



UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA
SECOND SEMESTER EXAMINATIONS, APRIL/MAY 2019

COURSE NO: ES 372
COURSE NAME: HYDROLOGY
CLASS: ES III **TIME:** 3 HOURS

Name: _____ Index Number: _____

Answer questions one (1) and two (2) and two other questions. Marks will be awarded for good presentation

- 1.
- a. Briefly explain the following terms as applied in hydrology
- | | |
|----------------------------|---------------------------|
| i. Permafrost | ii. Rating curve |
| iii. Effective porosity | iv. Phreatic surface |
| v. Groundwater basin | vi. Flow event separation |
| vii. Infiltration capacity | viii. Interflow |
| ix. Groundwater overdraft | x. Hydraulic conductivity |
- (2 marks each)*
- b. For a small catchment, the infiltration rate at the beginning of rain was observed to be 90 mm/hr and decreased exponentially to a constant rate of 8 mm/hr after 2.5 hr. The total infiltration during 2.5 hr was 50 mm. Develop the Horton's equation for the infiltration rate at any time $t < 2.5$.
- (5 marks)*
- 2.
- a. What is a unit hydrograph? *(1 mark)*
- b. The ordinates of a 6-h unit hydrograph are given. A storm had three successive 6-h interval of rainfall magnitude of 3, 5, 4 cm respectively. Assuming a ϕ -index of 0.2 cm/h and baseflow of 30 m³/s, determine with the aid of a graph the resulting hydrograph of flow.

Time (h)	0	6	12	18	24	30	36	42	48	54	60	66	72
UH ordinate (m ³ /s)	0	250	600	800	700	600	450	320	200	100	50	0	

(10 marks)

- c. A 3-hour storm occurred at a place and the precipitations in the neighbouring rain gauge stations A, B and C were measured as 3.8, 4.1 and 4.5 cm, respectively. The precipitation in the neighbouring station S could not be measured since the rain-gauge bottle was broken. The normal precipitation in the four stations A, B, C and D as per the National News Bulletin were 45, 48, 53 and 50 cm, respectively. Estimate the storm precipitation at station D.
- (4 marks)*

3. a. Describe four (4) types of springs (4 marks)

- b. The velocity of groundwater flow can be described by the following equation:

$$v = \left(\frac{K}{n} \right) i$$

where K = hydraulic conductivity, n = porosity and i = hydraulic gradient.

With the information provided below, how many metres (m) will groundwater travel in 1 year

h ₁ (m)	105.00
h ₂ (m)	110.22
K (m/d)	2.35
n	0.16
L (m)	279

(3 marks)

- c. As Environmental hydrologist, do you think it is necessary to survey flood? Why?

(3 marks)

- 4.

The following data were collected for a stream at a gauging station. Compute the discharge by (i) mid-section method (ii) mean-section method.

Distance from one end of water surface (m)	Depth of water (m)	Velocity (m/s)		
		at 0.6d	at 0.2d	at 0.8d
0	0	-	-	-
1.2	0.7	0.4	-	-
2.4	1.7		0.7	0.5
3.6	2.5		0.9	0.6
4.8	1.3		0.6	0.4
6.0	0.5	0.35		
7.2	0	-	-	-

(10 marks)

- 5.

- a. On the basis of rainfall recorded over 50 years, 24-hour maximum at Tarkwa is found to be 20 cm. Find the probability of a 24-hour rainfall of magnitude equal to or greater than 20 cm occurring at Tarkwa.

- i. Once in 10 successive years
- ii. At least once in 10 successive years

(2 marks)

- b. Information is provided on the annual maximum 1-day flood between 1981 and 2000. Determine the return periods and the percent probability of each flood event using Weibull's method.

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual Max. 1-day flood (m ³ /s)	14.57	8.44	14	22.62	29.3	24.2	12.45	18.3	9.68	11.43
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Annual Max. 1-day flood (m ³ /s)	21.24	8.5	9.72	19.65	20.96	18.7	10.34	12.88	42.45	37.3

(8 marks)

Examiners: J. Seidu/Dr A. Asante-Annor