BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering, Term Final (Fall) Examination 2024: April 2025

Student Group: 36<Earned Credit Hours ≤ 72

Subject: EWCE 263, Engineering Hydrology

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory.
c. Answer any other **TWO** out of the remaining **THREE** questions from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Why is hydrologic cycle a system? Hydrologic cycle involves changes of state and quality of water- explain. **5**

b. Show in a figure a catchment, sub-catchment, streams of order 1 and 2. **4**

c. Write down the components of water balance equation for a watershed and explain each term. **4**

d. Explain with figures the difference between double mass curve and mass curve. **4**

e. What is rating curve? Why is extrapolation of rating curve necessary? **4**

f. Draw the velocity profile of a river and explain why it is approximately logarithmic. **4**

g. The Horton's equation for a soil is: $f_p = 2.1+8.3e^{-1.3t}$ .What are the values of f_o, f_c and Horton's constant? At what rainfall intensity is this equation of f_p valid? **5**

Question 2

a. Explain briefly the process of formation of precipitation. **6**

b. Explain with a figure how relative humidity is related to temperature. **4**

c. What are the differences between: hail and snow, point measurement and areal measurement of rainfall? **5**

d. Find the average rainfall for the catchment shown in the Figure 1 by Isohyetal method. Draw at least five isohytes and attach the graph with your answer script. Each small square is 1 ha and rainfall is in mm. **15**

Question 3

a. How is rainfall estimated by satellites? What are the advantages of such measurement? **5**

b. What is consistency of rainfall data? Why is Isohyetal method generally more accurate than Theissen Polygon method? **5**

c. Explain the difference between latent heat of fusion and sublimation. How does wind speed affect the evaporation? **5**

d. The Infiltrometer test data from a 256 ha catchment is shown in the following table. Determine the volume of infiltration after 1.5 hours. **15**

Time from start of test (min)	2	10	20	40	60
Infiltration capacity (cm/hr)	3.4	3.1	3.0	2.6	2.3

Time from start of test (min)	80	100	120	140
Infiltration capacity (cm/hr)	2.25	2.15	2.1	2.1

Question 4

a. What is 'Lysimeter'? Temperature has double effect on evaporation- Explain. **5**

b. Explain with figures the mid-section and mean-section methods of discharge measurement. Which is more accurate and why? **6**

c. What is 'loop rating curve' and why dos it occur? **4**

d. Calculate the discharge of the river from the following data. **15**

Section	0	1	2	3	4	5	6
Boat Velocity (m/s)	0	1.7	1.8	2.1	2.3	1.6	0
Angle of boat (θ)	-	50	57	65	60	50	-
Depth (m)	-	1.7	2.1	3.3	4.0	2.0	-
Time (sec)	-	100	100	120	110	90	-

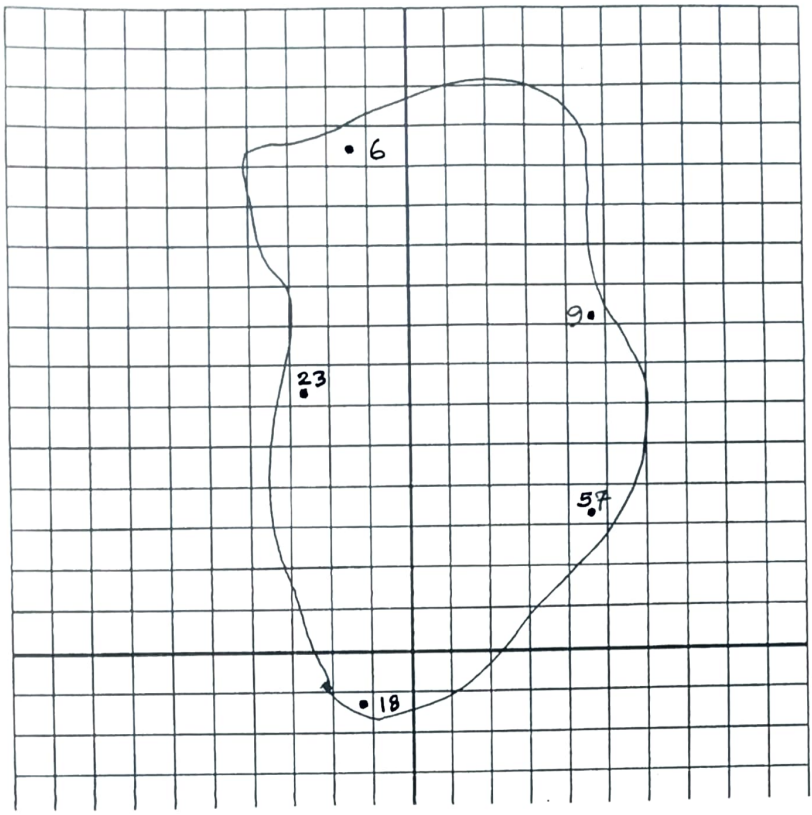


Figure 1
Question 2(d)

SECTION-B

Question 5 (Compulsory)

a. Define runoff. Explain the difference between surface runoff, overland flow and direct runoff. **5**

b. Explain with figures the difference between: base period and base flow, lag time and time of concentration, through fall and stream flow. **6**

c. What is 'Synthetic unit hydrograph'? What is the assumption behind development of such hydrograph? **4**

d. What is drainage density? Explain how it affects the process of runoff generation and peak flow. **5**

e. What is the difference between return period and exceedance probability? If the exceedance probability of a flood is 5% then what is its return period? **6**

f. The peak flow and base period of a 3-hr unit hydrograph is $40m^3$/sec and 30 hrs. What would be the peak flow and base period of a 4-hr unit hydrograph? Explain your answer qualitatively. **4**

Question 6

a. Write down two major differences between a 2-hr unit hydrograph and 2-hr hydrograph. **4**

b. Explain the linearity of response assumption for the development of unit hydrograph. **4**

c. The rank of the flood of 2020 of a river with discharge data from 1990-2022 is 3. What is the probability and return period of the flood of 2020? **4**

d. The outflows from a 4-hr unit hydrograph are shown in the following table. Determine the peak flows from a 2-hr and 6-hr unit hydrograph. **18**

Time (hr)	0	2	4	6	8	10	12	14	16	18	20
Outflow (m^3/sec)	0	6	33	90	119	103	79	50	25	7	0

Question 7

a. The crest level of an embankment is designed for 100-yr flood. What is the risk and reliability of the design? What is the probability of two 100-yr floods during the design period? **8**

b. What is pan coefficient and Why it is necessary? **4**

c. Find the 20-yr 4-hr peak flow from a 25 ha basin (suburban area: 12 ha, forest 8 ha and rest farmland with runoff coefficient of 0.55, 0.15 and 0.35 respectively) having an average slope of 3% and maximum flow length of 1400m. The yearly maximum 4-hr rainfalls are shown in the following table. **18**

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rainfall (mm)	40	52	90	70	55	47	35	28	21

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall (mm)	82	25	20	65	42	85	72	62	45

Question 8

a. The annual rainfall recorded by five gages of a catchment are shown in the following table. Determine the minimum number of gages required for 90% accuracy in measurement. **7**

Station	A	B	C	D	E
Rainfall (cm)	83.5	105.2	86.7	182.5	138.2

b. The hourly rainfall intensities of a 6-hr storm in a 24 ha basin are shown in the following table. If the total runoff is 2cm then calculate the ϕ index and the volume of infiltration. **8**

Time (hr)	1	2	3	4	5	6
Rainfall intensity (cm/hr)	0.5	1.5	1.2	0.3	1.0	0.6

c. The inflow to a river is given in the following table. If the travel time K=1.4 hr and the weighing factor X=0.20, then find the peak outflow from the river. **15**

Time (hr)	0	2	4	6	8	10
Inflow (m^3/sec)	0	800	2000	4200	5200	4400

Time (hr)	12	14	16	18	20
Inflow (m^3/sec)	3200	2500	2000	1000	400