and Non-uniform flow

(iv) Rigid boundary and mobile boundary channel

(b) Water flow at a depth of 2·0 m with velocity of 1·5 m/s in a wide rectangular channel. Find the height of hump required to produce critical flow without affection u/s depth. 8

7. *(a)* Derive the Chezy equation to compute the frictional losses. 5

(b) What is the most efficient channel section? A trapezoidal channel section with side slopes of 1 : 1 has to be designed to convey 10 m^3/s at a velocity of 2 m/s, so that the amount of concrete lining for the bed and sides is minimum.

(i) Calculate the area of lining required for one metre length of the canal.

(ii) If the rugosity coefficient, $n = 0·015$, calculate the bed slope of the canal for uniform flow. 9

8. *(a)* Discuss briefly the classification of flow profiles of gradually varied flow. 6

(b) A rectangular channel 9 m wide discharges water at normal depth 3·65 m. The bed slope is 1 in 4000 and Manning's $n = 0.017$. A dam placed downstream raises the level to a height of the profile to 6·8 m immediately behind the dam. Determine the length of the profile by single step. 8

9. *(a)* What are the different uses of hydraulic jump? Derive the equation of sequent depth ratios and energy loss in a rectangular channel. 6

(b) In a rectangular channel of width 6·5 m, water is flowing at the rate of 95 m^3/s, find the conjugate depth for an initial depth of 2 m. Also find the loss of energy. 8

10. Write short notes on any *three* of the following : 14

(a) Economical channel section

(b) Control sections

(c) Types of hydraulic jumps

(d) Causes of unsteady flow

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