**Military Institute of Science and Technology**

**B.Sc. in Environmental, Water Resources, and Coastal Engineering**

**Term Final (Fall) Examination 2023: Dec 2023- Feb2024**

**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** questions out of **THREE** 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. What are the differences between a 2-hr unit hydrograph and a 2-hr hydrograph? Which one would have a higher peak flow and why? **05**

b. Define lapse rate. Explain with figure the difference between hydrograph and mass curve. **05**

c. The outflow from a 2-hr rainfall in a 20 $km^2$ basin are shown in the following table 1(c) considering a constant base flow of 75 $m^3$/sec, derive a 2-hr unit hydrograph. Considering successive rainfalls of 2-hrs with effective amounts of 1.1, 2.1, and 1.8 cm in the same basin. Determine the resulting peak flow. **20**

**Table 1(c)**

| Time(hrs) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Flow($m^3$/sec) | 75 | 110 | 205 | 305 | 280 | 205 | 130 | 75 |

**Question 2**

a. What is base flow? Show in a hydrograph base flow, base period, interflow, direct runoff and inflection point. **04**

b. Briefly explain four important basin characteristics that affect the amount of runoff **05**

c. Why isohyetal method is generally considered as better than Thiessen polygon method of estimating average rainfall? What is the limitation of isohyetal method? **04**

d. The stage-discharge data of a perennial river is shown in the following table 2(d). Derive the rating curve and discharge for a water level of 10.2 m. **17**

**Table 2(d)**

| Water level (m) | 1.7 | 2.8 | 4.0 | 5.1 | 6.1 | 6.9 | 7.8 | 8.1 |
|---|---|---|---|---|---|---|---|---|
| Flow ($m^3$/sec) | 305 | 1050 | 2100 | 4050 | 5250 | 7720 | 9000 | 9500 |



Scanned with CamScanner

**Question 3**

a. What is drainage density? Explain with a figure how does it affect the peak flow?

b. Draw the velocity profile of a river and explain why it is considered as approximately logarithmic?

c. Explain the process of formation of precipitation. What are the conditions for the precipitation to fall on the surface?

d. The infiltration rate at the beginning of a storm is 4.5 cm/hr and decreased to a constant rate of 0.5 cm/hr after 10 hours. If the total infiltration during 10 hours is 30 cm then what is the value of K of Horton's equation? State the assumption of your solution.

e. The amount of rainfall during a 12-hr storm is shown in the following table 3(e). Determine the Φ index if the total runoff is 4.9 cm. What is the total infiltration?

**Table** 3(e)

| Duration(hr) | 0-2 | 2-5 | 5-7 | 7-10 | 10-12 |
|---|---|---|---|---|---|
| Rainfall (cm) | 2.8 | 6.9 | 2.2 | 2.1 | 0.6 |

**Question 4**

a. What are the two differences between interflow and base flow?

b. What are the similarities and differences between a 2-hr unit hydrograph and a 6-hr unit hydrograph?

c. If the base period and peak flow of a 2-hr unit hydrograph are 40 hrs and 90 $m^3$/ sec, then what would be the base period of a 6-hr unit hydrograph? Explain what would happen to the peak flow?

d. Explain with figures the types of rivers in terms of connectivity with groundwater.

e. If a flood of 5 m or greater occurs on average once in every 20 years then what is the probability that it will not occur in the next 8 years? What is the probability of occurring at least once in 20 years?

f. If a road is designed for 50-year flood then what is the probability that the 50-year flood will occur once in 10 years? What are the risk and reliability of the design?

## SECTION-B

**Question 5 (Compulsory)**

a. Why is the unit hydrograph concept not used for large basins?

b. Explain the terms: dew, mist and fog.

c. Evaporation does not always increase with the increase in wind velocity- explain with a figure.

d. The flow during the recession period of a hydrograph are shown in Table 5(d). Determine the recession equation and the flow at 40 hours.

Scanned with CamScanner

**Question 6**

a. What is a synthetic unit hydrograph? For the generation of synthetic unit hydrograph why it is important that the basin is located near a gaged basin? **05**

b. How is rainfall estimated by a satellite? What are the advantages and disadvantages of such situation? **07**

c.. The maximum 24-hr rainfalls at Mirpur for 1980-2001 period are shown in Table 6(c). Develop the 24-hr IDF curve for Mirpur. **18**

**Question 7**

a. What is routing? What is attenuation and why does it occur? **04**

b. Yearly rainfall data of Joydebpur are available from 1962-2010. If the peak of the rainfall in 2001 is 10, then what is the exceedance probability and return period of that rainfall? **05**

c. What is ADCP and how does it work? **04**

d. From the inflow and outflow data of river shown in Table 7(d) determine the values of K and X. **17**

**Question 8**

a. River storage is more dependent on outflow than inflow- explain. **03**

b. The outflow versus storage (O and $\frac{2\Delta S}{t} + O$) data of a reservoir are shown in Table 8(b). Calculate the peak outflow from the reservoir for the given inflows. **20**

c. The following data of rainfall were taken from the gage stations of a catchment given in Table 8(c). What is the missing rainfall at station X? **07**

Scanned with CamScanner™

Table 5(d)

| Time (days) | 16 | 18 | 20 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|
| Flow ($m^3$/sec) | 250 | 151 | 100 | 70 | 58 | 49 | 41 |

Table 6(c)

| Year | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall (mm) | 127 | 135 | 129 | 160 | 124 | 156 | 130 | 116 | 162 | 2 |

| Year | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall (mm) | 210 | 260 | 180 | 127 | 220 | 190 | 154 | 130 | 138 | 12 |

Table 7(d)

| Time (hrs) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Inflow ($m^3$/sec) | 10 | 30 | 68 | 50 | 40 | 31 | 23 | 10 |
| Outflow ($m^3$/sec) | 10 | 12 | 26 | 44 | 46 | 43 | 37 | 28 |

Table 8(b)

| Outflow ($m^3$/sec) | 0 | 5 | 10 | 15 | 20 |
|---|---|---|---|---|---|
| $(2S/\Delta t + O)$ $m^3$/sec | 0 | 55 | 130 | 200 | 400 |

| Time (hrs) | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Inflow ($m^3$/sec) | 0 | 20 | 40 | 60 | 50 | 30 | 0 |

Table 8(c)

| Station | Annual rainfall (cm) | Storm Event (cm) |
|---|---|---|
| A | 42 | 2.6 |
| B | 41 | 3.1 |
| C | 39 | 2.3 |
| D | 47 | 3.1 |
| X | 35 | ? |

Scanned with CamScanner