B.E. (Civil) 5th Semester Examination, 2011

Subject: Water Resources Engineering (CE-503)

Time: 3 hours | Use separate answer scripts for each half | Full Marks: 70

First Half

Answer Question 5 and any two from the rest.

1. a) Hyetograph of a storm is shown in Fig. 1. Determine the rainfall mass curve.

   b) For an area in Burdwan (23°55′ N), following data are available. There is a reservoir in the neighbouring area of surface area 70km², monthly evaporation loss from which is also given in the table. Assume that you can save 65% of this loss using cetyl alcohol and can use the saved water for irrigation. Two alternate crops are possible to grow during this period. For which crop irrigated area will be more? Use Blaney-Criddle formula to estimate the consumptive use for each crop. [5+9 = 14]

Month	May	Jun	Jul	Aug	Sep	Oct	Nov
Temp (°C)	34	32	31	28	28	27	22
Ph (%)	9.30	9.18	9.38	9.06	8.31	8.15	7.45
K (crop1)	0.85	1.1	0.95	0.91	1.0	0.8	0.85
K (crop2)	1.05	1.25	0.90	0.85	1.1	0.8	0.80
E_U (mm)	42	37	35	35	32	30	30

2. a) A catchment area (Fig. 2(a)) is approximated to a compound shape as shown in Fig. 2 (b). There are six raingauge stations A, B, C, D, E and F at different corners of the catchment. During a particular storm, the rainfall values recorded by the stations are 35, 30, 28, 39, 47 and 41 mm respectively. Find the average rainfall over the catchment using Thiessen Polygon method.

   b) If initial abstraction = 4mm, evaporation loss = 8mm and infiltration loss = 11mm, determine the volume of runoff at the catchment outlet, D.

   c) Determine the order of the catchment. [8+4+2 = 14]

3. a) Draw a schematic diagram of the moving boat method of discharge measurement and discuss how you can obtain the discharge through the section.

   b) Following data were obtained from a routine area-velocity measurement across a river section. Determine the discharge. The notations have their usual meanings and V = 0.31Ns + 0.035 m/s.

Distance from edge (m)	0	2	4	6	9	12	15	17	19
y (m)	0	0.50	1.10	1.95	2.25	1.85	1.25	0.65	0
Ns	0	85	97	114	135	110	102	90	0
Time(s)	0	180	120	120	120	120	120	150	0

   c) A salt solution of concentration 20 mg/cc was discharged into a stream at a constant rate of 2 litres per minute. The samples collected at a downstream section sufficiently far away indicated an equilibrium concentration of 0.05 ppm. If the background concentration was 0.005 ppm, determine the stream discharge. [5+6+3 = 14]

4. a) A small stream has a trapezoidal cross section with base width 12m and side slope 2(H):1(V) in a reach of 10 km. During a flood, the recorded high water elevations at the u/s and d/s end of the reach were 102.75m and 101.4m respectively. Corresponding bed elevations were 100.2m and 98.5m respectively. Assuming Manning's n as 0.030, estimate the flood discharge.

   b) Stage-discharge data of a river given below. If stage for discharge = 0 is 35m, what is the stage for discharge = 600 m³/s? [8+6 = 14]

Stage	39	41	43	48	51	55	61
Discharge	90	154	224	424	555	738	1015

5. a) Write a program to calculate the flood discharge in a stream using slope-area method (direct). [7]

   Or b) Write a program to calculate the discharge in a stream using area-velocity method. [7]

Second Half

Answer Question 10 and any two from the rest.

6. a) Ordinates of a flood hydrograph due to a 2-h isolated storm over a catchment area of 160 km² are given below. Determine the ordinates of a 2-h UH. Assume the base flow to be linearly reducing from 40 m³/s to 30 m³/s. [Hint. Calculate the DRH area as $\Delta t^* \sum$ (all ordinates)]

Time (h)	0	2	4	6	8	10	12	14	16	18	20
Discharge (m³/s)	40	144	323	427	396	305	208	129	77	46	30

b) Ordinates of a DRH resulting from ER of 3cm, 5cm and 2cm occurring in successive 4-h durations are given below. Derive the ordinates of a 4-h UH. [7+7 =14]

Time (h)	0	4	8	12	14	20	24	28	32	36	40	44	48
Discharge (m³/s)	0	105	460	935	1200	1130	864	566	321	154	55	10	0

7. a) Ordinates of a 3-h UH for a catchment are given below. Derive the ordinates of a 6-h UH. There was a precipitation over this catchment of magnitudes 14mm for the first 6-h, 4mm for the second 6-h and 24mm for the third 6-h. If the ϕ-index for this storm is 0.7 mm/h, derive the DRH due to this storm.

Time (h)	0	3	6	9	12	15	18	21	24	27	30	33	36
Discharge (m³/s)	0	25	65	105	125	112	85	52	27	12	5	2	0

b) A 4-h UH for a catchment is approximated as a triangle with base 36-h and peak discharge 80 m³/s and time to peak 16h. Calculate the equilibrium discharge of a S-curve derived from this 4-h UH. [10+4 = 14]

8. a) The average rainfall over a basin of area 50 ha during a storm was as follows. If the volume of runoff from this storm was 25×10^3 m³, determine the ϕ-index.

Time (h)	0	1	2	3	4	5	6	7
Rainfall (mm)	0.0	6.0	11.0	34.0	28.0	12.0	5.0	1.0

b) A water resources project has an expected life of 25 years. i) For an acceptable risk of 5% against the design flood, what design return period is to be adopted? If the above return period is adopted and the life of the structure can be enhanced to 40 years, what will be the possible change in the risk value? [7 +7 =14]

9. a) With neat sketch, derive the expression for steady discharge from a fully penetrating well in a confined aquifer.

b) A 30-cm well fully penetrates an unconfined aquifer of saturated depth 25m. When a discharge of 2100 litres per minute was being pumped for a long time, observation wells at radial distances of 30 and 90 cm indicated drawdown of 5m and 4m respectively. Draw a neat sketch of the system and estimate the coefficient of permeability of the aquifer. What is the drawdown at the pumping well? [6+8 = 14]

10. a) Write a program to derive a T-h UH from a D-h UH using method of superposition. [7]

Or b) Write a program to calculate the mean, standard deviation and skewness of a sample of size N. [7]

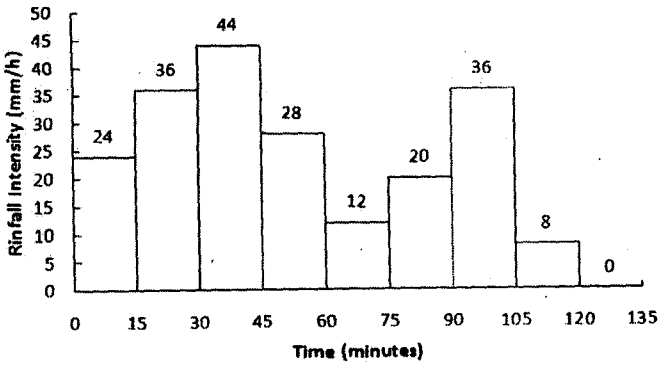

Fig. 1 Rainfall Hyetograph

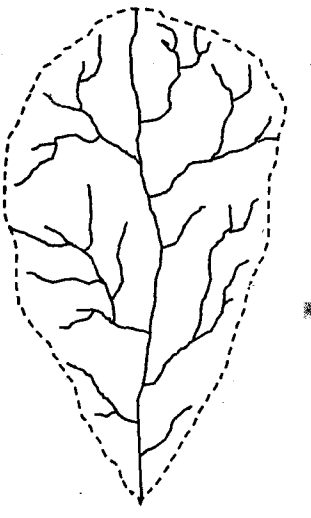

Fig. 2 (a) Catchment

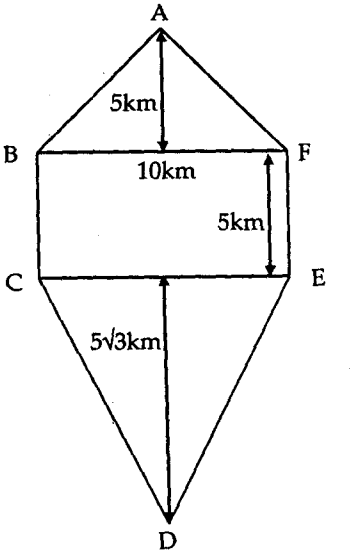

Fig. 2 (b) Schematic