

**Bengal Engineering and Science University, Shibpur**

B. E. (CE) 5th Semester Examination, 2012

Sub: Water Resources Engineering (CE - 503)

Time: Three Hours

Full Marks : 70

**First Half**

*Answer Question 6 and any three from the rest*

1. A storm produced the following rainfall excess: 2cm in the first 6h and 5cm in the next 6h. In order to estimate the DRH due to this storm, only a 2-h UH was available as shown below. Derive a 6-h UH and estimate the DRH. (10)

Time (h)	0	2	4	6	8	10	12	14	16	18	20	22
2-h UH (m <sup>3</sup> /s)	0	25	95	165	200	175	125	70	35	15	5	0

2. Ordinates of a 4-h UH is given below Derive the ordinates of a 2-h UH from this UH. (10)

Time (h)	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
6-h UH (m <sup>3</sup> /s)	0	13	35	70	120	140	125	95	68	48	34	25	20	15	12	8	0

3. Given below are the monthly rainfall P and the corresponding runoff R values for a catchment. Develop a correlation equation between R and P. (10)

Month	1	2	3	4	5	6	7	8	9	10
P (cm)	5	30	45	25	15	5	35	28	20	10
R (cm)	2	18	30	15	5	1	15	15	12	4

4. Water is being pumped out at a steady rate of 2000 litres per minute from a 30 cm dia well fully penetrating a confined aquifer of thickness 30m. If drawdowns in two observation wells 30m and 120m away from the pumping well are 3m and 0.3m respectively, determine the permeability of the aquifer. What will be drawdown in the third observation well 75m away from the pumping well? (10)
5. The time of travel of a tracer from one well to the another well 100m apart with 1m difference in water surface elevation was found to be 20 hours. If the porosity of the aquifer is 0.35, find the coefficient of permeability of the aquifer.
6. Write a program to calculate evaporation loss using Meyers formula, given KM, ew, ea, and U2 at 2m. (5)  
Or,  
A 6-h UH of a catchment is triangular in shape with a base width of 66 h and a peak ordinate of 30 m<sup>3</sup>/s. Calculate the equilibrium discharge of an S-curve derived from this 6-h UH. (5)

**Second Half**

*Answer Question 12 and any three from the rest*

7. Following data were obtained for two sections A and B across a river during a particular flood. Section B is 10 km downstream of A. Calculate the discharge using Slope-Area method. Assume Manning's n as 0.02; eddy loss coefficient as 0.3 for gradual expansion and 0.1 for gradual contraction. (10)

Section	Stage (m)	Area (m <sup>2</sup> )	Hydraulic radius (m)
A	105.8	75.0	2.75
B	104.3	95.0	3.01

8. (a) In a stream gauging operation, a common salt solution of concentration 200g/litre was injected at a constant rate of 30 litres/second. Estimate the stream discharge if the equilibrium concentration at a section sufficiently downstream is 50 ppm. Take background concentration as 10 ppm. (5)
- (b) During a certain flood, water surface elevation of a river at a section was found to rise at a rate of 25 cm/h. The bed slope of the river is 1 in 4900. Assuming celerity of flood wave as 2.1 m/s, determine the actual discharge, if the normal discharge as obtained from the rating curve is 200 m<sup>3</sup>/s. (5)

9. Following data were obtained from a stream gauging operation. A current meter with a calibration equation  $V = (0.3N + 0.03)$  m/s was used to measure the velocity at  $0.6d$ , where  $N$  is the revolutions per second and  $V$  is the velocity in m/s. Calculate the discharge in the stream using Area-Velocity method. (10)

Distance from left bank (m)	0	2	4	6	9	15	20	22	24
Depth of water, $d$ (m)	0	0.5	1.1	1.95	2.25	1.75	1.5	1.25	0
No. of revolutions	-	80	80	130	140	115	90	85	-
Observation Time (s)	-	180	120	120	120	120	120	120	

10. For an agricultural area in Burdwan ( $23^{\circ}55''$  N) following data are available. Calculate the seasonal consumptive use of water for the two crops growing this season using *Blaney-Criddle* formula. If the area for crop1 is 250 ha and for crop2 is 310 ha, calculate the volume of irrigation water needed. (Note: crop periods for the two crops are different) (10)

Month	May	Jun	Jul	Aug	Sep	Oct
Temp ( $^{\circ}$ C)	34	32	31	28	28	27
Ph (%)	9.30	9.18	9.38	9.06	8.31	8.15
K for crop1	0.85	1.1	0.95	0.91	0.8	-
K for crop2	-	0.9	1.0	1.1	0.85	0.8

11. (a) The mass curve ordinates of an isolated storm occurred on a catchment of area 600 ha is shown below. If the  $\Phi$ -index is 0.4 cm/h, estimate the volume of runoff from the catchment in  $Mm^3$ . (4)

Time(h)	0	2	4	6	8	10	12	14	16	18
Rainfall (cm)	0	0.8	2.5	2.9	4.1	7.3	10.8	11.9	12.3	12.6

- (b) The infiltration capacity  $f_{et}$  in cm/h of a catchment is given by  $0.5 + 1.2 e^{-0.5t}$  where  $t$  is in hour. A 4-h storm with rainfall intensity higher than the maximum infiltration capacity occurred on this catchment. Estimate the resulting total infiltration. (6)

12. Write a program to calculate the average depth of rainfall using Thiessen Polygon method for a catchment having  $N$  rain gauge stations. (5)

Or,

- A river bridge has an expected life of 80 years. What return period for the design storm is to be adopted, if the probability of occurrence of it at least once during the life of the bridge is to be limited to 0.08? (5)