

3-2

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

Course Title: Design of Concrete Structures II
 Time: 3 hours

Credit Hour: 3.00

Course Code: CE 317
 Full Marks: 100

Answer all the questions

QUESTION 1 [20 MARKS]

- a. A 5-storeyed warehouse building is constructed with **flat slab** as shown in **Figure 1**; live load of the warehouse is 6 kN/m^2 . Thickness of the slab could be considered as 250 mm . The concrete strength (f_c') is 25 N/mm^2 . Positive and negative moment coefficients of the panel are 0.35 and 0.65 , respectively. Design the **Slab S2** for **long span** only. [14]

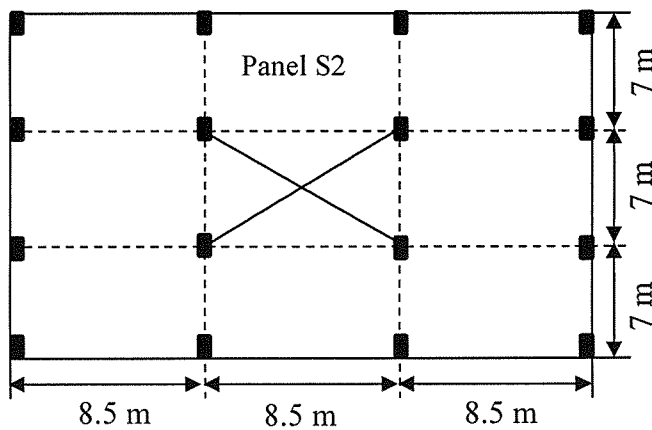


Figure 1. Flat slab floor plan

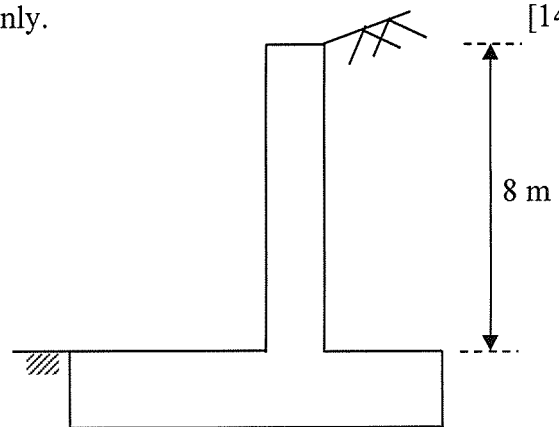


Figure 2. Retaining wall

- b. Eccentric curved tendon is the economical choice for post-tensioning prestressing system, justify through comparative analysis of a concrete girder. The girder could be assumed as 12 m span with simply supported condition having cross section of $1000 \text{ mm} \times 300 \text{ mm}$. The girder is subjected to uniformly distributed dead load (including self weight) of 30 kN/m and live load of 12 kN/m . Eccentricity of the tendon (at mid-span of beam) is 250 mm from bottom of the girder. [6 Marks]

QUESTION 2 [20 MARKS]

- a. A multi-storeyed building is supported with bore pile foundation. The capacity of 600 mm diameter bore pile is 1000 kN . The foundation is subjected to 2400 kN dead load and 600 kN live load from column. Thickness of the pile cap could be considered as 900 mm . Design the pile cap considering safety and environmental issues of BNBC 2020. Concrete strength (f_c') is 25 N/mm^2 . [14 Marks]
- b. Design the cantilever retaining wall of a river bank of hilly area as shown in **Figure 2**. Density of soil beside the wall is 1700 kg/m^3 , active soil pressure coefficient is 0.5 , soil is saturated with water (void ratio of the soil is 30%). Concrete strength (f_c') could be used as 25 N/mm^2 . Thickness of the wall could be assumed as 1000 mm . [6 Marks]

QUESTION 3 [20 MARKS]

The floor plan of an 8-storeyed RC frame structure of a residential building is shown in **Figure 3**. Slabs of the floor is supported by beams (300 mm x 600 mm). Design the short span of slab panel "S1" with the minimum thickness considering safety and environmental issues of BNBC 2020. Required data has to be assumed in design. Shear force co-efficient is 0.5.

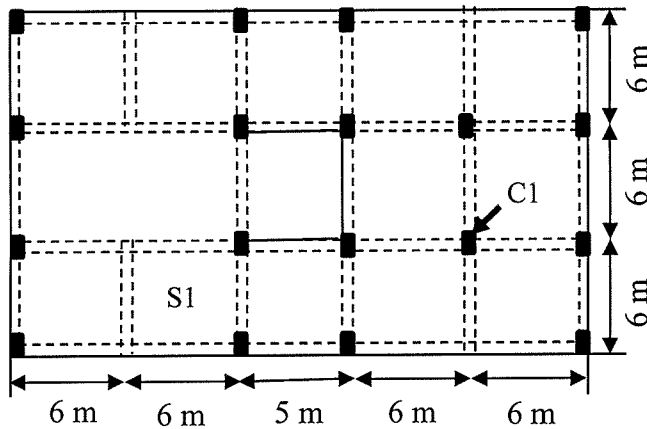


Figure 3. Floor plan of 8 storeyed apartment

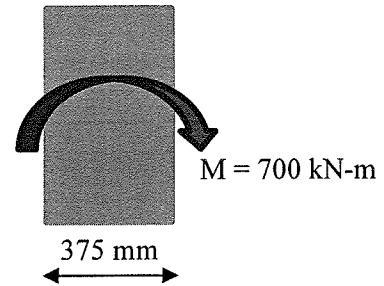


Figure 4. Column

QUESTION 4 [20 MARKS]

The **ground floor column of C1** as shown in **Figure 3** of **Question 3** has to be designed as tie column. The column is subjected to 700 kN-m moment at critical axis due to lateral load. As per the requirement of Architect, the maximum width of the column is 375 mm (**Figure 4**). Design the column as rectangular tie column, considering safety, environment and societal requirements. Dimension and reinforcement of the column are required to be minimized as much as possible in accordance to the provisions of BNBC 2020. The strength of concrete could be used as 40 N/mm² to minimize the dimension of column.

QUESTION 5 [20 MARKS]

The column "C1" of the project (**Question 3**) is supported by isolated **pad footing**. Bearing capacity of the soil under the foundation is 200 kN/m². The strength of concrete could be used as 40 N/mm² to minimize depth of footing. Based on the first principle approach, formulate the required design equations for flexure and shear. The depth of footing is required to be minimized as much as possible with the steel ratio within the range of 0.0025 to 0.004 considering flexural and punching requirements in accordance to safety and environmental issues of BNBC 2020. Dimension of column could be assumed based on the design of Question 4.

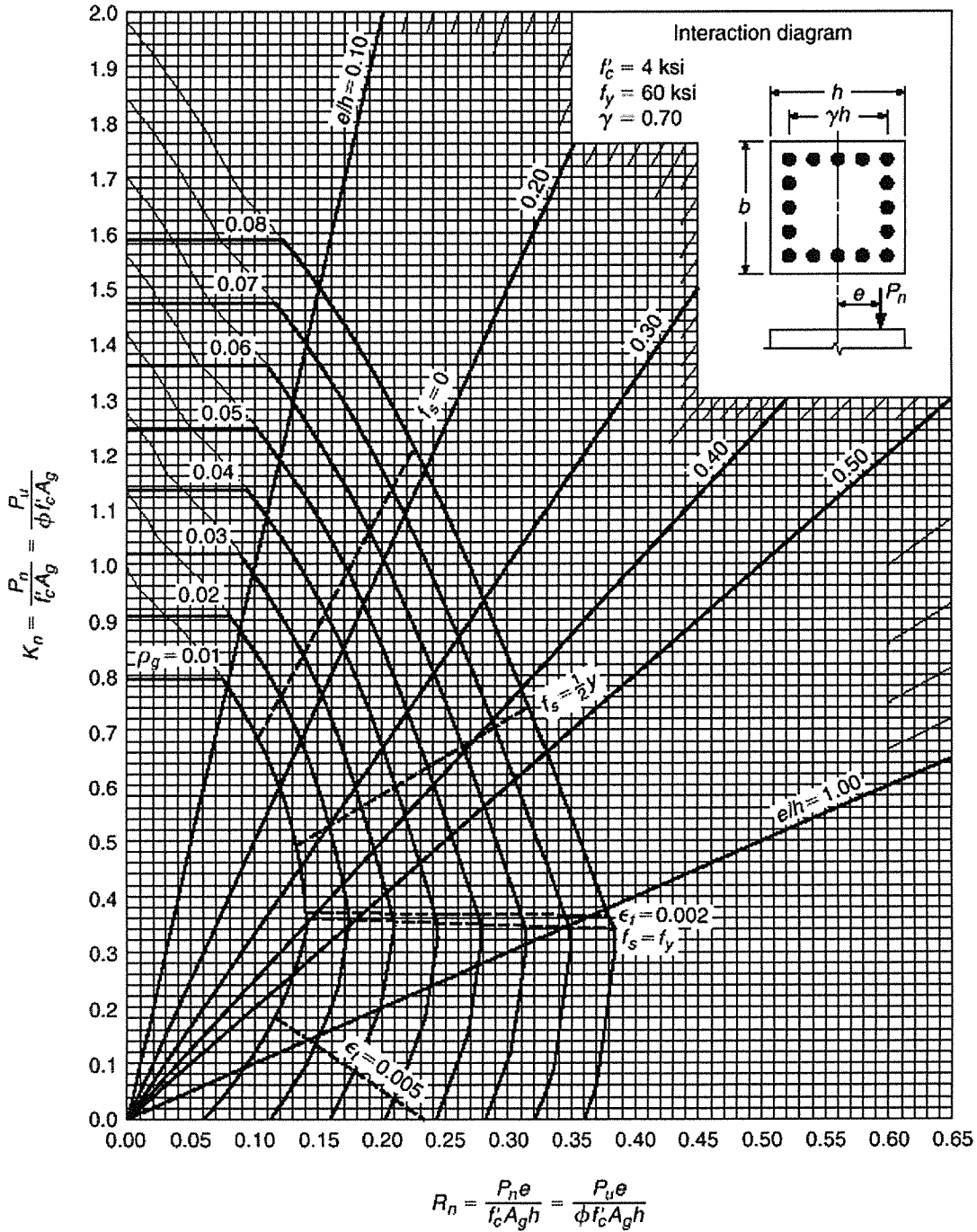
$$\beta_1 = 0.85 - 0.007143(f'_c - 28)$$

APPENDIX

Direct Design Method:

Minimum thickness of Flat Slab

Exterior Panels without Edge Beams	Exterior Panels with Edge Beams	Interior Panels
$L_n/33$	$L_n/36$	$L_n/36$



6.2.5.3.3 The minimum thickness, h for slabs with beams spanning between the supports on all sides, shall be as follows:

- (a) For α_{fm} equal to or less than 0.2, the provisions of Sec 6.2.5.3.2 shall apply;
- (b) For α_{fm} greater than 0.2 but not greater than 2.0, h shall not be less than

$$h = \frac{l_n \left(0.8 + \frac{f_y}{1400}\right)}{36 + 5\beta(\alpha_{fm} - 0.2)} \geq 125 \text{ mm} \quad (6.6.5)$$

- (c) For α_{fm} greater than 2.0, h shall not be less than

$$h = \frac{l_n \left(0.8 + \frac{f_y}{1400}\right)}{36 + 9\beta} \geq 90 \text{ mm} \quad (6.6.6)$$

Table 6.6.8: Coefficients for Negative Moments in Slabs †

$$M_{a,neg} = C_{a,neg} w l_a^2$$

$$M_{b,neg} = C_{b,neg} w l_b^2$$

Where, w = total uniform dead plus live load per unit area

Span Ratio, $m = \frac{l_a}{l_b}$	Moment Coefficient	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,neg}$		0.045		0.050	0.075	0.071		0.033	0.061
	$C_{b,neg}$		0.045	0.076	0.050			0.071	0.061	0.033
0.75	$C_{a,neg}$		0.069		0.076	0.085	0.088		0.061	0.078
	$C_{b,neg}$		0.022	0.056	0.024			0.044	0.036	0.014

Table 6.6.9: Coefficients for Dead Load Positive Moments in Slabs †

Span Ratio $m = \frac{l_a}{l_b}$	Moment Coefficient	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,dl}$	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	$C_{b,dl}$	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.75	$C_{a,dl}$	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	$C_{b,dl}$	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007

Table 6.6.10: Coefficients for Live Load Positive Moments in Slabs †

1.00	$C_{a,ll}$	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	$C_{b,ll}$	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.75	$C_{a,ll}$	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	$C_{b,ll}$	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013

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
 Time: 3 hour

Credit Hour: 3

Course Code: CE 363
 Full Marks: 100

Answer all the questions

QUESTION 1 [20 MARKS]

- a. 'Among the components of hydrologic cycle, EVAPORATION is the most difficult parameter to estimate. However, in some areas it is the most important parameter to estimate' Do you agree? Justify your statement. [10]
- b. Draw a schematic diagram of remote sensing process and discuss the remote sensing process briefly. [10]

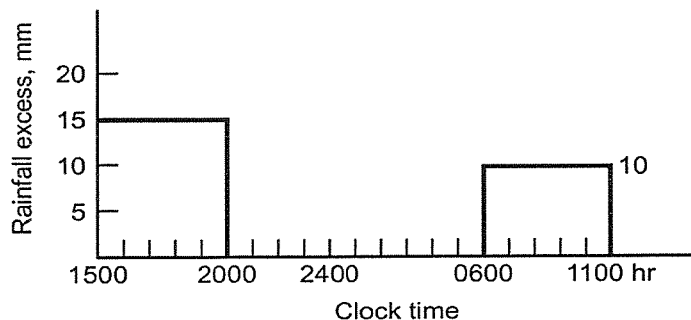
QUESTION 2 [20 MARKS]

- a. The baseflow in a stream and 5-hr unit hydrograph for the basin are given in the table below. [12]

Time (hr)	Unit Hydrograph (m ³ /s)	Baseflow (m ³ /s)
15:00	0	8
20:00	4.7	8.5
01:00	8.5	9
06:00	7.5	9.5
11:00	5.8	10
04:00	4.2	10
09:00	3.5	10
14:00	2.1	10
19:00	0.9	10
24:00	0	10

Same baseflow continues

Determine the total flow hydrograph for the rainfall pattern given below.



b. Fill up the table given below using rational method.

[8]

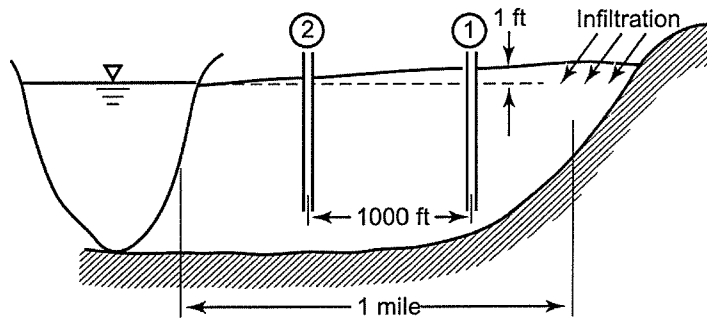
Inlet	Contributing Area	Area, A (acres)	C	Route	Travel Time (min)		Intensity (in/hr)	Max Q (cfs)
					Inlet	In Sewer		
1	X	5	0.25	X→1	15	0		
	Y	3	0.2	Y→1	12	0		
2	X	5	0.3	X→1→2	10	3		
	Y	3	0.35	Y→1→2	11	3		
	Z	4	0.25	Z→2	15	0		

Rainfall intensity(in/hr) is given as $i = 40/(t+7)$, where t is in minutes.

QUESTION 3 [10 MARKS]

Flow in a valley takes place as shown in the figure below.

[10]



The formation in the valley has a hydraulic conductivity of 400 ft/day and a porosity of 0.25. The difference in the water levels in the two wells shown is 1 foot. The average depth of the aquifer is 100 feet.

- (i) Determine the flow per mile width of the aquifer.
- (ii) How long will it take the groundwater to travel from the head of the valley to the stream (1 mile)?

QUESTION 4 [15 MARKS]

Determine the ordinates of unit hydrograph from the data given below for a site having drainage area 6550 km². [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]

- a. Define flow routing. What happens when hydrograph travels downstream? [5]
b. What are the factors affecting infiltration? [5]

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)
1	1200	13	3000
2	1500	14	2500
3	3200	15	2200
4	4100	16	4000
5	3800	17	5000
6	3000	18	4400
7	2500	19	5200
8	2000	20	1000
9	3200	21	650
10	2400	22	2700
11	4200	23	3300
12	2000	24	7200

Plot the data using the Weibull plotting position formula. Based on the frequency curve and the mathematical equation estimate the 10-year annual maximum and the exceedance probability and return period for an event of 3000 ft³/s using (i) lognormal and (ii) normal distribution. The standard deviation of normally and lognormally distributed data are 1493.34 and 0.24 ft³/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

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Final Examination, Fall 2024
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 [10 MARKS]

[5+5]

In a rural area where families have long relied on traditional pit latrines due to limited sanitation infrastructure, recent years have seen a concerning rise in waterborne diseases among children. Contamination of local water sources—often caused by poorly maintained latrines and seasonal flooding—has made clean water scarce, putting children at higher risk and raising serious public health concerns.

Select an on-site sanitation system for the community that can overcome the problems associated with pit latrines, and explain how human waste generated from your proposed sanitation system can be converted into energy.

QUESTION 2 [35 MARKS]

- a) Explain how a septic tank brings a change in the SBS in terms of sewer network and treatment plant design. [14]
- b) Discuss how nutrients are removed in waste stabilization ponds and highlight the challenges related to phosphorus removal in these systems. [9]
- c) Explain the process of treatment of tannery effluent with a flow diagram. [12]

QUESTION 3 [15 MARKS]

[15]

Wastewater flow from an area averages 6500 m³/d during November (winter) and 8500 m³/d during June (summer). The average temperature of November is 10°C, and in June (summer), the average temperature is 35°C. The mean concentration of influent BOD is 300mg/L. Reaction coefficient K is 0.25 d⁻¹ at 20°C, and θ is 1.06. Design a facultative pond treatment system for the area to remove 90% of the incoming BOD. Use the following graphical plot of the Thirumurthi equation shown in **Figure 1** if required.

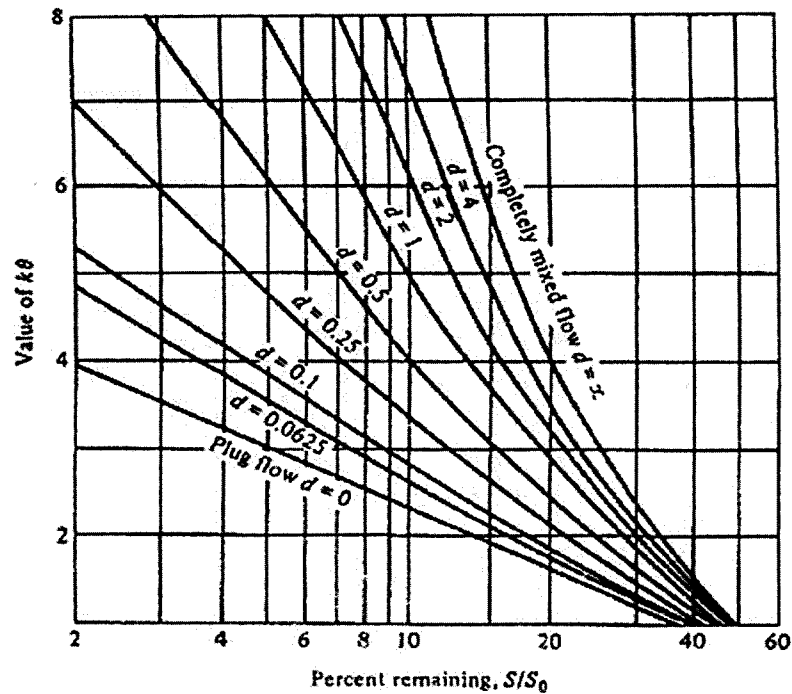


Figure 1: Graphical plot of the Thirumurthi equation.

Section B

QUESTION 4 [30 MARKS]

a) The domestic wastewater generated from a community is discharged to open water bodies without any treatment. Due to severe quality degradation of such water bodies, the local authority has proposed a combination of primary and secondary treatment processes for domestic wastewater treatment. The authority has selected trickling filters as a secondary treatment process. Under such circumstances: [15]

Select two-stage trickling filters (for the community) using the NRC formula from the following dataset:

- Water temperature= 30°C
- Incoming wastewater= 4000 m³/d
- Influent BOD₅=100 mg/L
- Estimated effluent BOD₅=30 mg/L
- Depth of each filter=2 m
- Recirculation for filter 1 and 2 ($r_1=r_2$)=1.5
- Assume both filters will have equal BOD₅ removal efficacy

Use the following equations if required:

$$E_1 + E_2(1 - E_1) = E \quad F = \frac{1+r}{(1+0.1r)^2} \quad E_1 = \frac{100}{1+0.532\sqrt{\frac{W}{VF}}} \quad E_2 = \frac{100}{1+\frac{0.532}{1-E_1}\sqrt{\frac{W'}{VF}}}$$

- b) Explain the operational mechanisms of the sequential batch reactors (SBR) for removing wastewater pollutants. [10]
- c) Describe the function of the aeration tank in an activated sludge process. [5]

QUESTION 5 [30 MARKS]

- a) Explain the main differences between pre-precipitation and simultaneous precipitation-based phosphorus removal processes. [10]
- b) You have been assigned to propose wastewater treatment plants for a food processing and tannery industry. The wastewater produced by the food industry will be treated naturally. The effluent from the tannery industry will be treated by a combination of activated sludge and natural processes. The chemical properties of the wastewater produced from these industries are summarized below:

Table. Pollutant concentration of the wastewater produced from the two industries.

		Food processing	Tannery
	Unit	Concentration	
pH	---	5.1	10.1
DO		0.2	0.04
NH ₄ -N		100	250
NO ₃ -N	mg/L	55	300
TN		190	600
BOD ₅		3000	10000
COD		8000	25000
TP		4	10

- (i) Recommend a flow diagram of the natural treatment process to treat the effluent of the food processing industry. [7.5]
- (ii) Recommend a flow diagram of the combined process to treat the effluent of the tannery industry. [7.5]
- (iii) Justify how your proposed natural treatment system will encounter the occasional phosphorus concentration increase in the effluent of the food industry. [5]

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

Course Title: Principles of Management
Time: 2 hours

Credit Hour: 2.00

Course Code: IMG 301
Full Marks: 50

Instructions:

- (1) Answer any 5 questions*
- (2) Return the question paper along with your answer sheet*

QUESTION 1 [10 MARKS]

- a. Destiny Group in Bangladesh collapsed due to the lack of proper control and misuse of funds. Top officials ignored audits and BDT 4,200 crore was missing from their funds. Weak oversight led to investor losses and arrests. Operations were shut down. The case exposed the need for stricter corporate control in Bangladesh.
How do you think this situation could have been avoided if there was proper control? [8]
- b. Mention the elements of the organizational structure. [2]

QUESTION 2 [10 MARKS]

- a. In modern workplace, work-family life balance is considered as an extremely necessary element. Briefly describe the ways in which work-family life balance could be ensured with examples. [5]
- b. Differentiate between interpersonal and organizational communication. [5]

QUESTION 3 [10 MARKS]

- a. Describe the dimensions of Hersey and Blanchard's Situational Leadership theory in your own words. [5]
- b. Define group. Discuss the stages in group development with relevant example. [5]

QUESTION 4 [10 MARKS]

- a. Apple Inc. sells a range of tech products. The iPhone leads global sales in a fast-growing market and requires constant investment. The MacBook remains highly profitable, though it operates in a mature, slower-growing market. The newly launched Vision Pro headset targets a fast-growing segment but has limited sales so far. The iPod, once a hit, is now outdated with very low demand and minimal contribution.

Using the BCG Matrix, classify each of the following Apple products—iPhone, MacBook, Vision Pro, and iPod—into the appropriate category and justify your choices briefly. [5]

- b. Though MBO is preferred by many people, it also has many problems. Discuss about the disadvantages of MBO logically. [5]

QUESTION 5 [10 MARKS]

- a. At NovaTech, executives chose to continue the working with their flawed AI software, justifying it by the \$10 million already invested, while the leadership team unanimously agreed without challenging the risks to maintain unity. After the product failed, several managers claimed they had always had doubts about its success. Ironically, initial support had skyrocketed when the proposal was framed as having an “80% success rate” instead of highlighting its 20% failure risk. Identify the four decision-making errors in this scenario and justify your answer. [5]

- b. NovaTech invested \$10 million in developing a new AI software product. They also spent an additional \$2 million on marketing and launch. After the product failed in the market, the company only managed to recover \$3 million through minor licensing deals and asset sales.

Calculate NovaTech’s ROI (Return on investment) in this given scenario. [5]

QUESTION 6 [10 MARKS]

[2*5=10]

Shortly discuss any five of the following topics:

- a. Operational Planning:
- b. Benchmarking
- c. Transactional vs. transformational leadership
- d. Cognitive dissonance
- e. Machiavellianism
- f. Attitude vs. personality

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

Course Title: Structural Engineering II
 Time: 3 hours

Credit Hour: 3.0

Course Code: CE 313
 Full Marks: 100

ANSWER ALL QUESTIONS. Assume any missing data reasonably.

PART-A

QUESTION 1 [8 MARKS]

1. Calculate the vertical deflection at B of the frame shown in **Figure 1** by the Unit Load Method [EI= Constant] [8]

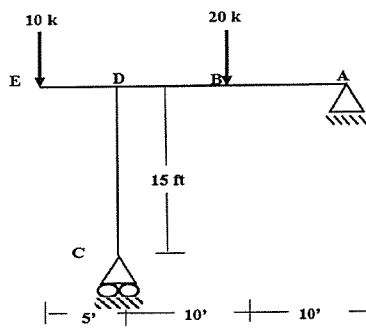


Figure 1

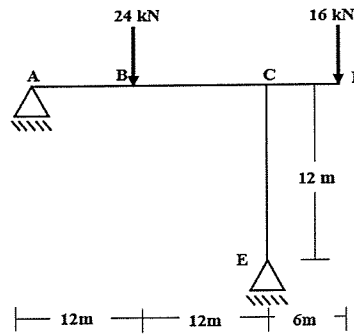


Figure 2

QUESTION 2 [16 MARKS]

2. Analyze the frame shown in **Figure 2** by Force Method and determine the support reactions. Consider the horizontal reaction at A or E as redundant. [EI=Constant] [16]

QUESTION 3 [14 MARKS]

3. Analyze the beam in **Figure 3** by Force Method [EI=Constant] and determine the reactions. Consider the vertical reaction at C as the redundant. Also note that $Q=64$ kN for even rolls and $Q=96$ kN for odd rolls. [14]

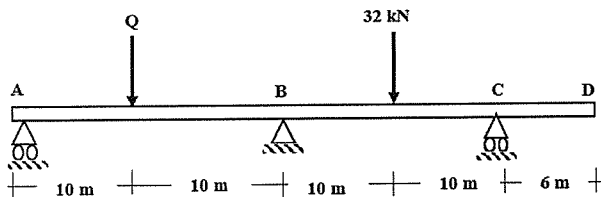


Figure 3

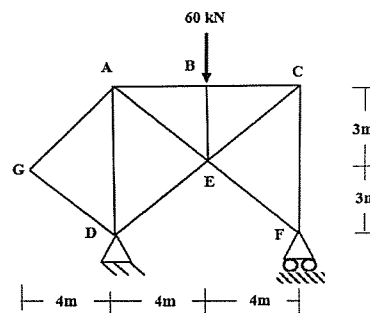


Figure 4

QUESTION 4 [12 MARKS]

4. Calculate the horizontal deflection at support F of the truss in **Figure 4** by the Unit Load Method [EA=Constant]. [12]

PART-B

QUESTION 5 [10 MARKS]

5. Analyze the frame shown in **Figure 5** by Cantilever Method to draw the Shear Force and Bending Moment diagrams. [10]

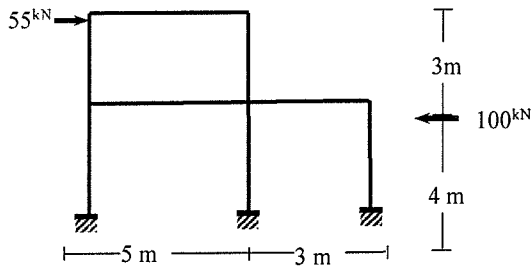


Figure 5

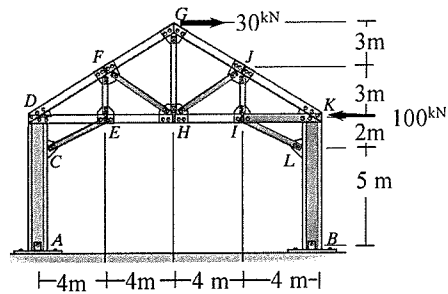


Figure 6

QUESTION 6 [05 MARKS]

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

QUESTION 7 [15 MARKS]

7.(i) Draw the qualitative influence lines of the beam shown in **Figure 7**,

- (a) Bending moments M_B , M_G , M_D
- (b) Support reactions R_D , R_B and
- (c) Shear forces $V_B^{(L)}$, $V_D^{(L)}$

[05]

(ii) Analyze the beam to calculate the maximum value of M_G , if the beam of **Figure 7** is subjected to a uniformly distributed dead load of 20 kN/m, moving live load of 30 kN/m and 150 kN concentrated load [Given: $EI = \text{Constant}$]. [10]

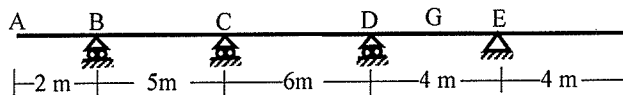


Figure 7

QUESTION 8 [15 MARKS]

8. Analyze the frame in **Figure 8** using Moment Distribution Method to draw the bending moment diagram [$EI = \text{Constant}$]. [15]

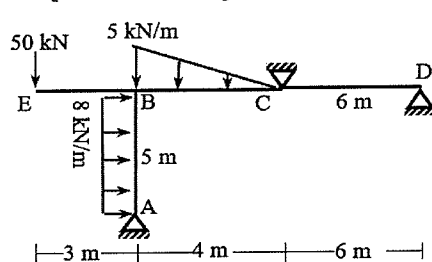


Figure 8

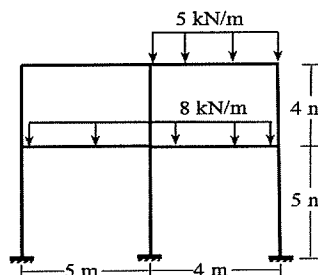


Figure 9

QUESTION 9 [5 MARKS]

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

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

Course Title: Transportation Engineering I
 Time: 3 hours

Credit Hour: 3.00

Course Code: CE 351
 Full Marks: 120

(Answer all the questions)

QUESTION 1 [25 MARKS]

- a. Explain the driver's reaction or PIEV time. Identify key issues related to pedestrian characteristics and propose effective solutions to address them. [5+5]
- b. Identify the local problems associated with traffic signals. Discuss the disadvantages of traffic signal focusing on rear-end collisions- at dilemma zones with an illustrative diagram. [5+10]

QUESTION 2 [20 MARKS]

The cycle length (C) to effective green time (g) ratio at a signalized intersection is 2.7. The number of vehicles passing through the intersection during three cycle's vehicles count per interval is provided in Table 1: [PCU factors for Car, Motor-Cycle and Auto-Riqshaw are 1, 0.3 and 0.5 respectively]

- i) Calculate avg PCU for each interval and draw the saturation flow diagram.
- ii) Calculate initial and final loss times.
- iii) Determine the saturation flow and approach capacity of the intersection. [10+4+6]

Table 1: Vehicle Count from Traffic Survey

No of vehicles per 8 seconds interval		Cycles		
		1	2	3
0-8 sec	Car	4	2	1
	Motor-Cycle	5	4	3
	Auto-Riqshaw	3	1	2
8-16 sec	Car	2	0	4
	Motor-Cycle	6	6	4
	Auto-Riqshaw	4	2	3
16-24 sec	Car	3	4	2
	Motor-Cycle	4	0	5
	Auto-Riqshaw	4	5	4
24-30 sec	Car	3	3	5
	Motor-Cycle	4	4	7
	Auto-Riqshaw	5	2	3
30-38 sec	Car	2	1	2
	Motor-Cycle	5	0	3
	Auto-Riqshaw	4	3	5

QUESTION 3 [20 MARKS]

- a. Illustrate with clear sketches, the placement of the traffic signals proposed by BRTA. Briefly outline the general requirements of traffic control devices. [5+5]
- b. Explain the implementation of a fixed-time controller to reduce traffic wait time, using a hypothetical time-distance diagram for a linked signal system. [10]

QUESTION 4 [15 MARKS]

The Panthapath intersection is to be converted into a two-phase signalized intersection for which the data are obtained as follows: [6+6+3]

		N-S	E-W	
Amber:	4 sec	Inter-Green:	9	7
Red-Amber:	3 sec	Lost Time:	2	3
	North	South	East	West
Flow, pcu/hr	720	690	875	610
Saturation flow, pcu/hr	2210	2380	2680	2028

- i) Design the signal for the intersection.
- ii) Draw the concerned bar diagram.
- iii) Draw the phase diagram.

QUESTION 5 [15 MARKS]

- a. Differentiate among the different methods of parking. [5]
- b. A survey has been conducted on eight vehicles traversing throughout a 50 km stretch of a road to calculate spot speed. Data are obtained as follows: [4+6]

Vehicle No.	Travel Time (hr)	Spot Speed (kmph)	Cumulative Frequency (%)
1	6	A	5
2	3	B	8
3	1.64	C	15
4	1.21	D	20
5	1.11	E	30
6	0.961	F	50
7	0.833	G	70
8	0.769	H	100

- i) Determine time-mean speed.
- ii) Determine design speed and safe speed for the road (use graph paper).

QUESTION 6 [25 MARKS]

- a. Discuss briefly about the traffic volumes accounted for daily basis. [6]
- b. Briefly explain (i) Contra flow, (ii) Tidal flow and (iii) Induced flow [6]
- c. A traffic engineer collected vehicle volume data on a rural primary road. He found 1500 vehicles for 7 AM to 8 AM on Thursday, December 2024. To get more appropriate estimation, he again took the volume data for 6 PM to 7 PM on the same day. Additionally, a data is known of AWT= 85,000 for the road. [3+4+6]
 - i) Determine ADT.
 - ii) Determine vehicle volume obtained for 6 PM to 7 PM.
 - iii) Determine AADT.