# University of Asia Pacific

## Department of Civil Engineering

## Final Examination Fall 2012

## Program: B.Sc. Engineering (Civil)

Course title: Engineering Hydrology **(SECTION A)** Course code: CE 363

Time: 3 hours Total Marks: 150

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## Section A

Answer any **THREE** out of **FOUR** questions. Each question has **25** marks. The figures in the right margin indicate full marks.

**1.** a) Briefly describe the following terms **(any two)**: **(6)**

i. Pan coefficient ii. Energy balance method iii. Factors affecting evaporation

b) Calculate the evaporation rate from an open water source, if the net radiation is 300 W/m$^2$ and the air temperature is 30 deg C. Assume zero sensible heat, ground heat flux, heat stored in water body and advected energy. The density of water at 30 deg C is 996 kg/m$^3$. **(5)**

c) A reservoir has an average surface area of 20 km$^2$ during March 1980. In that month, the mean rate of inflow= 10 m$^3$/s, outflow = 15 m$^3$/s, monthly rainfall = 10 cm and change in storage= 16 million m$^3$. Assuming seepage losses to be 1.8 cm, estimate the evaporation in that month. **(4)**

d) How does vapor pressure and wind speed affect the evaporation process? **(6)**

e) State the difference between actual and potential evapotranspiration. **(4)**

**2.** a) State the differences between recording and non-recording gauges? **(5)**

b) Describe two methods for estimating missing rainfall data. **(6)**

c) List the different types of hydrologic data. **(4)**

d) In a catchment area (Figure 1, attached at the end of the question paper), four rainfall stations are situated inside the catchment and one station is outside in its neighbourhood. Also given are the annual precipitation recorded by the five stations in 1980. Determine the average annual precipitation by the Thiessen polygon method. Consider each square as 1 sq km. **(10)**

**3.** a) Briefly write down what you know about the Intensity-Duration-Frequency (IDF) curve. **(5)**

b) What are differences between frontal and cyclonic weather system? **(5)**

c) Define the following terms: i. Normal precipitation ii. Return period **(5)**

d) Estimate the average depth of precipitation over the following catchment based on the isohytal map given below. The isohytes are given in **mm** and area should be calculated in **sq. km**. Consider each square as 1 sq. km (Figure 2). **(10)**

4. a) Briefly describe different characteristics of rainfall. **(5)**

b) List the causes responsible for inconsistency in rainfall record. **(4)**

c) Discuss briefly on the climate of Bangladesh. **(6)**

d) Annual rainfall depth data are available below (Table 1) for three consistent gauges (E, F, G) and one inconsistent gauge H. Gauge H was relocated permanently at the end of 1981. Therefore rainfall data for gauge H for the period 1979-1981 must be adjusted to the rainfall characteristics at the new location. **(10)**

Table 1

| Year | Annual rainfall (in) | | | |
|---|---|---|---|---|
| | E | F | G | H |
| 1979 | 22 | 26 | 23 | 28 |
| 1980 | 21 | 26 | 25 | 33 |
| 1981 | 27 | 31 | 28 | 38 |
| 1982 | 25 | 29 | 29 | 31 |
| 1983 | 19 | 22 | 23 | 24 |
| 1984 | 24 | 25 | 26 | 28 |
| 1985 | 17 | 19 | 20 | 22 |
| 1986 | 21 | 22 | 23 | 26 |

## Section B

## Answer any THREE

5. (a) What are the factors that affect the shape of a flood hydrograph? Describe the different methods of base flow separation. **(10)**

(b) The following are the ordinates of the hydrograph of flow from a catchment area of 780 km$^2$ due to a 6-hr rainfall. Derive the ordinates of 6-hr unit hydrograph for the basin. Make suitable assumptions regarding base flow. **(15)**

| Time (hr) | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 |
|---|---|---|---|---|---|---|---|---|
| Discharge (cumec) | 40 | 64 | 215 | 360 | 405 | 350 | 270 | 205 |

| Time (hr) | 54 | 60 | 66 | 72 | 78 |
|---|---|---|---|---|---|
| Discharge (cumec) | 145 | 100 | 70 | 50 | 42 |

6. (a) What are the assumptions of a unit hydrograph? **(3)**

(b) Explain the procedure of deriving a synthetic unit hydrograph for a catchment by using Snyder's method. **(10)**

(c) The ordinates of 4-hr UH are given below. Derive the ordinates of an 8-hr UH using S-curve method.

**(12)**

| Time (hr) | 0 | 4 | 8 | 12 | 16 | 20 | 24 | 28 |
|---|---|---|---|---|---|---|---|---|
| 4-hr UH ordinates (cumec) | 0 | 24 | 82 | 159 | 184 | 151 | 103 | 64 |

| Time (hr) | 32 | 36 | 40 | 44 |
|---|---|---|---|---|
| 4-hr UH ordinates (cumec) | 36 | 17 | 6 | 0 |

**7.** (a) The following data were collected for a 24m wide stream at a gauging station. Compute the discharge.

**(10)**

| Distance from one end of Water surface (m) | (m) depth, d | Immersion of current meter at 0.6d below water surface REV | SEC |
|---|---|---|---|
| 3 | 1.4 | 12 | 50 |
| 6 | 3.3 | 29 | 53 |
| 9 | 5.0 | 35 | 56 |
| 12 | 9.0 | 42 | 59 |
| 15 | 5.4 | 32 | 51 |
| 18 | 3.8 | 33 | 53 |
| 21 | 1.8 | 18 | 50 |

Calibration equation of current meter: $v = 0.3N + 0.05$, N = revolutions per seconds, v = velocity, m/s.

(b) The inflow and outflow hydrographs for a reach of a river are given below. Determine the best values of the Muskingum coefficients k and x for the reach.

**(15)**

| Time (hr) | Inflow (cumec) | Outflow (cumec) |
|---|---|---|
| 0 | 20 | 20 |
| 12 | 191 | 30 |
| 24 | 249 | 120 |
| 36 | 164 | 176 |
| 48 | 110 | 164 |
| 60 | 82 | 135 |
| 72 | 62 | 116 |
| 84 | 48 | 90 |
| 96 | 32 | 68 |
| 108 | 28 | 52 |

**8.** (a) Describe different methods to estimate the magnitude of a flood peak. **(7)**

(b) Annual maximum recorded floods in a tributary of the river Brahmaputra for the period 1939 to 1968 is given below which fits well the Gumbel extreme value distribution. Estimate the flood discharge with recurrence interval of (i) 100 years and (ii) 150 years. Also find 95% confidence limits for these estimates. **(18)**

| Year | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | 1946 | 1947 | 1948 |
|---|---|---|---|---|---|---|---|---|---|---|
| Flood (cumec) | 14570 | 8440 | 14000 | 22620 | 4820 | 29300 | 24200 | 12450 | 7270 | 6230 |

| Year | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 |
|---|---|---|---|---|---|---|---|---|---|---|
| Flood (cumec) | 18300 | 9680 | 6480 | 3680 | 11430 | 21240 | 8500 | 9720 | 5810 | 19650 |

| Year | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 |
|---|---|---|---|---|---|---|---|---|---|---|
| Flood (cumec) | 37300 | 7220 | 20860 | 18700 | 7650 | 6090 | 4390 | 10340 | 12880 | 42450 |

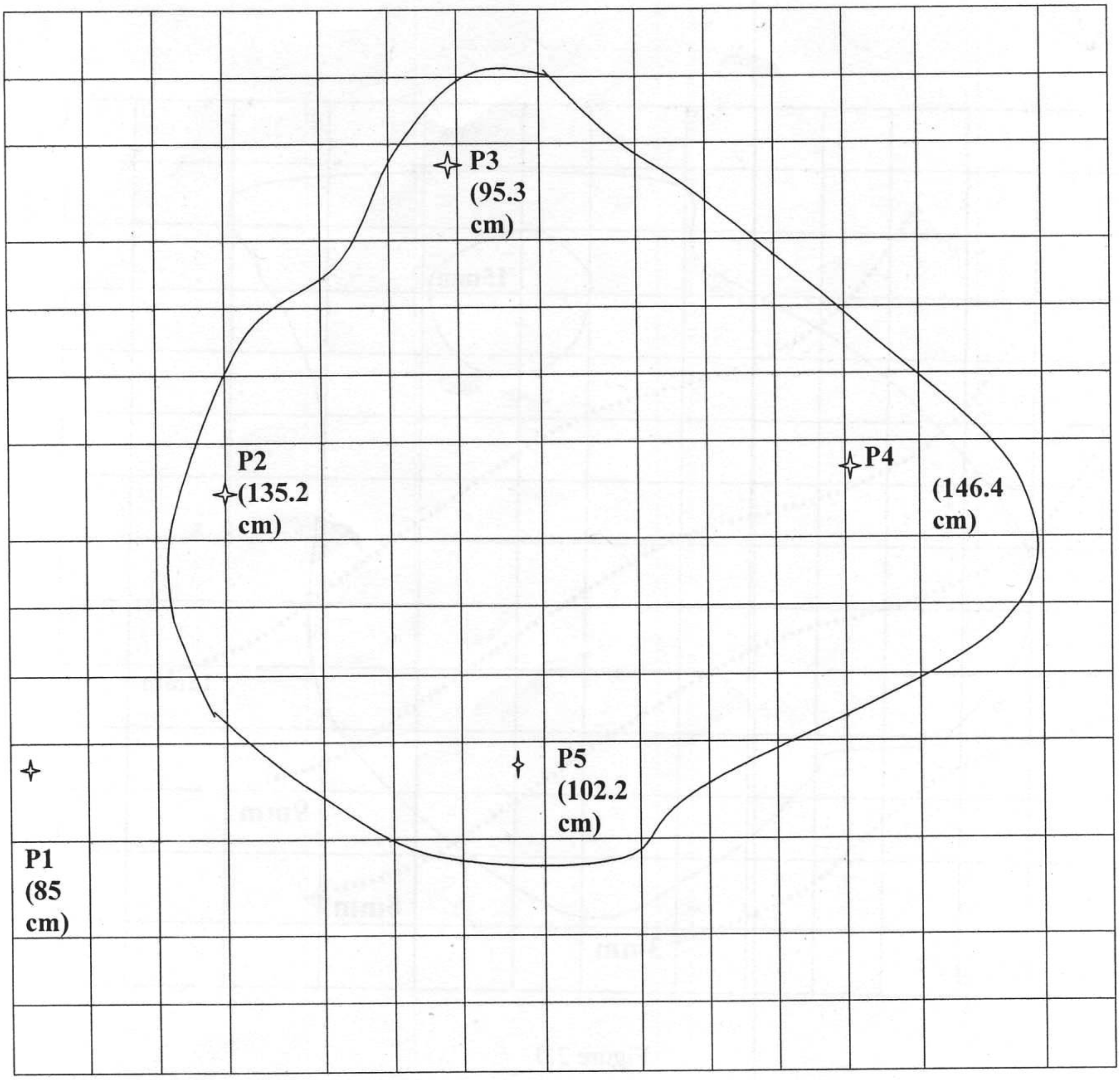



Figure 1.0

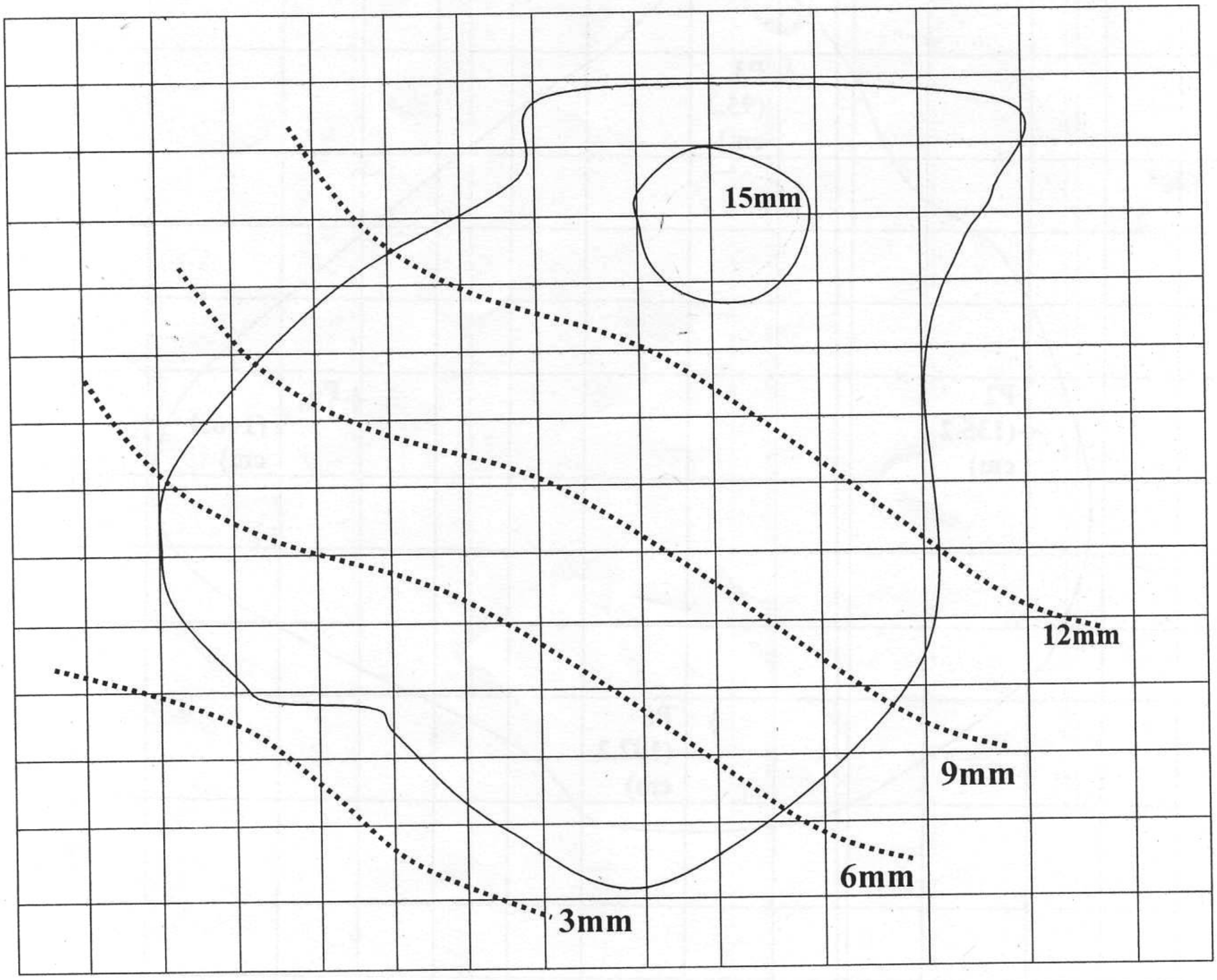



Figure 2.0

$$x_T = \bar{x} + K\sigma_{n-1} \qquad \sigma_{n-1} = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N-1}}$$

$$K = \frac{y_T - \bar{y}_n}{S_n} \qquad y_T = -\left[\ln . \ln \frac{T}{T-1}\right]$$

$$T = 1/P \qquad P = \frac{m}{N+1}$$

$$H_n = H_a + H_e + H_g + H_s + H_i$$

$$E = \frac{H_n - H_g - H_s - H_i}{l_v \rho_w (1+\beta)}$$

$$E = \frac{H_n - H_g - H_a - H_i - H_s}{l_v \rho_w}$$

$l_v = 2.501 \times 10^6 - 2370T$ where T is in deg C.

$$x_{1/2} = x_T \pm f(c)\, S_e$$

$$S_e = \text{probable error} = b\frac{\sigma_{n-1}}{\sqrt{N}}$$

$$b = \sqrt{1 + 1.3K + 1.1K^2}$$

| $c$ in per cent | 50 | 68 | 80 | 90 | 95 | 99 |
|---|---|---|---|---|---|---|
| $f(c)$ | 0.674 | 1.00 | 1.282 | 1.645 | 1.96 | 2.58 |

TABLE 7.3 REDUCED MEAN $\bar{y}_n$ IN GUMBEL'S EXTREME VALUE DISTRIBUTION

$N$ = sample size

| N | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.4952 | 0.4996 | 0.5035 | 0.5070 | 0.5100 | 0.5128 | 0.5157 | 0.5181 | 0.5202 | 0.5220 |
| 20 | 0.5236 | 0.5252 | 0.5268 | 0.5283 | 0.5296 | 0.5309 | 0.5320 | 0.5332 | 0.5343 | 0.5353 |
| 30 | 0.5362 | 0.5371 | 0.5380 | 0.5388 | 0.5396 | 0.5402 | 0.5410 | 0.5418 | 0.5424 | 0.5430 |
| 40 | 0.5436 | 0.5442 | 0.5448 | 0.5453 | 0.5458 | 0.5463 | 0.5468 | 0.5473 | 0.5477 | 0.5481 |
| 50 | 0.5485 | 0.5489 | 0.5493 | 0.5497 | 0.5501 | 0.5504 | 0.5508 | 0.5511 | 0.5515 | 0.5518 |
| 60 | 0.5521 | 0.5524 | 0.5527 | 0.5530 | 0.5533 | 0.5535 | 0.5538 | 0.5540 | 0.5543 | 0.5545 |
| 70 | 0.5548 | 0.5550 | 0.5552 | 0.5555 | 0.5557 | 0.5559 | 0.5561 | 0.5563 | 0.5565 | 0.5567 |
| 80 | 0.5569 | 0.5570 | 0.5572 | 0.5574 | 0.5576 | 0.5578 | 0.5580 | 0.5581 | 0.5583 | 0.5585 |
| 90 | 0.5586 | 0.5587 | 0.5589 | 0.5591 | 0.5592 | 0.5593 | 0.5595 | 0.5596 | 0.5598 | 0.5599 |
| 100 | 0.5600 | | | | | | | | | |

TABLE 7.4 REDUCED STANDARD DEVIATION $S_n$ IN GUMBEL'S EXTREME VALUE DISTRIBUTION

$N$ = sample size

| N | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.9496 | 0.9676 | 0.9833 | 0.9971 | 1.0095 | 1.0206 | 1.0316 | 1.0411 | 1.0493 | 1.0565 |
| 20 | 1.0628 | 1.0696 | 1.0754 | 1.0811 | 1.0864 | 1.0915 | 1.0961 | 1.1004 | 1.1047 | 1.1086 |
| 30 | 1.1124 | 1.1159 | 1.1193 | 1.1226 | 1.1255 | 1.1285 | 1.1313 | 1.1339 | 1.1363 | 1.1388 |
| 40 | 1.1413 | 1.1436 | 1.1458 | 1.1480 | 1.1499 | 1.1519 | 1.1538 | 1.1557 | 1.1574 | 1.1590 |
| 50 | 1.1607 | 1.1623 | 1.1638 | 1.1658 | 1.1667 | 1.1681 | 1.1696 | 1.1708 | 1.1721 | 1.1734 |
| 60 | 1.1747 | 1.1759 | 1.1770 | 1.1782 | 1.1793 | 1.1803 | 1.1814 | 1.1824 | 1.1834 | 1.1844 |
| 70 | 1.1854 | 1.1863 | 1.1873 | 1.1881 | 1.1890 | 1.1898 | 1.1906 | 1.1915 | 1.1923 | 1.1930 |
| 80 | 1.1938 | 1.1945 | 1.1953 | 1.1959 | 1.1967 | 1.1973 | 1.1980 | 1.1987 | 1.1994 | 1.2001 |
| 90 | 1.2007 | 1.2013 | 1.2020 | 1.2026 | 1.2032 | 1.2038 | 1.2044 | 1.2049 | 1.2055 | 1.2060 |
| 100 | 1.2065 | | | | | | | | | |

# University of Asia Pacific
# Department of Civil Engineering
# Final Examination, Fall 2012
# Program: B.Sc Engineering (Civil)

Course Title: Engineering Hydrology (SECTION B) — Course Code.: CE 363
Time: 3 hours — Full Marks: 150

## Section A (Answer any THREE)

(Assume any reasonable data if not given)

1. (a) Explain the following (any Three) **(9)**
   i) Consistency test for rainfall records
   ii) Estimating the missing rainfall data
   iii) Pan coefficient
   iv) Φ-index
   v) Initial loss to reduce the water volume available for runoff

   (b) Distinguish between the following (any Two) **(8)**
   i) Recording and non-recording rain gauges
   ii) Infiltration capacity and infiltration rate
   iii) Field capacity and wilting point

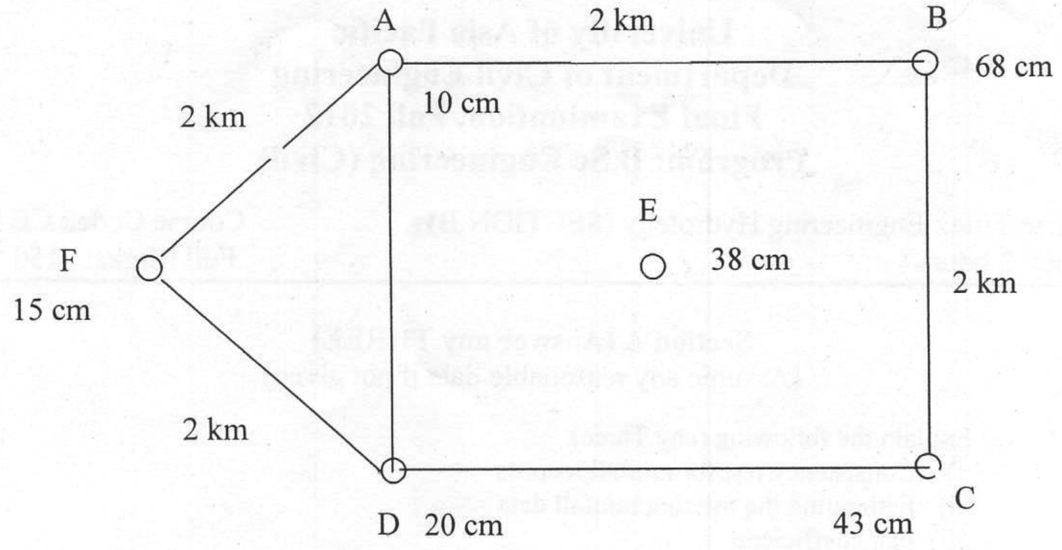
   (c) Rainfall of magnitude 3.8cm and 2.8cm occurring on two consecutive 4-h durations on a catchment of area 27 $km^2$ produced the following hydrograph of flow at the outlet of the catchment. Estimate the rainfall excess and Φ-index. **(8)**

| Time (h) | -6 | 0 | 6 | 12 | 18 | 24 | 30 | 36 | 42 |
|---|---|---|---|---|---|---|---|---|---|
| Observed Flow ($m^3/s$) | 6 | 5 | 13 | 26 | 21 | 16 | 12 | 9 | 7 |

| Time (h) | 48 | 54 | 60 | 66 |
|---|---|---|---|---|
| Observed Flow ($m^3/s$) | 5 | 5 | 4.5 | 4.5 |

2. (a) A reservoir had an average area of 20 $km^2$. In a particular month the mean rate of inflow = 10 $m^3/s$, outflow = 15 $m^3/s$, monthly rainfall = 10 cm and increase in storage = 16 million $m^3$. Assuming the seepage losses to be 1.8 cm, estimate the evaporation in that month. **(10)**

   (b) Find the mean precipitation for the area shown below by Thiessen polygon method. The area is composed of a square plus an equilateral triangular plot of side 2 km. Rainfall readings are in cm at the various stations indicated. **(15)**




3. (a) Discuss the factors that affect the process of evaporation? **(10)**

(c) Estimate the daily potential evapotranspiration for the following data by Penman's formula: **(15)**

i) Slope of the saturation vapour pressure vs. temperature at the mean air temperature = 1.00 mm/°C
ii) Mean temperature = 19°C
iii) Relative humidity = 75%
iv) Wind velocity at 2 m height = 85 km/day
v) Saturated vapour pressure $e_w$ = 16.5 mm of Hg
vi) Net radiation = 1.99 mm of water per day
vii) Psychrometric constant = 0.49 mm of Hg/°C

4. (a) A catchment area has five rain gauge stations. In a year the annual rainfall recorded by the gauges are as follows:

| Station | A | B | C | D | E |
|---|---|---|---|---|---|
| Rainfall(cm) | 88 | 104 | 138 | 78 | 56 |

For a 10% error in the estimation of the mean rainfall, calculate the minimum number of additional stations required to be established in the catchment. **(10)**

(b) Rain gauge station D was inoperative for part of a month during which a storm occurred. The storm rainfall recorded in the three surrounding stations A, B and C were 8.5, 6.7 and 9.0 cm, respectively. If the average annual rainfall for the stations are 75, 84, 70 and 90 cm, respectively, estimate the storm rainfall at station D. **(10)**

(c) Sketch the schematic diagram of energy budget method of estimating evaporation from a lake. **(5)**

## Section B

Answer any **THREE**. Each question has **25** marks. The figures in the right margin indicate full marks.

5. a) Describe Horton's infiltration curve and equation. **(4)**

   b) Differentiate between the two: **(6)**

   i. φ-index and W-index.

   ii. Saturation overland flow and Hortonian overland flow

   c) Describe the different components of a hydrograph with a figure. **(3)**

   d) Calculate the streamflow hydrograph for a storm of 6 inches excess rainfall , with 2 inches in the first half hour, 3 inches in the second half hour and 1 inch in the third half hour. Use the half hour unit hydrograph given below and assume a baseflow of 500 cfs. **(12)**

| Time (0.5 h) | Excess precipitation (in) | Unit hydrograph ordinates (cfs/in) |
|---|---|---|
| 1 | 2 | 404 |
| 2 | 3 | 1079 |
| 3 | 1 | 2343 |
| 4 | | 2506 |
| 5 | | 1460 |
| 6 | | 453 |
| 7 | | 381 |
| 8 | | 254 |
| 9 | | 173 |

6. a) Briefly discuss about the three types of streams: perennial, ephemeral and intermittent. Draw figures. **(5)**

   b) Describe how the following factors affect a streamflow hydrograph: **(5)**

   i. Shape of the basin ii. Drainage density iii. Land use

   c) Describe different baseflow separation methods using figures wherever possible. **(5)**

   d) A 3-h unit hydrograph for a basin has the following ordinates (Table 1). Using the **s-curve** method, determine the 12- h unit hydrograph. **(10)**

7. a) Define attenuation and time lag using a hydrograph. **(4)**

   b) Describe prism and wedge storage in a channel and the role of 'x' in the Muskingum method of channel routing. **(6)**

**Table 1**

| Col 1 | Col 2 (3-h UH) |
|---|---|
| 0 | 0 |
| 3 | 12 |
| 6 | 75 |
| 9 | 132 |
| 12 | 180 |
| 15 | 210 |
| 18 | 183 |
| 24 | 156 |
| 27 | 135 |
| 30 | 144 |
| 33 | 96 |
| 36 | 0 |

c) A reservoir for detaining flood flows has an outlet structure including a 3 ft diameter rein-forced concrete pipe as the outlet structure. The headwater discharge relation for the outlet pipe is given in **col 2** and **col 3** of Table 2.0. Use the level pool routing method ( Goodrich equation) to calculate reservoir outflow from the inflow hydrograph given in **col 6** and **col** 7 of Table 2. Assume the reservoir is initially empty. **(15)**

$$\frac{2S_{j+1}}{\Delta t} + Q_{j+1} = (I_j + I_{j+1}) + (\frac{2S_j}{\Delta t} - Q_j)$$

Here $I_j$ and $I_{j+1}$ are inflows, $S_j$ is storage and $Q_j$ is outflow from previous time step and $S_{j+1}$ and $Q_{j+1}$ are two unknowns.

**Table 2.0**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| index j | elevation h-ft | discharge Q-cfs | storage S-ft3 | (2S/Δ t )+Q cfs; Δ t=10min | time (min) | inflow 'I' (cfs) |
| 1 | 0 | 0 | 0 | | 0 | 0 |
| 2 | 0.5 | 3 | 21780 | | 10 | 60 |
| 3 | 1 | 8 | 43560 | | 20 | 120 |
| 4 | 1.5 | 17 | 65340 | | 30 | 180 |
| 5 | 2 | 30 | 87120 | | 40 | 240 |
| 6 | 2.5 | 43 | 108900 | | 50 | 300 |
| 7 | 3 | 60 | 130680 | | 60 | 360 |
| 8 | 3.5 | 78 | 152460 | | 70 | 300 |
| 9 | 4 | 97 | 174240 | | 80 | 220 |
| 10 | 4.5 | 117 | 196020 | | 90 | 140 |
| 11 | 5 | 137 | 217800 | | 100 | 0 |

8. a) What is Intensity-Duration-Frequency (IDF) curve? How is it used in peak flood estimation? **(4)**

b) List the different techniques of stream flow measurement. **(4)**

c) Briefly explain the concept of 'return period' and 'confidence limit' in flood frequency analysis. **(5)**

d) Flood frequency computations for the river Turag was completed using Gumbel's method and following results were obtained. Estimate the flood magnitude in this river with a return period of 500 years. **(12)**

| Return period T (years) | Peak flood ($m^3/s$) |
|---|---|
| 50 | 30,000 |
| 100 | 35,300 |

$$x_T = \bar{x} + K\sigma_{n-1} \qquad \sigma_{n-1} = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N-1}}$$

$$K = \frac{y_T - \bar{y}_n}{S_n} \qquad y_T = -\left[\ln . \ln \frac{T}{T-1}\right]$$

$$T = 1/P \qquad P = \frac{m}{N+1}$$

$$H_n = H_a + H_e + H_g + H_s + H_i$$

$$E = \frac{H_n - H_g - H_s - H_i}{l_v \rho_w (1+\beta)}$$

$$E = \frac{H_n - H_g - H_a - H_i - H_s}{l_v \rho_w}$$

$l_v = 2.501 \times 10^6 - 2370T$ where T is in deg C.

$$x_{1/2} = x_T \pm f(c)\, S_e$$

$$S_e = \text{probable error} = b\frac{\sigma_{n-1}}{\sqrt{N}}$$

$$b = \sqrt{1 + 1.3K + 1.1K^2}$$

| | | | | | | |
|---|---|---|---|---|---|---|
| $c$ in per cent | 50 | 68 | 80 | 90 | 95 | 99 |
| $f(c)$ | 0.674 | 1.00 | 1.282 | 1.645 | 1.96 | 2.58 |

TABLE 7.3 REDUCED MEAN $\bar{y}_n$ IN GUMBEL'S EXTREME VALUE DISTRIBUTION

$N$ = sample size

| N | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.4952 | 0.4996 | 0.5035 | 0.5070 | 0.5100 | 0.5128 | 0.5157 | 0.5181 | 0.5202 | 0.5220 |
| 20 | 0.5236 | 0.5252 | 0.5268 | 0.5283 | 0.5296 | 0.5309 | 0.5320 | 0.5332 | 0.5343 | 0.5353 |
| 30 | 0.5362 | 0.5371 | 0.5380 | 0.5388 | 0.5396 | 0.5402 | 0.5410 | 0.5418 | 0.5424 | 0.5430 |
| 40 | 0.5436 | 0.5442 | 0.5448 | 0.5453 | 0.5458 | 0.5463 | 0.5468 | 0.5473 | 0.5477 | 0.5481 |
| 50 | 0.5485 | 0.5489 | 0.5493 | 0.5497 | 0.5501 | 0.5504 | 0.5508 | 0.5511 | 0.5515 | 0.5518 |
| 60 | 0.5521 | 0.5524 | 0.5527 | 0.5530 | 0.5533 | 0.5535 | 0.5538 | 0.5540 | 0.5543 | 0.5545 |
| 70 | 0.5548 | 0.5550 | 0.5552 | 0.5555 | 0.5557 | 0.5559 | 0.5561 | 0.5563 | 0.5565 | 0.5567 |
| 80 | 0.5569 | 0.5570 | 0.5572 | 0.5574 | 0.5576 | 0.5578 | 0.5580 | 0.5581 | 0.5583 | 0.5585 |
| 90 | 0.5586 | 0.5587 | 0.5589 | 0.5591 | 0.5592 | 0.5593 | 0.5595 | 0.5596 | 0.5598 | 0.5599 |
| 100 | 0.5600 | | | | | | | | | |

TABLE 7.4 REDUCED STANDARD DEVIATION $S_n$ IN GUMBEL'S EXTREME VALUE DISTRIBUTION

$N$ = sample size

| N | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.9496 | 0.9676 | 0.9833 | 0.9971 | 1.0095 | 1.0206 | 1.0316 | 1.0411 | 1.0493 | 1.0565 |
| 20 | 1.0628 | 1.0696 | 1.0754 | 1.0811 | 1.0864 | 1.0915 | 1.0961 | 1.1004 | 1.1047 | 1.1086 |
| 30 | 1.1124 | 1.1159 | 1.1193 | 1.1226 | 1.1255 | 1.1285 | 1.1313 | 1.1339 | 1.1363 | 1.1388 |
| 40 | 1.1413 | 1.1436 | 1.1458 | 1.1480 | 1.1499 | 1.1519 | 1.1538 | 1.1557 | 1.1574 | 1.1590 |
| 50 | 1.1607 | 1.1623 | 1.1638 | 1.1658 | 1.1667 | 1.1681 | 1.1696 | 1.1708 | 1.1721 | 1.1734 |
| 60 | 1.1747 | 1.1759 | 1.1770 | 1.1782 | 1.1793 | 1.1803 | 1.1814 | 1.1824 | 1.1834 | 1.1844 |
| 70 | 1.1854 | 1.1863 | 1.1873 | 1.1881 | 1.1890 | 1.1898 | 1.1906 | 1.1915 | 1.1923 | 1.1930 |
| 80 | 1.1938 | 1.1945 | 1.1953 | 1.1959 | 1.1967 | 1.1973 | 1.1980 | 1.1987 | 1.1994 | 1.2001 |
| 90 | 1.2007 | 1.2013 | 1.2020 | 1.2026 | 1.2032 | 1.2038 | 1.2044 | 1.2049 | 1.2055 | 1.2060 |
| 100 | 1.2065 | | | | | | | | | |