

B.E. (Civil) 6th Semester Final Examination, 2007
 Sub: Water Resources Engineering – I (CE-605)

Time: Three hours

Full Marks: 70

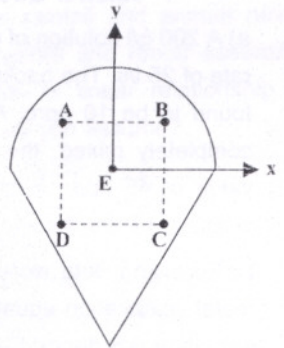
(Figures in the margin indicate full marks)

First Half

Answer Q.5 and any two from the rest

- The annual rainfalls at 7 raingauge stations in a basin are 58, 94, 60, 45, 20, 88 and 68 cm respectively. What is the percentage accuracy of the existing network in the estimation of the average depth of rainfall over the basin? How many additional gauges are required if the error to be limited to only 10%?
 - During a daily routine observation, 10 litres of water was added to bring the water surface in the evaporation pan to the stipulated level and the nearby raingauge measured 4mm of rainfall. What was the evaporation recorded for the day if the diameter of the pan is 120cm? (10+5)

- A catchment area is approximated as a semicircle of diameter 40 km with an equilateral triangle of side 40 km below its diameter. Five rain gauges A (-10,10), B(10,10), C(10,-10), D(-10,-10), and E(0,0) are located within the basin as shown in Figure. If the rainfall recorded by these gauges are 90, 95, 82, 100 and 75 mm respectively, determine i) the average depth of rainfall using Thiessen polygon method and ii) volume of surface runoff at the basin outlet if 40% of the rainfall is lost in evaporation and infiltration.



- Find the missing data for rain gauge D using normal ratio method. (10+5)

Gauge	A	B	C	D	E	F
Normal rainfall (cm)	100	110	98	82	105	100
Annual rainfall in 2005 (cm)	92	103	100	?	97	98

- Find the consumptive use for the crop, from the following data.

Month	July	Aug	Sept	Oct
Mean monthly temp (°C)	25.3	24.1	22.0	22.5
Monthly percent of daytime hours	8.84	8.74	8.26	8.29
Crop coefficient	0.80	0.80	0.70	0.60

- With neat sketch, derive the expression for E_L , using energy budget method. What is pan coefficient and why it is used? (5+10)



4. a) Discuss the relationship between rainfall intensity, infiltration rate and infiltration capacity.
- b) The Horton's infiltration equation for a basin is given by $f_{ct} = 5 + 25e^{-2t}$, where f_{ct} is in mm/h and t is in hours. What are the f_{co} , f_{cf} and K values? If a storm of uniform intensity 35mm/h occurs over this basin for 75 minutes, determine the average rate of infiltration and total depth of infiltration during this period.
- c) The runoff from a catchment due to a 8h storm was found to be 5.8cm. Given the mass curve of rainfall as below, estimate the ϕ -index. (3+5+7)
- | | | | | | | | | | |
|---------------------|---|---|----|----|----|----|----|----|-----|
| Time from start (h) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Acc. rainfall (mm) | 0 | 4 | 13 | 28 | 51 | 69 | 85 | 95 | 100 |
5. Write a program to derive hyetograph from a given rainfall mass curve. (5)

Second Half

Answer Question No. 10 and any two from the rest.

6. a) A 200 g/l solution of common salt was discharged into a stream at a constant rate of 25 l/s. The background concentration of the salt in the stream water was found to be 10 ppm. At a downstream section where the solution has been completely mixed, the salt concentration was found to reach an equilibrium value of 45 ppm. Estimate the discharge in the stream. (Before solving the problem, derive the expressions first.)
- b) Following data were obtained from a stream gauging operation. A current meter (calibration equation $V = 0.32N_s + 0.032$ m/s) was used to measure the velocity a 0.6 depth. Calculate the discharge in the stream using Area-Velocity method. (6+9)

Distance from left bank (m)	0	2	4	6	9	12	15	18	20	22	23
Depth (m)	0	0.5	1.1	1.9	2.3	1.8	1.7	1.6	1.1	0.8	0
No. of rev.	-	60	83	131	139	121	114	109	92	85	-
Time (s)	-	180	120	120	120	120	120	120	120	120	-

7. a) Following water surface elevations of a small stream were observed at a section A and at another station B, 10km downstream of A. Using slope-area method, estimate the discharge in the stream. Assume Manning's $n = 0.020$, and eddy loss coefficient $K_e = 0.3$ and calculate up to 3rd iterations.

Section	Water surface elevation (m)	Area of cross-section (m ²)	Hydraulic Radius (m)
A	105.4	74.5	2.75
B	104.0	95.8	3.2



b) Three points on a rating curve of a stream gauging station have the following co-ordinates: $(100\text{m}^3/\text{s}, 121.67\text{m})$, $(200\text{ m}^3/\text{s}, 122.23\text{m})$, and $(400\text{ m}^3/\text{s}, 123.04\text{m})$. Compute the rating curve parameters. Also calculate the discharge for a depth of 124.5m . (10+5)

8. a) The ordinates of 6-h UH is given as follows:

Time(h)	0	3	6	9	12	18	24	30	36	42	48	54	60	66
Discharge (m^3/s)	0	150	250	450	600	800	700	600	450	320	200	100	50	0

A storm had three successive 6-h intervals of rainfall excess magnitude of 3, 5 and 4 cm respectively. Determine the resulting flood hydrograph.

b) Derive a 2-h UH from the 4h UH given below. (5+10)

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

9. a) From the following observed values of annual rainfall and annual runoff (yield) of a basin, find the correlation between rainfall and runoff assuming linear relationship. Check whether the assumption of linear relationship is correct or not. If not, then what type of relationship will you assume?

Year	1989	1990	1991	1992	1993	1994
Annual Rainfall (cm)	90.5	111	38.7	128.5	145.5	99.8
Runoff (cm)	30.1	50.0	5.3	61.5	74.8	39.9
Year	1995	1996	1997	1998	1999	2000
Annual Rainfall (cm)	50.9	120.2	90.3	65.2	75.9	82.5
Runoff (cm)	6.5	46.1	36.2	24.6	20.0	19.5

b) Describe the runoff characteristics of ephemeral stream. (12+3)

10. Write a program to determine the discharge in a stream using area-velocity method. (5)