3-2

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
3rd Year 2nd Semester

Course Title: Professional Practices & Engineering Ethics | Course Code: CE 303
Time: 3 Hour | Credit Hours: 3.00 | Full Marks: 150

Answer all the questions

QUESTION 1 [15 MARKS] [15]

A "duty to defend" clause requires one party to cover another's legal defense costs if a claim arises. A large developer company attempted to shift its risk to an engineering firm by including an overly broad "duty to defend" clause in a client-developed contract. In this case, the contract unfairly tried to make the engineering firm pay the client's legal expenses for any claim, even loosely related to the engineer's work, even if the engineer wasn't at fault.

Discuss and explain how the engineering firm can avoid this situation.

QUESTION 2 [20 MARKS] [12+8]

A garment industry decided to recruit 50 workers. The HR department prepared a contract for all the new workers. The contract has the following clauses:

- Workers have to work 10 hours a day, 60 hours a week, with a weekly rest day.
- The overtime payment will be equal to regular payment.
- Workers are entitled to provide sick leave but no festival leave or annual leave.
- Wages will be equal for male and female workers for work of equal nature or value.
- Canteen is available for their workers.
- No worker is permitted to establish or join any kind of trade union inside the factory.

Suppose, you are going to sign the contract as a worker in that factory. Discuss whether the contract clauses are satisfactory or not according to the Bangladesh Labor Law (BLL) and identify the problems with the clauses mentioned above. Write your course of action in this situation. [e.g., should you sign the contract or not.]

QUESTION 3 [20 MARKS] [12+8]

In September 2025, the Ministry of Shipping suspended two senior officials of the Bangladesh Inland Water Transport Authority (BIWTA) for allegedly taking a payment of Tk 2 lakh from a contractor in exchange for awarding a Tk 17 crore fuel supply tender.

Determine whether this payment would be considered a "gift" and justify your answer. Explain your answer with reference to the concept of bribes & kickbacks.

QUESTION 4 [18 MARKS] [18]

In online platforms such as Reddit or Quora, a popular topic of debate is whether celebrities such as actors, musicians or sports players are overpaid compared to researchers. In one discussion, a commenter stated, "Researchers are considered professionals, whereas acting or composing music can be considered occupations."

Based on your understanding of professionalism, discuss this statement. Demonstrate how one can distinguish between a profession and an occupation using the attributes.

QUESTION 5 [14 MARKS] **[4+10]**

Define "Multinational Corporation". "The strategies and policies of multinational corporations can lead to ethical issues globally." Express your own opinion to evaluate the statement.

QUESTION 6 [18 MARKS] **[18]**

"The Bangladesh Labor Law is considered a progressive advancement because it ensures the protection of children and safeguards the equal rights of women." Apply your understanding to justify this statement.

QUESTION 7 [20 MARKS] **[10+10]**

"Yet, it has happened again – this time with deadly consequences. Today (26 October), around 12:20 PM, a load-bearing pad on Pillar 433 near Farmgate station detached and fell, resulting in the death of a pedestrian and injury of two others."- *The Business Standard*

The recent Farmgate metro pillar accident highlights how negligence, cost-cutting by contractors, and poor supervision can lead to fatal structural failures.

Applying your knowledge of safe design criteria, investigate the possible causes behind such incidents. Additionally, as a civil engineering student, illustrate the role of engineers in ensuring public safety in design and construction.

QUESTION 8 [25 MARKS] **[10+15]**

Mr. Farhan Hossain, a process engineer at Madhumoti Energy Corporation (MEC), works at a cooling facility in a small town of 5,000 people near Sylhet. The plant uses hexavalent chromium (Cr-6) to prevent corrosion in pipes. According to safety protocols, wastewater from the cooling process must be treated to remove Cr-6 before being discharged into the ground.

After several years, residents report serious health problems and contaminated groundwater and a class-action lawsuit is filed against MEC, alleging toxic leakage of Cr-6 into local water sources. However, the company publicly denies responsibility, claiming it was unaware of any contamination and that all discharges met legal limits.
While reviewing old files, Mr. Farhan discovers an internal report showing repeated violations of Cr-6 effluent standards. The report had been marked "Confidential – For Internal Circulation Only" and never shared with the environmental regulatory board.

Farhan realizes this hidden report could prove the MEC's knowledge of pollution. However, disclosing it would violate his confidentiality agreement, risking his job, reputation, and potential legal action. As the court date nears, the victims' lawyer lacks solid proof. Now, Farhan is the only person who could expose the truth.

a) What are the two NSPE Codes of Ethics that come into conflict in Mr. Farhan's case?
b) As a professional engineer, what should he do? Discuss his ethical obligations and the possible consequences of his choice.

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2025
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering II | Course Code: CE 313 (Old)
Time: 3 hours | Credit Hour : 3.0 | Full Marks: 100

ANSWER ALL QUESTIONS. Assume any missing data reasonably.
(**Roll**=Last three digits of your registration number)

PART-A

[Show all the relevant bending moment diagrams (M0,M1,M2 etc) or axial force(N0,N1,N2 etc) with loads and reactions]

QUESTION 1 [12 MARKS]

Analyze the frame in ***Fig.1*** to determine the horizontal deflection at **E** by the Unit Load Method [P= 42 kN for **Even** Rolls or P= 31 kN for **Odd** Rolls and EI=Constant]. **[12]**

CO2/PO2/C4

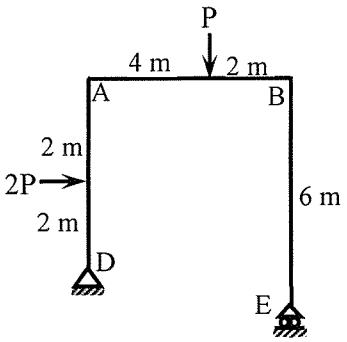


Fig.1

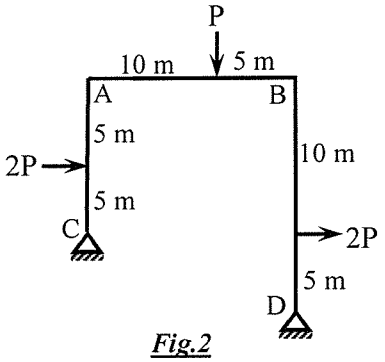


Fig.2

QUESTION 2 [14 MARKS]

Analyze the frame in ***Fig.2*** by Force Method and calculate the reactions. Consider the horizontal reaction at ***D*** as redundant [P= 42 kN for **Even** Rolls or P=31 kN for **Odd** Rolls and EI=Constant]. **[14]**

CO3/PO2/C4

QUESTION 3 [12 MARKS]

Analyze the Beam in ***Fig.3*** by the Force Method and calculate the reactions. Consider the reaction at ***C*** for **Even** Rolls or the reaction of ***A*** for **Odd** Rolls as the redundant [P= 42 kN for **Even** Rolls or P= 31 kN for **Odd** Rolls and EI=Constant]. **[12]**

CO2/PO2/C4

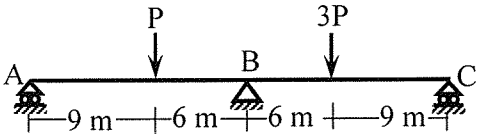


Fig.3

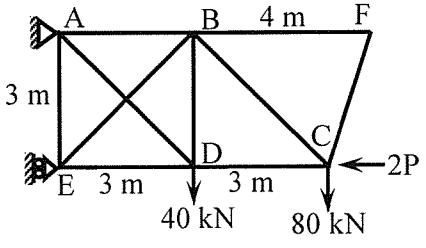


Fig.4

QUESTION 4 [12 MARKS]

Analyze the truss in ***Fig.4*** by the Force Method and calculate the bar forces. Consider the member force in ***AD*** as redundant . [P= 42 kN for **Even** Rolls or P= 31 kN for **Odd** Rolls and EA=Constant]. **[12]**

CO2/PO2/C4

PART-B

QUESTION 5 [10 MARKS]

Analyze the frame shown in shown in ***Fig.5*** by Cantilever Method to draw the axial force and moment diagram of columns. **[10]**

CO2/PO2/C4

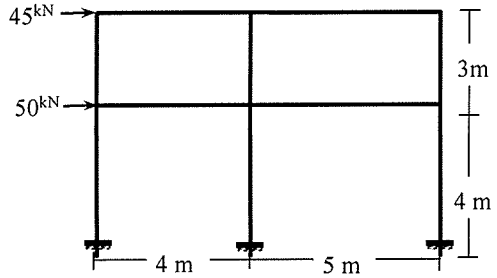


Fig.5

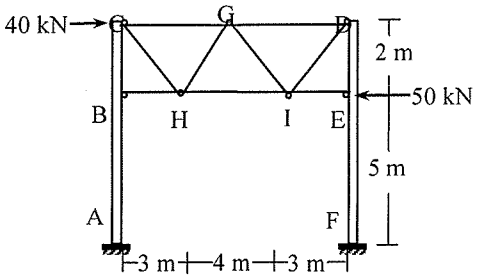


Fig.6

QUESTION 6 [5 MARKS]

Analyze the mill bent shown in ***Fig.6*** by Portal Method to determine the reactions at support **A** and **F**. Also, determine the force in members **GD** and **CH**. **[05]**

CO2/PO2/C4

QUESTION 7 [15 MARKS]

(i) Draw the qualitative influence lines of the beam shown in ***Fig.7***, **[05]**

(a) Bending moments M_B, M_G

(b) Support reactions R_E, R_D and

(c) Shear forces $V_B^{(L)}$, $V_C^{(L)}$

CO1/PO1/C3

(ii) Analyze the beam to calculate the maximum value of R_D , if the beam ***(Fig.7)*** is subjected to a uniformly distributed dead load of 25 kN/m, moving live load of 25 kN/m and 30 kN moving concentrated load [Given: EI = constant]. **[10]**

CO2/PO2/C4

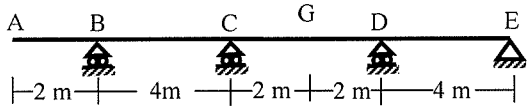


Fig.7

QUESTION 8 [15 MARKS]

Use Moment Distribution Method to draw bending moment diagram of the frame shown in ***Fig.8***

[Given: E = 220 GPa , I = 95×10^6 mm^4]. **[15]**

CO2/PO2/C4

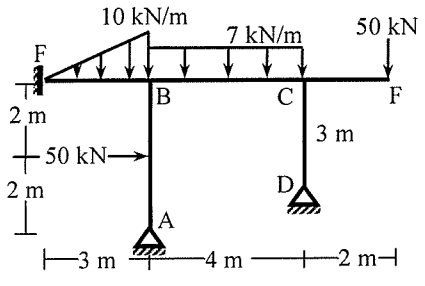


Fig.8

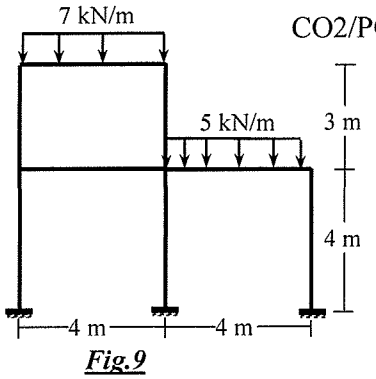


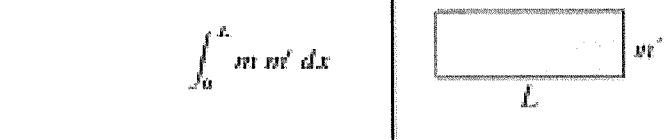
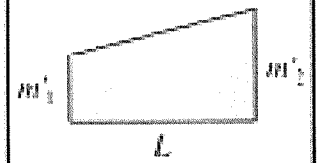
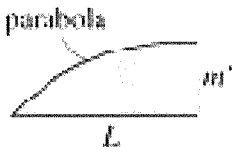
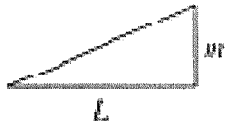
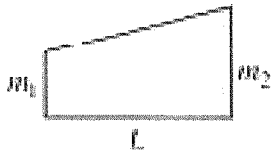
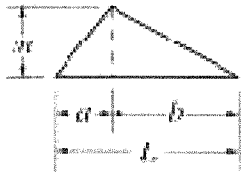
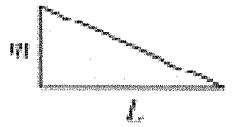
Fig.9

QUESTION 9 [05 MARKS]

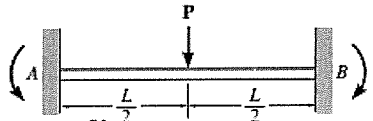
Analyze the frame is shown in ***Fig.9*** using Vertical Load (Approximate) Method and draw the shear force and bending moment diagram of the frame. **[05]**

CO2/PO2/C4

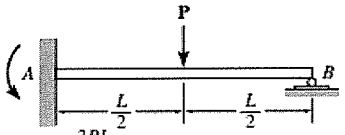
Table for Evaluating $\int_0^L m\, m'\, dx$

$\int_0^L m\, m'\, dx$				
	$mm'L$	$\frac{1}{2}mm'L$	$\frac{1}{2}m(m'_1 + m'_2)L$	$\frac{2}{3}mm'L$
	$\frac{1}{2}mm'L$	$\frac{1}{3}mm'L$	$\frac{1}{6}m(m'_1 + 2m'_2)L$	$\frac{5}{12}mm'L$
	$\frac{1}{2}m'(m_1 + m_2)L$	$\frac{1}{6}m'(m_1 + 2m_2)L$	$\frac{1}{6}[m'_1(2m_1 + m_2) + m'_2(m_1 + 2m_2)]L$	$\frac{1}{12}[m'(3m_1 + 5m_2)]L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'(L + a)$	$\frac{1}{6}m[m'_1(L + b) + m_2(L + a)]$	$\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'L$	$\frac{1}{6}m(2m'_1 + m'_2)L$	$\frac{1}{4}mm'L$

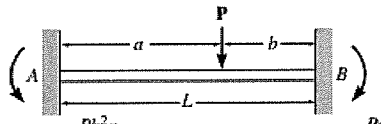
Fixed End Moments



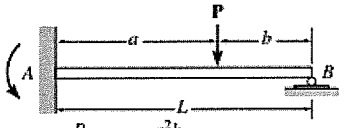
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



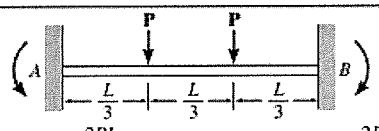
$(FEM)'_{AB} = \frac{3PL}{16}$



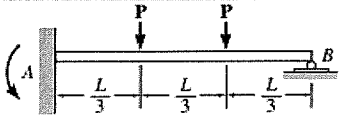
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



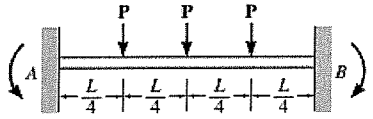
$(FEM)'_{AB} = \left(\frac{P}{L^2}\right)\left(b^2a + \frac{a^2b}{2}\right)$



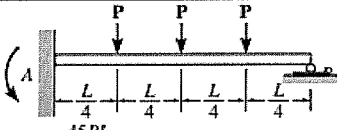
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



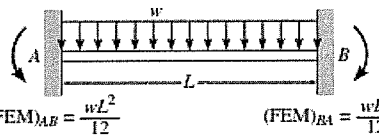
$(FEM)'_{AB} = \frac{PL}{3}$



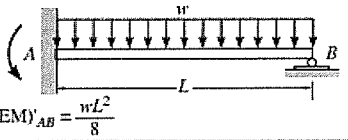
$(FEM)_{AB} = \frac{5PL}{16}$ $(FEM)_{BA} = \frac{5PL}{16}$



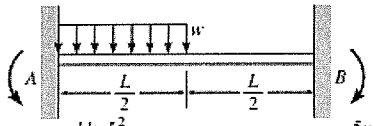
$(FEM)'_{AB} = \frac{45PL}{96}$



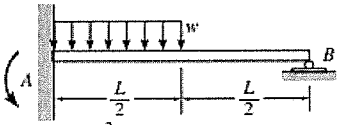
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



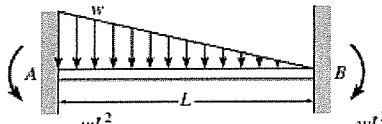
$(FEM)'_{AB} = \frac{wL^2}{8}$



$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



$(FEM)'_{AB} = \frac{9wL^2}{128}$



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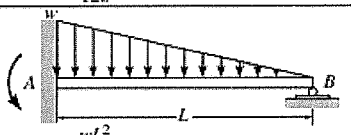
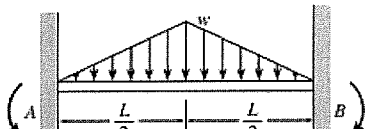
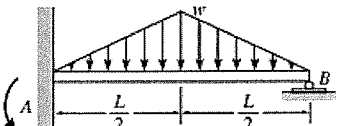


$(FEM)'_{AB} = \frac{wL^2}{15}$



$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$



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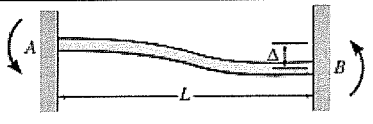
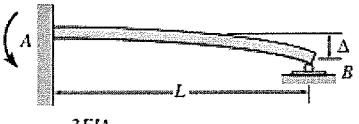


$(FEM)_{AB} = \frac{6EI\Delta}{L^2}$ $(FEM)_{BA} = \frac{6EI\Delta}{L^2}$



$(FEM)'_{AB} = \frac{3EI\Delta}{L^2}$

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
3rd Year 2nd Semester

Course Title: Design of Concrete Structures II | Course Code: CE 317
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 100

Answer all the questions

QUESTION 1 [20 MARKS]

a. The corner slab panel of an office building (live load 2.4 kN/m^2) is shown in **Figure 1**. The floor will be constructed with beam supported slab and it carries 3 kN/m^2 dead load due to random wall and floor finishes. The negative moment coefficient (at continuous support) of the slab is 0.05, thickness is 175 mm. Apply the concept to design the slab for support moments (both continuous and discontinuous edges) only. Assume required data for design, concrete strength (f_c') could be used as 20 N/mm^2. [14]

b. Design the cantilever retaining wall of an artificial lake as shown in **Figure 2**. Density of soil beside the wall is 1700 kg/m^3, active soil pressure coefficient is 0.33, soil is saturated with water (void ratio of the soil is 40%). Concrete strength (f_c') could be used as 20 N/mm^2. Thickness of the wall could be assumed as 750 mm. [6]

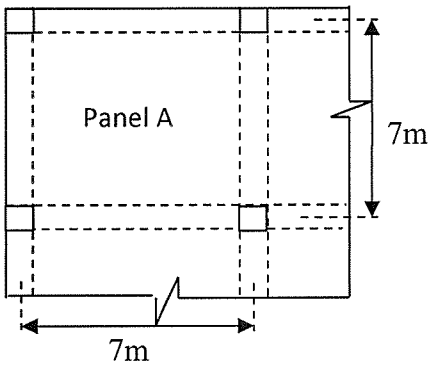


Figure 1. Panel of beam supported slab

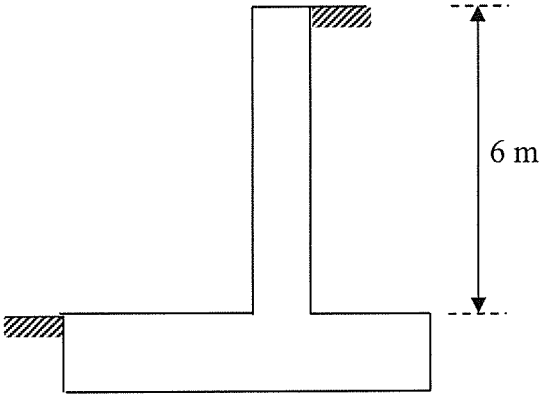


Figure 2. Retaining wall

QUESTION 2 [20 MARKS]

a. A column of a multi-storeyed residential building is subjected to dead and live loads of 1500 kN and 350 kN, respectively. Dimension of the column is 400 mm x 550 mm. The column is supported by isolated pad footing, the bearing capacity of the soil under the footing is 180 kN/m^2. The depth of the footing could be assumed as 600 mm. Apply the concept to design the footing with checking of punching shear. Assume required data to design the footing. [14]

b. A 12 m span simply supported post-tensioned slab of car park is subjected to uniformly distributed 12 kN/m dead load (including self-weight) and 2.4 kN/m live load. The cross section of each panel is 250 mm (thickness) x 1000 mm (width). Justify "eccentric post-tensioning tendon is economical as compared to straight tendon" through comparative analysis of the panel in terms of prestressing force and stresses. Maximum eccentricity of the tendon is 50 mm, assume required data to analyse the slab. [6]

QUESTION 3 [20 MARKS]

The floor slab layout plan of a 10-storeyed office building is shown in **Figure 3**. The floor of the structure will be constructed with a **flat slab system** and it carries 3 kN/m^2 dead load due to random wall and floor finishes. Design the **long span column strip of Panel A (Figure 3) in accordance to safety and societal requirements (BNBC 2020)**. Synthesis (optimize) the thickness of the slab considering deflection and punching requirements of BNBC 2020 code. Assume required data to design the slab. [20]

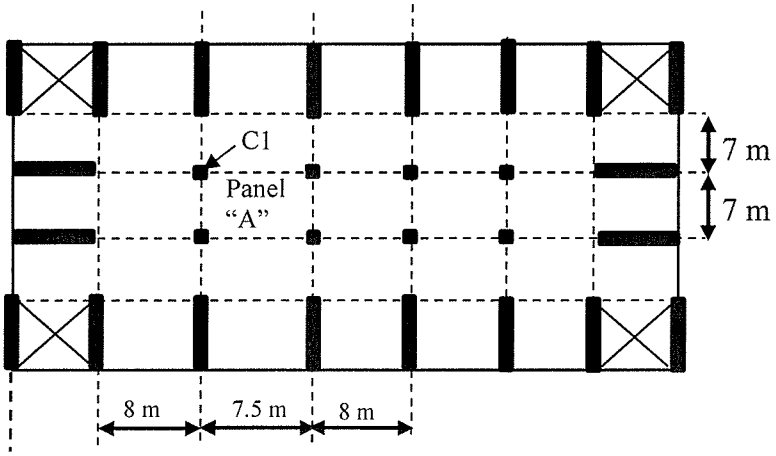


Figure 3. Structural model (floor plan) of building

QUESTION 4 [20 MARKS]

The column "C1" as shown in **Figure 3** of the building structure stated in **Question 3** is required to be designed as rectangular tie column. The uni-axial design moment of the column at ground floor could be considered as 500 kN-m (smaller direction), use approximate method to obtain design load of the column. The column has to be designed for the lowest minimal dimension considering all possible options of BNBC 2020. Propose a solution to design the ground floor column with structural details considering safety and societal requirements of code. The column design chart as shown in Appendix could be used to design the column. [20]

QUESTION 5 [20 MARKS]

The column **"C1"** as shown in **Figure 3** of the building structure stated in **Question 3** is supported by **pile foundation**. The capacity of 600 mm diameter bore pile could be considered with the maximum value of 1200 kN. Thickness of the pile cap is required to be minimal in design considering all possible options (strength of concrete, number of piles, dimension of column, flexural and punching shear) in accordance to BNBC 2020. High strength concrete (minimum is 35 MPa) has to be used to minimize the thickness of pile cap. Assume that the strength of concrete has been changed as $0.9f_c'$ rather than $0.85f_c'$ in stress block of code. Formulate the required design equations. **Propose** a solution to **design the pile cap** with the **minimum thickness**. Assume required data to design the pile cap. [20]

APPENDIX

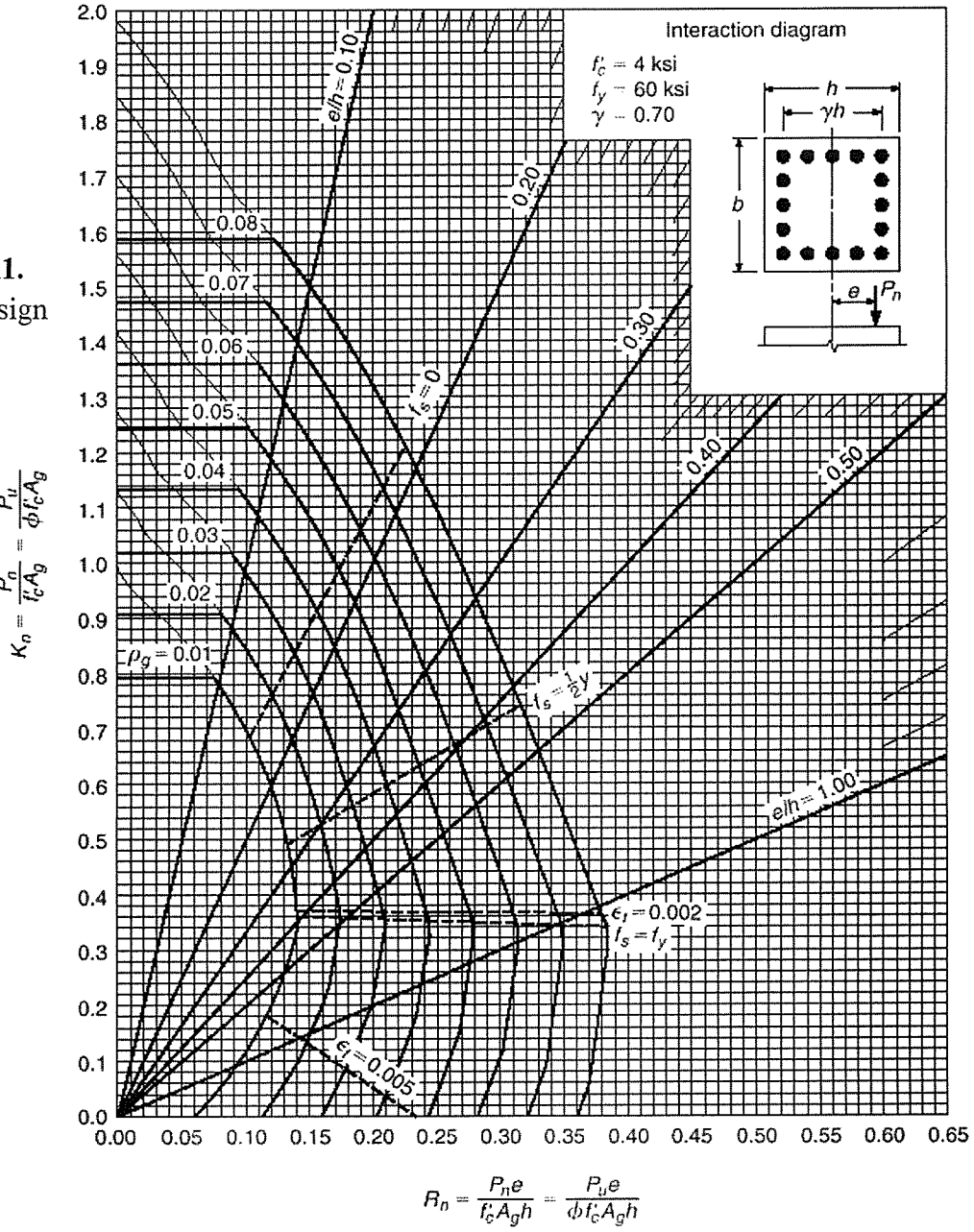


Figure A1. Column design chart.

Table 6.6.3: Minimum Thickness of Slabs without Interior Beams*

f_y, MPa†	Without drop panels‡		
	Exterior panels		Interior panels
	Without edge beams	With edge beams§	
280	$l_n/33$	$l_n/36$	$l_n/36$
420	$l_n/30$	$l_n/33$	$l_n/33$
520	$l_n/28$	$l_n/31$	$l_n/31$

In an interior span, total static moment,

Negative factored moment: 0.65

Positive factored moment: 0.35

$$\beta_1 = 0.85 - 0.007143(f'_c - 28) \; and \; 0.65 \leq \beta_1 \leq 0.85$$

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B. Sc. Engineering (Civil)
3rd Year 2nd Semester

Course Title: Environmental Engineering II | Course Code: CE 333
Time: 3.00 Hours | Credit Hour: 3.00 | Full Mark: 120

There are five (5) questions. Answer all the questions in both sections. Assume any missing data. (Necessary formulae are attached; Assume reasonable data if necessary)

Section A

QUESTION 1 [24 MARKS]

a) On a shifting river-island (char) in the Jamuna delta, homesteads sit on low earthen plinths that flood inundates several times each monsoon and are scoured by cyclone backwash every 2–3 years. Many households still use pit latrines built from brick rings that crack under flood loading; during surges, pits overflow into drainage khals that feed fishponds. Groundwater from shallow tubewells is arsenic-prone, so families rely on rainwater jars and a community pond—both easily contaminated when pits fail. After the last flood, the primary school and cyclone shelter reported diarrhea clusters and fly nuisance around latrines. Electricity there is intermittent; LPG prices have spiked. The Union Parishad has raised a 1,200 m² plot beside the bazar above the 1-in-20-year flood level to host a small FSM hub. The council seeks a flood-resilient on-site sanitation option and an FSM chain that prevents contamination and produces biogas for a women-run community kitchen serving the school midday meal and the cyclone shelter during emergencies. **[5+5]**

Select adequate on-site sanitation system integrated with Fecal Sludge Management for the community that can overcome the problems associated with pit latrines, and explain the FSM flow from the household to biogas use.

b) Discuss the treatment process of anaerobic baffled reactor (ABR) using a neat sketch. **[14]**

QUESTION 2 [21 MARKS]

a) Describe the nutrients removal mechanism in a waste stabilization pond. **[9]**

b) Explain the treatment process of constructed wetlands for textile wastewater treatment using engineering diagram. **[12]**

QUESTION 3 [15 MARKS] **[15]**

Design the size of the required anaerobic digester for treating sludge with the following properties:

Parameter	Value
Average design flow	4500 m^3/d
Dry solids removed	0.20 kg/m^3
Ultimate BOD removed	0.18 kg/m^3
Solids content	6%
θc	25 d
Y	0.05 kg/kg BOD
kd	0.04 d^{-1}
Solid specific gravity	1.02
Waste utilization efficiency	80%

Also, determine the volume of total gas produced from the anaerobic digester.

Section B

QUESTION 4 [30 MARKS]

a) Calculate the volume of the aeration tank of a high-purity oxygen activated sludge system for municipal wastewater treatment employing the following data set, and check with design parameters. Also, calculate the expected effluent BOD_5 concentration of the system. **[15]**

Parameter	Value
Design average flow, Q	5000 m^3/d
Influent BOD	200 mg/L
Influent TSS	120 mg/L
F/M	0.6 lb BOD applied/lb MLVSS.d
MLSS	8000 mg/L
VSS/TSS	0.7
Maximum volumetric BOD load	4 $kg/(m^3.d)$
Minimum aeration time	2h
Minimum cell residence time	4d
K_S	60 mg/L of BOD
k_d	0.06/d
Y	0.6VSS/mg BOD
k	$6d^{-1}$

Required formula: $F/M = \frac{S_0}{\theta X} = \frac{QS_0}{VX}$ $\theta_c = \frac{VX}{QX_i}$ $S = \frac{K_s(1+\theta_c k_d)}{\theta_c(Yk - k_d) - 1}$

b) Describe the operational mechanisms of the RBC system. **[10]**

c) Summarize the basic differences between CSTR and plug flow reactors. **[5]**

QUESTION 5 [30 MARKS]

a) Demonstrate the necessity of adding an external carbon source for achieving complete nitrogen removal in three sludge treatment systems. **[10]**

b) You have been assigned to propose wastewater treatment plants for a food processing industry. The pollutant concentration parameters of the wastewater produced by the industry are:

Table. Pollutant concentration of the wastewater.

	Unit	Concentration
pH	---	6.0
DO		0.8
NH_4-N		100
NO_3-N	mg/L	20
TN		190
BOD_5		5000
COD		12000
TP		6

(i) Design a natural treatment-based system to remove the above pollutant. **[7.5]**

(ii) Due to increased manufacturing capacity, the BOD_5 concentration of the food processing effluent increased to 7000 mg/L, and the COD concentration increased to 16000 mg/L. You are required to install additional treatment units with the existing system that you proposed in **Q (i)**. Produce a new flow diagram of the treatment systems. *Land shortage is a restraining factor to consider when proposing the new flow diagram.* **[7.5]**

(iii) Justify how you will address infrequent pH fluctuations in food processing wastewater; the lowest pH could be 4.0, and the highest pH could be 12.0. **[5]**

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
3rd Year 2nd Semester

Course Title: Transportation Engineering I | Course Code: CE 351
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 120

(Answer all the questions)

PART A

QUESTION 1 [20 MARKS]

a. A vertical curve has the following data:
- Design speed = 55 mph
- Stopping sight distance = 495 ft
- Back tangent grade = +4%
- Forward tangent grade = -6%

Assuming the standard eye and object height criteria and that the sight distance is less than the length of curve, calculate the minimum length of vertical curve. Use the following equation. [5]
[CO2/PO1/C3]

$$L = \frac{AS^2}{100(\sqrt{2h_1} + \sqrt{2h_2})^2}$$

b. A four-lane undivided highway has 12-ft lanes and a design speed of 50 mph. A tall building is located along the inside of the highway curve. The curve centerline radius is 700 ft. Determine the minimum lateral offset distance from the edge of the inside travel lane to the building needed for adequate stopping sight distance. Use the following equations. [15]
[CO2/PO1/C3]

$$SSD = Vt + \frac{V^2}{2g(f \pm G)}$$

$$\text{HSO} = R\left(1 - \cos\frac{28.65S}{R}\right)$$

QUESTION 2 [20 MARKS]

The Bijoy Sarani Intersection is to be operated as a two-phase signalized intersection. For one approach, the following data were collected during a field survey.

Signal cycle: Green= 27 sec, Amber= 3 sec, Red= 25 sec

The number of vehicles passing through the intersection were recorded for three consecutive signal cycles which is provided in Table 1. [PCU factors for Car and Heavy Vehicles (Bus/Truck) are 1 and 2 respectively]

i) Calculate average PCU for each interval and draw the saturation flow diagram.
ii) Calculate initial and final lost times.
iii) Determine the saturation flow and approach capacity of the intersection. [10+4+6]
[CO2/PO1/C3]

Table 1: Vehicle Count from Traffic Survey

No of vehicles per 8 seconds interval		Cycles		
		1	2	3
0-6 sec	Car	4	3	3
	Heavy Vehicles	1	0	3
6-12 sec	Car	7	8	0
	Heavy Vehicles	4	4	9
12-18 sec	Car	8	10	5
	Heavy Vehicles	5	2	5
18-24 sec	Car	6	7	8
	Heavy Vehicles	6	4	0
24-30 sec	Car	3	2	2
	Heavy Vehicles	2	1	3

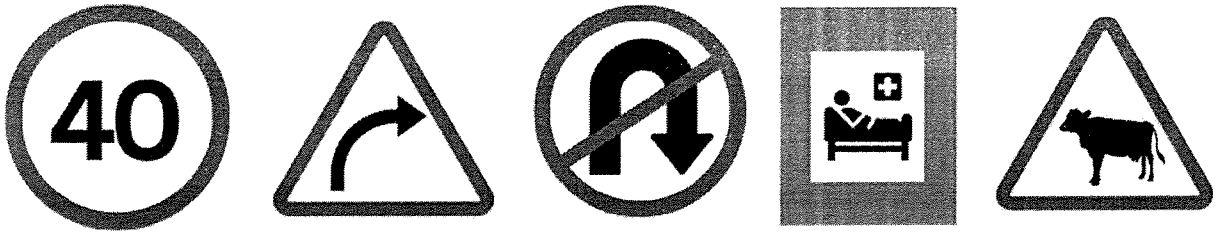
QUESTION 3 [20 MARKS]

a. Identify the local problems associated with road markings in the context of Bangladesh. [5]
[CO1/PO1/C2]

b. Define all-red period and discuss the conditions under which all-red period is needed to include in designing traffic signals. [5]
[CO1/PO1/C2]

c. You are driving from Dhaka to Chattogram on a busy national highway. Along the way, you encounter several traffic signs placed at different locations. Carefully observe the figures provided below and name each of the traffic sign along with stating its type (mandatory, cautionary or informatory). [10]
[CO1/PO1/C2]

1 2 3 4 5



QUESTION 4 [20 MARKS]

The Mirpur 10 Intersection is proposed to be converted into a two-phase signalized intersection, and the following data have been collected for analysis. Assume, any missing data. [10+6+4]
[CO2/PO1/C3]

	N-S	E-W
Inter-Green:	4 s	3 s
Lost Time:	3 s	2 s

	North	South	East	West
Flow, pcu/hr	700	450	800	650
Saturation flow, pcu/hr	2000	1900	2200	2100

i) Design the signal for the intersection, where the optimum cycle length can be calculated using the following equation: Co= [1.5L+5]/[1-Y]
ii) Draw the concerned bar diagram.
iii) Draw the phase diagram.

PART B

QUESTION 5 [15 MARKS]

a. Imagine you are analyzing an Origin-Destination (O-D) survey conducted within the Shahbag area, as outlined by the boundary on the map in Figure 1. Briefly discuss the different types of trips that originate in this area. Support your explanation with proper examples based on the map to clearly show each type of trip. [6]
[CO1/PO1/C2]

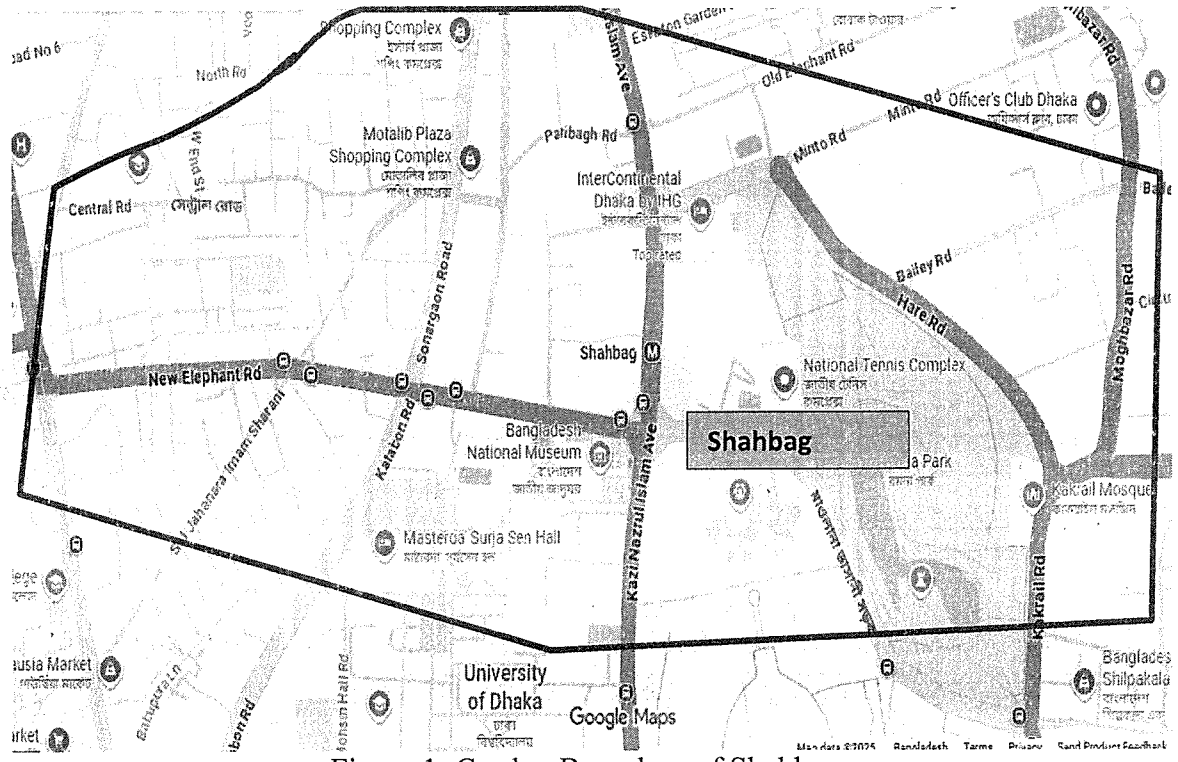


Figure 1: Cordon Boundary of Shahbag

b. Define (i) Contra flow, (ii) Tidal flow, (iii) Induced flow [6]
[CO1/PO1/C2]

c. Differentiate between the method of collecting time-mean speed and space-mean speed data. [3]
[CO1/PO1/C2]

QUESTION 6 [25 MARKS]

a. A traffic engineer requires vehicle volume data for geometric design purpose of a rural primary road. AADT for the concerned road is recorded as 20,500. He decided to carry out a hands-on survey on Saturday, January 2024. He went to the road at 8 AM, 2 PM and 7 PM and got vehicle volume data per hour of 450, 500 and 600 respectively. [5+5+3]
[CO2/PO1/C3]

i) Determine AWT for the survey Month.
ii) Determine ADT particularly for the survey day.
iii) Determine HEF for 7 PM.

b. A survey has been conducted on six vehicles traversing throughout a 20 km stretch of a road to calculate spot speed. Data are obtained as follows: [3+9]
[CO2/PO1/C3]

Vehicle No.	Travel Time (hr)	Spot Speed (kmph)	Cumulative Frequency
1	4	A	5
2	2	B	20
3	1.33	C	50
4	1	D	80
5	0.8	E	90
6	0.67	F	100

i) Determine time-mean speed.

ii) Determine design speed, median speed and safe speed for the road (use graph paper).

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
3rd Year 2nd Semester

Course Title: Engineering Hydrology | Course Code: CE 363
Time: 2 hour | Credit Hour: 2 | Full Marks: 100

Answer all the questions

QUESTION 1 [10 MARKS]

What methods are used to determine the average precipitation in a basin? Discuss the applicability and reliability of these methods. [10]

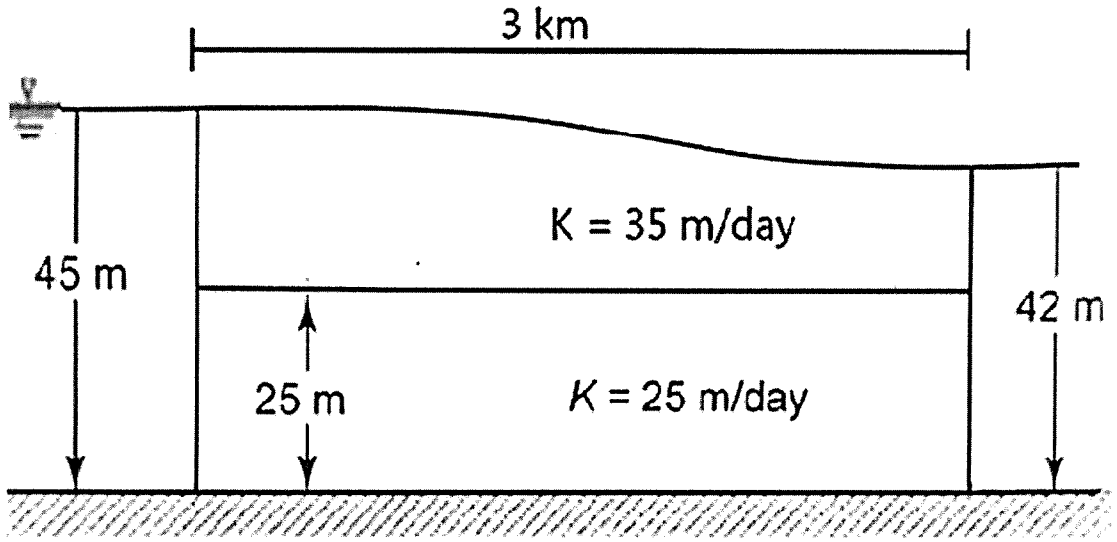
QUESTION 2 [15 MARKS]

Develop the equation of the Horton's Infiltration Model from the data given in the table below. [15]

Time (hour)	Rainfall intensity (in/hr)	Infiltration capacity (in/hr)
0	0	3
1	3	2.450513
2	5	2.03522
3	4	1.721349
4	5	1.48413
5	5.5	1.304843
6	6	1.169341
7	6.5	1.066931
8	7	0.989532
9	7.5	0.931034
10	8	0.886823
11	8.5	0.853408
12	9	0.828154
13	9.5	0.809068
14	10	0.794642
15	10.5	0.78374
16	11	0.7755
17	11.5	0.769273
18	12	0.764566
19	12.5	0.761009
20	9	0.75832
21	8	0.756288
22	8.5	0.754753
23	5	0.752715
24	4	0.752715

QUESTION 3 [15 MARKS]

Two streams are separated by an aquifer system (a confined aquifer underlies an unconfined aquifer) shown in the figure below. Determine the flow rate from one stream to another if the average width of the both aquifer is 10 km. [15]



QUESTION 4 [15 MARKS]

The ordinates of a 4-hour unit hydrograph for a basin are given in the following table. Find the 6-hour unit hydrograph by the S-Curve method. [15]

Time (hour)	Total Flow (m^3/s)
0	0
1	168
2	170
3	210
4	300
5	380
6	420
7	370
8	320
9	250
10	180
11	130
12	110
13	90
14	45
15	0

1`QUESTION 5 [15 MARKS]

Route the following hydrograph through a river reach for which K= 12.5 hours and x = 0.25. [15]
At the start of the inflow flood the outflow discharge is 12 m^3/s. Given that,

$$C_0 = \frac{-kx + \frac{1}{2}\Delta t}{\left(\frac{1}{2}\Delta t + k - kx\right)} \qquad C_1 = \frac{\left(kx + \frac{1}{2}\Delta t\right)}{\left(\frac{1}{2}\Delta t + k - kx\right)} \qquad C_2 = \frac{\left(k - kx - \frac{1}{2}\Delta t\right)}{\left(\frac{1}{2}\Delta t + k - kx\right)}$$

Time (hr)	0	6	12	18	24	30	36
Inflow (m^3/s)	12	20	50	60	55	45	35

QUESTION 6 [30 MARKS]

The annual maximum flood measured at a local valley for 24 years are given in the table below. [30]

Year	Max. Flood (cfs)	Year	Max. Flood (cfs)
2001	1000	2013	3000
2002	1200	2014	2500
2003	3200	2015	2200
2004	4100	2016	4000
2005	3900	2017	5000
2006	3000	2018	4400
2007	2400	2019	5800
2008	2000	2020	1000
2009	3200	2021	700
2010	2400	2022	2700
2011	4200	2023	3100
2012	2000	2024	6000

Plot the data using the Weibull plotting position formula. Based on the frequency curve and the mathematical equation estimate the 15-year annual maximum, the exceedance probability, and return period for an event of 3500 ft^3/s assuming (i) lognormal and (ii) normal distribution. The average of normally and lognormally distributed data are 3041.67 and 3.43 ft^3/s, respectively. The standard deviation of normally and lognormally distributed data are 1437.67 and 0.245 ft^3/s, respectively.

Based on the statistical analysis used in (i) and (ii), is it possible to investigate whether the data follows lognormal or normal distribution? If not what will you suggest to find a suitable distribution. Justify your suggestions. Use the frequency factor table (Table 11.6).

Table 11.6 Frequency Factor for Normal Distribution

Exceedance Probability	Return Period	*K*	Exceedance Probability	Return Period	*K*
0.0001	10,000	3.719	0.450	2.22	0.126
0.0005	2,000	3.291	0.500	2.00	0.000
0.001	1,000	3.090	0.550	1.82	−0.126
0.002	500	2.88	0.600	1.67	−0.253
0.003	333	2.76	0.650	1.54	−0.385
0.004	250	2.65	0.700	1.43	−0.524
0.005	200	2.576	0.750	1.33	−0.674
0.010	100	2.326	0.800	1.25	−0.842
0.025	40	1.960	0.850	1.18	−1.036
0.050	20	1.645	0.900	1.11	−1.282
0.100	10	1.282	0.950	1.053	−1.645
0.150	6.67	1.036	0.975	1.026	−1.960
0.200	5.00	0.842	0.990	1.010	−2.326
0.250	4.00	0.674	0.995	1.005	−2.576
0.300	3.33	0.524	0.999	1.001	−3.090
0.350	2.86	0.385	0.9995	1.0005	−3.291
0.400	2.50	0.253	0.9999	1.0001	−3.719

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2024
Program: B.Sc. in Civil Engineering
3rd Year 2nd Semester

Course Title: Engineering Hydrology **(Old)** Course Code: CE 363 **(Old)**
Time: 3 hours Credit Hour: 3 Full Marks: 100

Answer all the questions

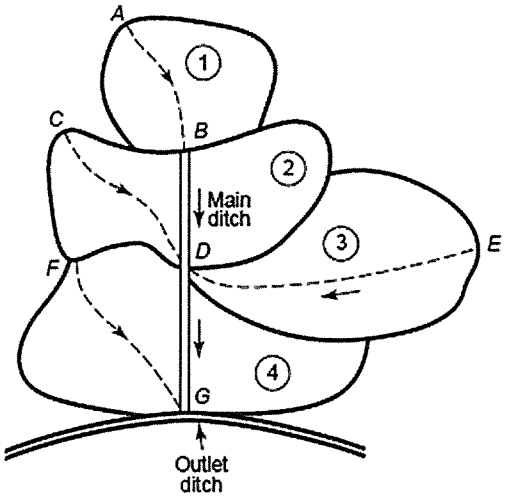
QUESTION 1 [20 MARKS]

a. What methods are used to determine the average precipitation in a basin? Discuss the applicability and reliability of these methods. [10]

b. Draw a schematic diagram of remote sensing process and discuss the remote sensing process briefly. [10]

QUESTION 2 [15 MARKS]

An urban watershed is shown below along with the travel paths from the most remote points in each subarea. The details of the subareas are given in the accompanied Table (Table 1). Use the provided Intensity-Duration-Frequency (IDF) curve with Kirpich formula to determine the 20-yr peak flow at the drainage outlet G. Kirpich formula for overland flow time, $t_i = 0.0078 \frac{L^{0.77}}{S^{0.385}}$ [15]



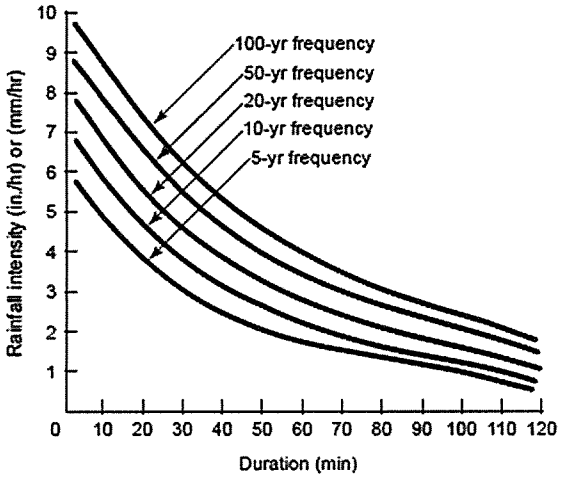


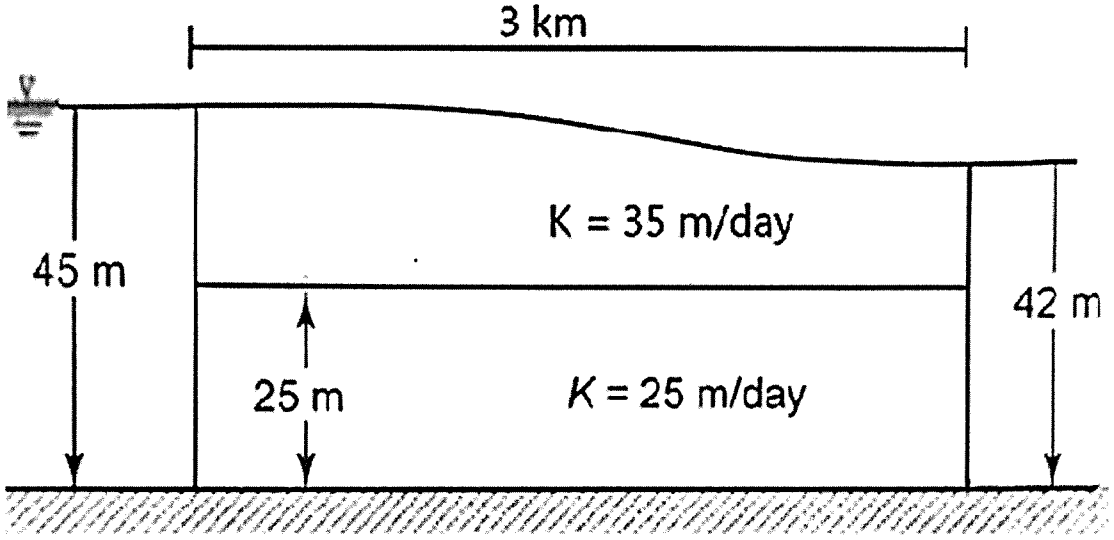
Table 1

Area	Drainage Area (acres)	Type of Surface	Path	Length (ft)	Slope (%)
1	12.0	Bare surface, $C = 0.4$	*AB*	1300	6.0
2	13.5	Asphalt paved, $C = 0.8$	*BD*	1250	1.5
			CD	1420	2.0
3	11.8	Lawn, $C = 0.3$	*ED*	1800	1.0
4	14.1	Concrete paved, $C = 0.9$	*DG*	1510	1.5
			FG	1660	2.5

QUESTION 3 [15 MARKS] CO2/PO1/C3

a. Prove that, Darcy's velocity is lower than the seepage velocity through the aquifer. [5]

b. Two streams are separated by an aquifer system shown in the figure below. Determine the flow rate from one stream to another if the average width of the aquifer is 10 km. [10]



QUESTION 4 [15 MARKS]

Determine the ordinates of unit hydrograph from the data given below for a site having drainage area 6550 km^2. [15]

Time (day)	Total Flow (m^3/s)	Baseflow (m^3/s)
1	168	168
2	170	170
3	210	175
4	300	180
5	380	170
6	420	160
7	510	150
8	580	140
9	420	130
10	370	120
11	320	110
12	250	100
13	180	95
14	90	90

QUESTION 5 [10 MARKS] CO3/PO2/C3

Route the following hydrograph through a river reach for which K= 12.5 hours and x = 0.25. At the start of the inflow flood the outflow discharge is 12 m^3/s. Given that [10]

$$C_0 = \frac{-kx + \frac{1}{2}\Delta t}{\left(\frac{1}{2}\Delta t + k - kx\right)} \qquad C_1 = \frac{\left(kx + \frac{1}{2}\Delta t\right)}{\left(\frac{1}{2}\Delta t + k - kx\right)} \qquad C_2 = \frac{\left(k - kx - \frac{1}{2}\Delta t\right)}{\left(\frac{1}{2}\Delta t + k - kx\right)}$$

Time (hr)	0	6	12	18	24	30	36
Inflow (m^3/s)	12	20	50	60	55	45	35

QUESTION 6 [25 MARKS]

The annual maximum flood measured at a local valley for 24 years are given in the table below. [25]

No.	Max. Flood (cfs)	No.	Max. Flood (cfs)
2001	1000	2013	3000
2002	1200	2014	2500
2003	3200	2015	2200
2004	4100	2016	4000
2005	3900	2017	5000
2006	3000	2018	4400
2007	2400	2019	5800
2008	2000	2020	1000
2009	3200	2021	700
2010	2400	2022	2700
2011	4200	2023	3100
2012	2000	2024	6000

Plot the data using the Weibull plotting position formula. Based on the frequency curve and the mathematical equation estimate the 10-year annual maximum, the exceedance probability, and return period for an event of 3000 ft^3/s using (i) lognormal and (ii) normal distribution. The standard deviation of normally and lognormally distributed data are 1437.67 and 0.25 ft^3/s, respectively.

Based on the statistical analysis used in (i) and (ii), is it possible to investigate whether the data follows lognormal or normal distribution? If not what will you suggest to find a suitable distribution. Justify your suggestions. Use the frequency factor table (Table 11.6).

Table 11.6 Frequency Factor for Normal Distribution

Exceedance Probability	Return Period	K	Exceedance Probability	Return Period	K
0.0001	10,000	3.719	0.450	2.22	0.126
0.0005	2,000	3.291	0.500	2.00	0.000
0.001	1,000	3.090	0.550	1.82	−0.126
0.002	500	2.88	0.600	1.67	−0.253
0.003	333	2.76	0.650	1.54	−0.385
0.004	250	2.65	0.700	1.43	−0.524
0.005	200	2.576	0.750	1.33	−0.674
0.010	100	2.326	0.800	1.25	−0.842
0.025	40	1.960	0.850	1.18	−1.036
0.050	20	1.645	0.900	1.11	−1.282
0.100	10	1.282	0.950	1.053	−1.645
0.150	6.67	1.036	0.975	1.026	−1.960
0.200	5.00	0.842	0.990	1.010	−2.326
0.250	4.00	0.674	0.995	1.005	−2.576
0.300	3.33	0.524	0.999	1.001	−3.090
0.350	2.86	0.385	0.9995	1.0005	−3.291
0.400	2.50	0.253	0.9999	1.0001	−3.719