

	Organization Name: አዲስ አበባ ሳይንስና ቴክኖሎጂ ዩኒቨርሲቲ ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY	Document No.: VPAA/DPT/OF/030	
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General Information

College: of Engineering

Course Name: Engineering Hydrology

Department: Civil Engineering

Course Code: CEng3108

Exam Type: Final

Year: 3th

Maximum Mark: 50

Semester: 2nd

Exam Date: June 9, 2025

Time Allowed: 3 hrs

Student Information

Student Name: _____ ID No.: _____ Section: _____

Tick an 'X' mark in the box where it applies you.

Freshman	Applied Science	<input type="checkbox"/>	Engineering	<input checked="" type="checkbox"/>
Regular (2 nd & above):	Undergraduate	<input checked="" type="checkbox"/>	Postgraduate	<input type="checkbox"/>
Continuing Education	Undergraduate	<input type="checkbox"/>	Postgraduate	<input type="checkbox"/>

Course Instructor(s) Name(s): Dr Sisay D., Dr. Mulugeta A. & Wossenu L

General Directions

- Write your name and ID No. both on this cover page and the answer sheet (if any).
- The examination booklet constitutes **4** type(s) of question(s),
- Please read the instructions carefully and attempt all the questions.
- Make sure that all the types are included in your booklet, which has **14** page(s) including the cover page and answer sheet page(s), if any.
- It is strictly forbidden to bring mobile phones into the examination room
- Unless permitted, no other electronic devices and materials are allowed in the examination room.
- Do not use a pencil and red pen.
- Do not hand any materials related to the course.
- Do not detach the answer sheet, if any, from the question paper.
- Cheating automatically nullifies your total scores.
- Do not start until you are told to do so!

For Instructor's Use Only

Question Type/ No.	Mark Allotted	Mark Scored
<i>Part I</i>	<i>5</i>	
<i>Part II</i>	<i>6</i>	
<i>Part III</i>	<i>10</i>	
<i>Part IV</i>	<i>29</i>	
<i>Total</i>	<i>50</i>	

ASCL
Dr. Sisay Demekru Derib (PhD)

ID. No. _____



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Part I: Matching (1 pt. each)

Choose appropriate word/phrases listed below and write them using capital letters on the space provided.

[*PRECIPITATION, CATCHMENT/WATERSHED, HYGROMETER, OROGRAPHIC
PRECIPITATION, HYDROLOGICAL MODELING, CONVECTIVE PRECIPITATION,
RATING CURVE, RAINFALL INTENSITY, HYETOGRAPH, HYDROGRAPH*]

1. It is an area with surface discharge through a common outlet without any surface inflows from outside. _____
2. It is the fall of water in various forms on the earth from the clouds.

3. It results from mechanical lifting moist air over mountain barriers.

4. It occurs due to the rising of warmer, lighter air by heating in cold, and denser surroundings. _____
5. It measures relative humidity.

Part II Multiple choice (2 pts. each)

1. The unit hydrograph is defined as the hydrograph resulting from:
 - A. 1 cm of rainfall excess in 1-hour duration
 - B. Depth of rainfall excess in any time
 - C. 1 cm of total rainfall in 1 hour
 - D. A storm of known duration
2. The technique of checking precipitation data consistency is named as:
 - A. Mass curve method
 - B. Double mass curve method
 - C. FDC curve method
 - D. IDF curve method
3. The S-curve hydrograph is primarily used to:
 - A. Determine infiltration losses
 - B. Convert rainfall intensity to depth
 - C. Derive a unit hydrograph of different duration
 - D. Develop a flow duration curve

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Part III Comprehension & discussion (2 pts each)

1. List the reasons behind making rainfall data consistency check and conversion of point rainfall data to areal?
2. Discuss the water balance for the watershed and water body systems.
3. Discuss the base flow separation methods.
4. Discuss how the design life, risk of failure and design period of a civil/hydraulic/ structure are related.
5. Discuss urban versus rural hydrology.

Part IV-Workouts

1. Rain-gauge station D was not functional for part of a month during which a storm occurred. The storm rainfall recorded in the three surrounding stations A, B, and C were 80, 70 and 90 mm, respectively. If the normal average annual rainfall values at the stations A, B, C & D are 750, 840, 720 and 890 mm, respectively, estimate the storm rainfall at station D using normal ratio method. **(5 pts)**

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2. A small watershed consists of 3.5 km² of cultivated area (c = 0.2), 2.5 km² under forest (c = 0.1) and 2 km² under residential (c = 0.85). There is a fall of elevation 50 m in a watercourse of 2 km distance. The IDF relation for the area is given by $I = \frac{800T^{0.2}}{(t_c + 12)^{0.5}}$

Kirpich modified formula $t_c = 0.02 * L^{0.8} S^{-0.4}$

Where I, in mm/hr., T-yr, t-min.

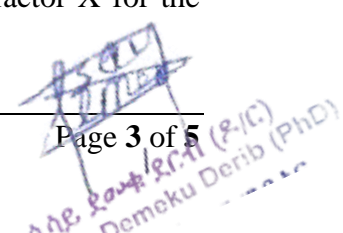
Estimate the design discharge for the 50-year return period. **(6 pts.)**

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3. Route the flood hydrograph given in table1 below through a channel reach and derive the outflow hydrograph. The values of storage-time constant K and weighing factor X for the river channel is taken as 20h and 0.32, respectively. **(6 pts.)**

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 Demeku Derib (PhD)

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Table 1

Time (hr)	0	6	12	18	24	30	36	42	48	54	60
Flood hydrograph(I) (m ³ /sec)	36	30	50	75	90	102	88	70	60	48	36

4. Annual flood data of a certain river covering the period of 1948 to 1979 yielded for the annual flood discharges a mean of 29,600 m³/s and a standard deviation of 14,860 m³/s. For a proposed bridge on this river near the gauging site, it is decided to have an expected life of 50 years. **(6 pts.)**

A. Estimate the flood discharge by Gumbel's method for use in the design of this structure.

B. What is the 50% confidence limit for the flood discharge you obtained in part a?

$$f(c)=0.674$$

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5. The hydrological data of mean monthly flow a river for 30 years is given below in table 2. Using the mass curve method, compute the minimum storage required to maintain a demand rate of 7 m³/s. Ignore the losses and assume that every month has 30 days. **(6 pts.)**

Table 2

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inflow (Q) m ³ /s	5	8	12	10	7	4	2	1	3	6	9	11

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Wish you success!

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Given formula and tables

$y_T = -[\ln \cdot \ln \frac{T}{T-1}]$	$K = \frac{y_T - \bar{y}_n}{s_n}$	$x_T = \bar{x} + K\sigma_x$	
$x_{1/2} = x_T \pm f(c) * S_e$	$S_e = \text{probable error} = b \frac{\sigma_{n-1}}{\sqrt{N}}$	$b = \sqrt{1 + 1.3K + 1.1K^2}$	$C_1 = \frac{\Delta t + 2Kx}{\Delta t + 2K - 2Kx}$ $C_2 = \frac{\Delta t - 2Kx}{\Delta t + 2K - 2Kx}$ $C_3 = \frac{-\Delta t + 2k - 2KX}{\Delta t + 2k - 2kx}$

Table 3 Values for reduced variates and reduced standard deviation

N	0	1	2	3	4	5	6	7	8	9
10	0.4952	0.4996	0.5035	0.507	0.51	0.5128	0.5157	0.5181	0.5202	0.522
20	0.5236	0.5252	0.5268	0.5283	0.5296	0.5309	0.532	0.5332	0.5343	0.5353
30	0.5362	0.5371	0.538	0.5388	0.5396	0.5402	0.541	0.5418	0.5424	0.543
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	0.553	0.5533	0.5535	0.5538	0.554	0.5543	0.5545
70	0.5548	0.555	0.5552	0.5555	0.5557	0.5559	0.5561	0.5563	0.5565	0.5567
80	0.5569	0.557	0.5572	0.5574	0.5576	0.5578	0.558	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	0.56									

Reduced mean Y_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	1.148	1.1499	1.1519	1.1538	1.1557	1.1574	1.159
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	1.177	1.1782	1.1793	1.1803	1.1814	1.1824	1.1834	1.1844
70	1.1854	1.1863	1.1873	1.1881	1.189	1.1898	1.1906	1.1915	1.1923	1.193
80	1.1938	1.1945	1.1953	1.1959	1.1967	1.1973	1.198	1.1987	1.1994	1.2001
90	1.2007	1.2013	1.202	1.2026	1.2032	1.2038	1.2044	1.2049	1.2055	1.206
100	1.2065									

Reduced standard deviation S_n in Gumbel's extreme value distribution, N = sample size

Dr. Sisay Demeku Derib (PhD)