3-1

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Open Channel Flow | Course Code: CE 361
Time: 1 hour | Credit Hour: 3 | Full Marks: 40

Answer to all questions

1. a) State the most appropriate type of flow that can be considered (based on time and space criterion) for the following cases: 4

i) Flood flow in a river ii) Flow upstream of a hydraulic jump

iii) Overland flow iv) Flow behind a dam

b) What are the three basic equations to describe steady one-dimensional open channel flow? Consider small slope and no inflow/outflow. Also state the principles on which these equations are based. 4

2. In a wide channel, the velocity varies along a vertical as $u = 1 + z^2/h$, where h is the depth of flow and u is the velocity at a distance z from the channel bottom. Consider h = 2 m. 12

i) Compute the discharge per unit width
ii) Determine the state of low
iii) Compute the velocity distribution coefficients α and β.

3. A sharp-crested weir in a rectangular channel has a discharge 6 m^2/s per unit width. Depth of flow just upstream and downstream of the weir are 3.0 m and 2.0 m, respectively. Compute the energy loss due to the weir and force per unit width on the weir for submerged flow condition. Neglect external friction force F_f due to small distance. 8

4. a) Prove that the specific energy at the critical state of flow of a rectangular channel is 1.5 times the depth of flow. 3

b) For a trapezoidal channel with b = 7 m and s = 1.0, compute the critical depth and velocity of flow using Newton-Raphson method, if flow rate, Q = 15 m^3/s and $\alpha = 1.10$. Start trial depth of flow, h = 1.0 m. Consider the following: 9

$f(h) = A^3 - (\alpha Q^2 B)/g$
$f'(h) = 3A^2B - [(\alpha Q^2)/g](dB/dh)$

Appendix
Open Channel Flow

Given Formula (Symbols carry their usual meaning):

$$Re = \frac{UR}{\nu}$$

$$Fr = \frac{U}{\sqrt{gD}}$$

$$E = h + U^2/(2g)$$

$$f(h) = A^3 - (\alpha Q^2 B)/g$$

$$f'(h) = 3A^2B - [(\alpha Q^2)/g](dB/dh)$$

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Design of Concrete Structures I Course Code: CE 315 Credit: 3.0
Time: 1 hour Full Marks: 50

Answer all questions

Question 01: **[5+5=10]**

a. Explain with diagram how fundamental assumptions of reinforced concrete are applied to design of reinforced concrete beams.
b. Brielfy explain the reason why ACI recommends a maximum steel ratio (ρ_{max}) is less than the balanced steel ratio (ρ_b).

Question 02: **[20]**

Figure 1 shows a building plan with beam layout. Design the concrete cross section and the steel area equired for a simply supported rectangular beam (C2-D2) as shown in the Figure 1, that is to carry a computed dead load of 1.27 kips/ft and a service live load of 2.15 kips/ft. Material strengths are $f_c' = 4000$ psi and $f_y = 60{,}000$ psi.

Question 03: **[20]**

A simply supported beam (B1-C1, in Figure 1). has cross section as shown in Figure. 2. Analyze the section to determine the design moment capacity of the beam. For simplicity, assume $d = d_t$. Use $f'_c = 5000$ psi, and $f_y = 60000$ psi,

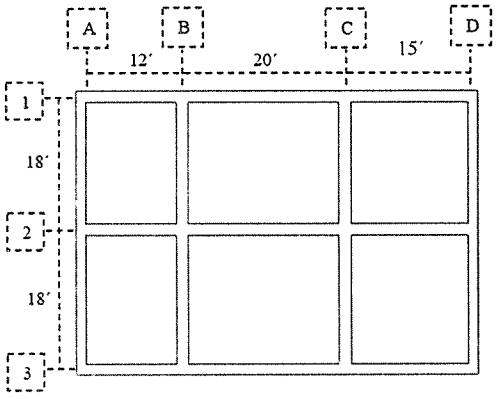


Figure 1: Beam layout

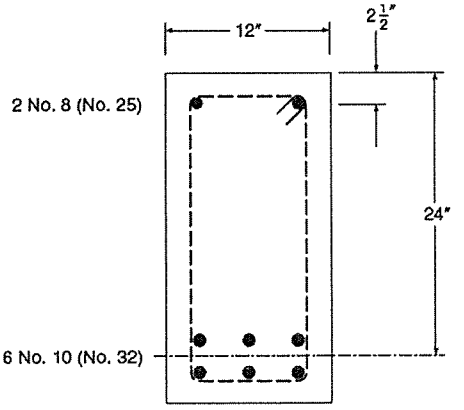


Figure 2: RC beam section

Formulae

$$\rho_{max} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + 0.004}$$

$$\rho_b = \alpha \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + \epsilon_y}$$

$$\overline{\rho}_{cy} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{d'}{d} \frac{\epsilon_u}{\epsilon_u - \epsilon_y} + \rho'$$

$$\rho_{0.005} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + \epsilon_t}$$

$$\varphi = 0.483 + 83.3\epsilon_t$$

$$c = \frac{\rho f_y d}{\alpha f_c'}$$

$$a = \frac{A_s f_y}{0.85 f_c' b}$$

$$a = \frac{(A_s - A_s')f_y}{0.85 f_c' b}$$

$$M_n = \rho f_y b d^2 \left(1 - 0.59 \frac{\rho f_y}{f_c'}\right)$$

$$M_n = A_s f_y \left(d - \frac{a}{2}\right)$$

$$A_s = \frac{M_u}{\phi f_y \left(d - \frac{a}{2}\right)}$$

$$M_n = M_{n1} + M_{n2} = A_s' f_y (d - d') + (A_s - A_s')f_y \left(d - \frac{a}{2}\right)$$

$$\rho_{min} = \frac{3\sqrt{f_c'}}{f_y} \geq \frac{200}{f_y}$$

$$A_{s,min} = \frac{3\sqrt{f_c'}}{f_y} bd \geq \frac{200bd}{f_y}$$

$$f_s' = \epsilon_u E_s \frac{c - d'}{c}$$

$$k = \frac{n}{n + r}$$

$$j = 1 - \frac{k}{3}$$

for $\phi = 0.90$ is

$$\overline{\rho}_{0.005} = \rho_{0.005} + \rho'$$

$$M = \left[\frac{f_c(kj)}{2}\right] bd^2$$

TABLE A.1
Designations, diameters, areas, and weights of standard bars

Bar No.				
Inch-Pound[a]	SI[b]	Diameter, in.	Cross-Sectional Area, in²	Nominal Weight, lb/ft
3	10	$\frac{3}{8}$ = 0.375	0.11	0.376
4	13	$\frac{4}{8}$ = 0.500	0.20	0.668
5	16	$\frac{5}{8}$ = 0.625	0.31	1.043
6	19	$\frac{6}{8}$ = 0.750	0.44	1.502
7	22	$\frac{7}{8}$ = 0.875	0.60	2.044
8	25	1 = 1.000	0.79	2.670
9	29	$1\frac{1}{8}$ = 1.128[c]	1.00	3.400
10	32	$1\frac{2}{8}$ = 1.270[c]	1.27	4.303
11	36	$1\frac{3}{8}$ = 1.410[c]	1.56	5.313
14	43	$1\frac{4}{8}$ = 1.693[c]	2.25	7.650
18	57	$2\frac{4}{8}$ = 2.257[c]	4.00	13.600

TABLE A.7
Maximum number of bars as a single layer in beam stems

$\frac{3}{4}$ in. Maximum Size Aggregate, No. 4 (No. 13) Stirrups[a]													
Bar No.		Beam Width b_w, in.											
Inch-Pound	SI	8	10	12	14	16	18	20	22	24	26	28	30
5	16	2	4	5	6	7	8	10	11	12	13	15	16
6	19	2	3	4	6	7	8	9	10	11	12	14	15
7	22	2	3	4	5	6	7	8	9	10	11	12	13
8	25	2	3	4	5	6	7	8	9	10	11	12	13
9	29	1	2	3	4	5	6	7	8	9	9	10	11
10	32	1	2	3	4	5	6	6	7	8	9	10	10
11	36	1	2	3	3	4	5	5	6	7	8	8	9
14	43	1	2	2	3	3	4	5	5	6	6	7	8
18	57	1	1	2	2	3	3	4	4	4	5	5	6

TABLE 4.1
Concrete stress block parameters

	f_c', psi				
	≤ 4000	5000	6000	7000	≥ 8000
α	0.72	0.68	0.64	0.60	0.56
β	0.425	0.400	0.375	0.350	0.325
$\beta_1 = 2\beta$	0.85	0.80	0.75	0.70	0.65
$\gamma = \alpha/\beta_1$	0.85	0.85	0.85	0.86	0.86

University of Asia Pacific
Department of Civil Engineering
Mid Term Examination (Spring 2024)
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering I (Water Supply Engineering) Course Code: CE 331
Time: 1 hour Credit Hours: 3.00 Full Marks: 60

(There are SIX questions. Answer all the questions. Assume reasonable data if any)

1. **a)** Indicate the chemical or chemicals (write the chemical formula with name) needed for each of the water treatment processes indicated below. Also, indicate the name of the precipitate if formed during the treatment process. **[12]**

Treatment	Chemical Added	Precipitate Formed
Coagulation-Flocculation		
Softening (Hardness Removal) If water only has temporary hardness $Ca(HCO_3)_2$, $Mg(HCO_3)_2$		
Softening (Hardness Removal) If water only has $MgSO_4$		

b) A **1,550 m^3/hour** drinking water plant needs rapid mix basins for chemical addition. If the detention time is 60 seconds and the volume of the tank cannot exceed 8 m^3, estimate how many tanks will be needed. Calculate the power in watts that needs to be supplied to **each tank** if the velocity gradient G is 80 sec^{-1}. Assume that the absolute viscosity of the water is 8.91×10^{-4} Pascals.second. [$t_d = V/Q$, $G = \sqrt{(P/\mu V)}$] **[8]**

c) Explain the contexts of using slow sand filters and rapid sand filters. Elaborate the pre-treatment option for slow sand filters. **[5]**

d) You are to provide a treatment solution for the Shitalakhhya River. Show in a flow diagram, which water treatment units would you propose to incorporate if the river water is composed of high suspended solids and turbidity? **[5]**

2. Consider that you have been appointed as an engineer in a locality and you must ensure adequate water supply to the people living there as soon as possible. The surface water sources are highly polluted by biological and chemical wastes and there are no fully operational treatment plants nearby. In this situation, which source of water will you plan to select? Justify your reasons. [5]

3. Briefly discuss a river/lake intake near an earth embankment with necessary figure. [5]

OR,

Briefly discuss a movable intake system with necessary figure.

4. Briefly discuss "Zone of Aeration" and "Zone of Saturation". [5]

OR,

Briefly discuss "Aquifer" and "Aquiclude".

5. A raw water quality data is as follows: [10]

Total alkalinity: 140 mg/L as $CaCO_3$
Calcium: 22 mg/L as Ca^{2+}
Total dissolved solids: 160 mg/L
Temperature: 30°C
pH: 6.7

Comment on the stability of water using Langelier Saturation Index.

6. A well of 18-inch diameter discharges 1250 gpm of water. It has a depth of 175 ft below the level of water table and the depth of water when is being pumped is 120 ft. The radius of drawdown is assumed to be 950 ft. Determine the coefficient of permeability of the soil. [5]

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Principles of Accounting | Course Code: ACN 301

Time: 1 hour | Credit Hour: 2 | Full Marks: 20

Submit your question inside your answer script

(5)

1. Answer any one of the followings:

a. What is accounting? Who are the users of accounting?

b. Define revenue recognition and matching principles of accounting.

(5+5= 10)

2. Mr. X started his own construction firm, X Developer, on July 1, 2022. The following transactions occurred during the month of July.

July 1: Mr. X invested TK 100,000 cash in the business.
2: Purchased some computers for TK 120,000 on note.
3: Paid TK 15,000 for office rent for the month.
5: Performed TK 40,000 of services on account.
15: Received a cash payment of TK 12,500 for services provided in July 5.

a. Show the effects of the previous transactions on the accounting equation using the following format.

Assets		=	**Liabilities** +	**Owner's equity**		
Cash +	Account Receivables +	Equipment =	Note Payable +	Owner's capital +	Revenue -	Expense

b. Prepare balance sheet based on transaction analysis.

(5)

3. Prepare the journal entries:

August 1: SOFT IT paid one-year insurance policy TK 12,000.
2: SOFT IT performed services of TK 50,000 to its clients.
8: SOFT IT provided employees' salaries of TK 60,000 on account.
9: Mr. Y withdraw TK 20,000 for personal use.
22: SOFT IT purchased supplies TK 2,000.

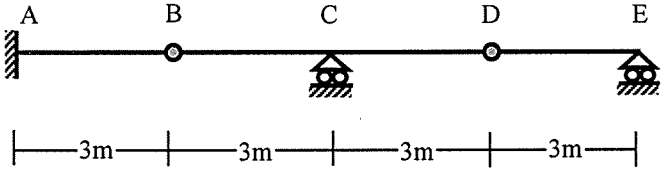
University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering I | Course Code: CE 311
Time: 1 hour | Credit Hour: 3.0 | Full Marks: 40

ANSWER ALL QUESTIONS.
Assume any missing data reasonably.

Part-A

1. Draw the influence lines for (i) R_E (ii) V_{CL} (iii) M_A of the beam shown in ***Fig.1*** **(ABCDE).** **[5]**



B and D are Internal Hinges

Fig.1

2. For the plate girder ABCD shown in **Fig.2**, draw the influence lines for R_A and V_{AB}, if unit load passes over the stringers **(EF).** **[5]**

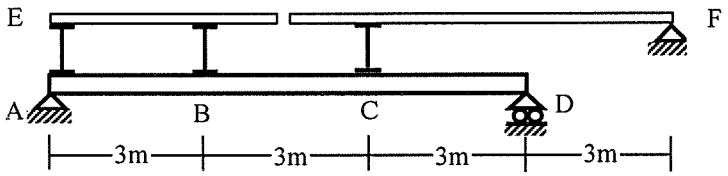


Fig.2

3. For the frame shown in ***Fig.3***, draw the influence lines for H_a, V_f, and M_d if the unit load moves over the beam ***be***. **[5]**

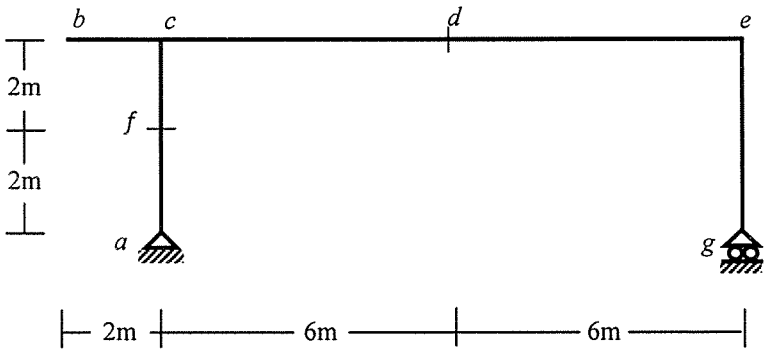


Fig.3

Part-B

4. Analyze the frame shown in ***Fig.4*** to obtain axial force, shear force and bending moment diagram. **[15]**

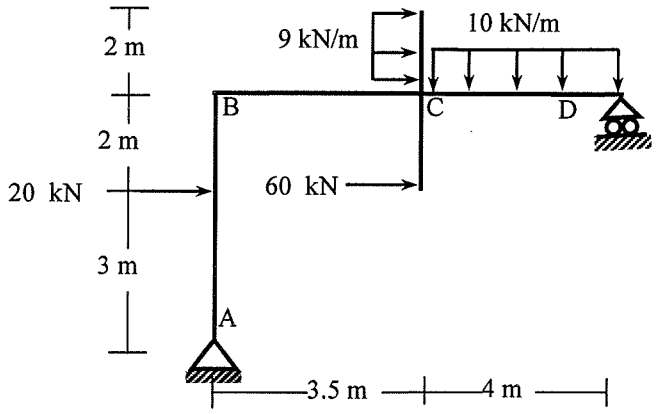


Fig.4

5. Analyze the cable as shown in **Fig. 5** to determine the unstress cable length and tension in each cable segment. Also, calculate the sag at each applied load. **[10]**

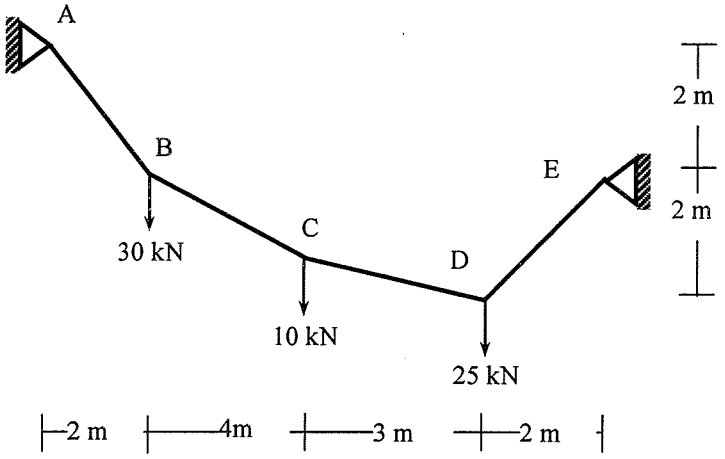


Fig.5

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Spring-2024
Program: B.Sc. Engineering (Civil)

Course Title: **Geotechnical Engineering I** Course Code: **CE 341**
Time: 1 hour Credit Hour: 3.0 Full Marks: 50

[Answer all the questions. Digits in the right margin inside the 1st parentheses indicate marks]

PART-A

1. (a) Define the following soil deposits:

(i) Laterite (ii) Verved clay (iii) Erratics (iv) Dunes (4)

(b) Classify different types of soils based on particle size according to Unified Soil Classification System (USCS). (3)

(c) A cone penetration test was performed on a silty clay sample and the following data were obtained:

Trial No.	1	2	3	4	5
Cone Penetration (mm)	16	18	22	26	30
Water Content (%)	33	40	54	68	82

Plot cone penetration (mm) versus water content (%) in a plain graph paper and hence estimate the liquid limit of the sample. (5)

2. (a) With neat sketches define various types of primary structure of coarse grained soil. (4)

(b) The values of liquid limit and flow index of a silty clay sample, as estimated from the flow curve, have been found to be 54% and 19%, respectively. The natural water content and plastic limit of the sample were found to be 37% and 23%, respectively. From grain size analysis, clay fraction (smaller than 0.002 mm) of the sample was found to be 41%. Calculate liquidity index, consistency index, toughness index and activity of the sample. (4)

(c) The following data were obtained in a shrinkage limit test conducted on a clay sample:

Weight of shrinkage dish = 10.7 gm; Volume of shrinkage dish = 16.3 cm^3

Weight of shrinkage dish + saturated soil = 39.6 gm

Weight of shrinkage dish + oven-dry soil pat = 30.5 gm

Weight of mercury displaced by oven-dry soil pat = 136.1 gm

Unit weight of water and mercury are 0.9963 gm/cm^3 and 13.6 gm/cm^3, respectively.

Calculate the values of shrinkage limit, shrinkage ratio and specific gravity of soil solids (G_s) of the sample. (5)

PART-B

3. a) Define soil compaction. What are the factors of soil compaction? **(3)**
   b) For a given soil, the attached table shows the results of compaction tests conducted in the laboratory. **(12)**

Wt. of can(gm)	Wt. of can + wet soil(gm)	Wt. of can + dry soil(gm)	Dry density (kg/m^3)
10	35.98	33.2	1650
9.9	38.29	34.8	1730
10	37.96	34.1	1750
9.8	37.06	32.9	1747
9.9	38.46	33.7	1720

The following are the results of a field density test performed on the same soil using sand cone method.

Calibrated dry mass of Ottawa sand = 4.56 kg
Volume of jar = 0.00283 m^3

Weight of jar + cone + sand (before filling the hole) = 9.31 kg
Weight of jar + cone+ sand (after filling the hole) = 5.10 kg
Calibrated mass of Ottawa sand to fill the cone = 1.54 kg

Weight of wet soil from hole = 3.53 kg
Moisture content of wet soil = 21.57 %

(i) Determine the maximum dry density in laboratory and optimum moisture content using graph.

(ii) If the specification of this highway project demands 100%±3% relative compaction to be achieved, then check whether the field compaction meets the demand or not.

4. An undisturbed soil sample was collected from the field in steel Shelby tubes for laboratory evaluation. The tube sample has a diameter of 6.6 cm, length of 56 cm, and a moist weight of 43.5 N. If the moisture content and specific gravity of soil solids are 11% and 2.8 respectively, then calculate the following: **(10)**

   a) Degrees of saturation and air content.
   b) Void ratio and porosity.
   c) Saturated unit weight.
   d) Effective unit weight.