3-1

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall - 2021
Program: B. Sc. in Civil Engineering

Course Title: Principles of Accounting   Course Code: ACN 301   Credit: 02
Time: 2 Hours   Full Marks: 50

(Answer ALL the Questions.)

1. **(7+4+3 = 14)**

On December 31, 2017, the trial balance of Bangladesh Lamps Limited showed the following.

Account Name	Amount (Tk.)	Account Name	Amount (Tk.)
Purchase	20,000	Purchase returns	1,000
Sales	55,000	Sales returns	500
Transportation in	6,000	Direct labor	1,500
Factory insurance	1,800	Maintenance, factory machinery	3,400
Administrative expense	700	Depreciation, office equipment	2,000
Marketing expense	1,100	Sales salaries	2,300

Inventories	January 1, 2017 (Tk.)	December 31, 2017 (Tk.)
Raw materials	4,000	6,000
Work in process	5,000	2,000
Finished goods	7,000	3,000

Requirements:

a) Prepare a schedule of cost of goods sold on December 31, 2017. **(7)**

b) Prepare an income statement for the year ended December 31, 2017. **(4)**

c) Determine total product cost, fixed cost and conversion cost. **(3)**

2. **(3+2+3+2+2 = 12)**

The sales and expenses of GPH Ispat Ltd. for last month are as follows:

	Total	Per Unit
Sales	Tk. 900,000	Tk. 30
Variable expenses	360,000	12
Contribution margin	540,000	Tk. 18
Fixed expenses	432,000	
Net operating income	Tk. 108,000	

Requirements:

a) What is the monthly break-even point in units sold and in sales taka? (1.5+1.5 = 3)

b) Without resorting to computations, what is the total contribution margin at the break-even point? (2)

c) How many units would have to be sold each month to earn a target profit of Tk. 1,80,000? Use the formula method. Verify your answer by preparing a contribution format income statement at the target sales level. (1+2 = 3)

d) Refer to the original data. Compute the company's margin of safety in both taka and percentage terms. (2)

e) What is the company's CM ratio? If sales increase by Tk. 1,00,000 per month and there is no change in fixed expenses, by how much would you expect monthly net operating income to increase? (2)

3. **(12+2 = 14)**

The comparative statements of BSRM Steels Limited are presented below.

BSRM Steels Limited

Income Statement

For the Years Ended December 31

Particulars	**2017**	**2016**
Net sales	**Tk. 2,97,500**	**Tk. 2,60,000**
Expenses		
Cost of goods sold	(2,07,500)	(1,77,000)
Selling and administrative expense	(60,400)	(57,400)
Interest expense	(3,900)	(3,000)
Income tax expense	(7,500)	(7,000)
Net income	**Tk. 18,200**	**Tk. 15,600**

BSRM Steels Limited

Balance Sheet

December 31

Particulars	**2017**	**2016**
Assets		
Cash	Tk. 19,500	Tk. 16,500
Accounts receivable (net)	45,500	37,000
Inventory	42,500	35,000
Total current assets	**1,07,500**	**88,500**
Plant assets (net)	2,11,500	1,91,500
Total assets	**Tk. 3,19,000**	**Tk. 2,80,000**

Liabilities and Shareholder's Equity		
Accounts payable	Tk. 61,000	Tk. 55,000
Income taxes payable	11,500	10,000
Total current liabilities	**72,500**	**65,000**
Bonds payable	60,000	40,000
Total liabilities	**1,32,500**	**1,05,000**
Common share (Tk. 5 par)	75,000	75,000
Retained earnings	1,11,500	1,00,000
Total shareholders' equity	**1,86,500**	**1,75,000**
Total liabilities and shareholders' equity	**Tk. 3,19,000**	**Tk. 2,80,000**

Requirements:

a) Compute the following ratios for 2017 and 2016. **(4*3 = 12)**

i) Current ratio

ii) Asset turnover (Total asset on 31/12/2015 was Tk. 2,60,000.)

iii) Earnings per share

iv) Debt to asset ratio

b) Comment on the findings from the comparison of the liquidity, profitability and solvency ratios between the years. **(2)**

4. **(3+5+2 = 10)**

Aftab Automobiles Limited has three projects under consideration. The cash flows for each project are shown in the following table. The firm has a 15% cost of capital.

	Project A	Project B	Project C
Initial Investment (CF_0)	Tk. 1,00,000	Tk. 1,00,000	Tk. 1,00,000
Year (*t*)	**Cash Inflows (CF_t)**		
1	25,000	15,000	35,000
2	25,000	20,000	30,000
3	25,000	25,000	25,000
4	25,000	30,000	20,000
5	25,000	35,000	15,000

Requirements:

a) Calculate each project's payback period. Which project is preferred based on this method? **(3)**

b) Calculate each project's net present value. Which project is preferred based on this method? **(5)**

c) Comment on your findings in parts a and b, and recommend the best project with explanation. **(2)**

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
Program: B. Sc. Engineering (Civil)

Course: Structural Engineering I
(Credit---3) Time: 3.00

Course Code: CE 311
Full Marks: 90

Answer all the Questions
Assume any missing data reasonably.

1. A cable is suspended from the points A and B which are 80m apart horizontally and are at different levels. The right point B is 5m below A and the lowest point of the cable is 10m below A. The cable is carrying a UDL of WkN/m along the horizontal span. Calculate the horizontal and vertical reactions at the ends and the maximum & minimum tension in the cable. Also calculate the maximum sag of the cable. (W = Last Digit of Roll + 10) (10)

2. Draw the Influence line, find the wheel position & then calculate the maximum shear force at a section 4m from the left support A of a simply supported beam of 15 m for the wheel load arrangement shown in Fig.1 (Q = Last Digit of Roll + 10) (10)

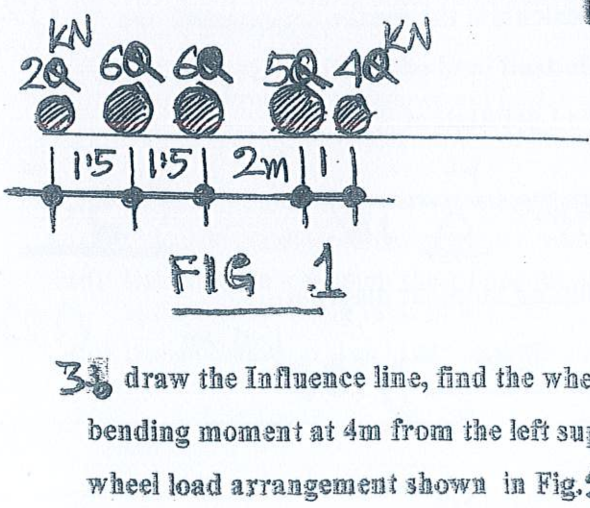


FIG 1

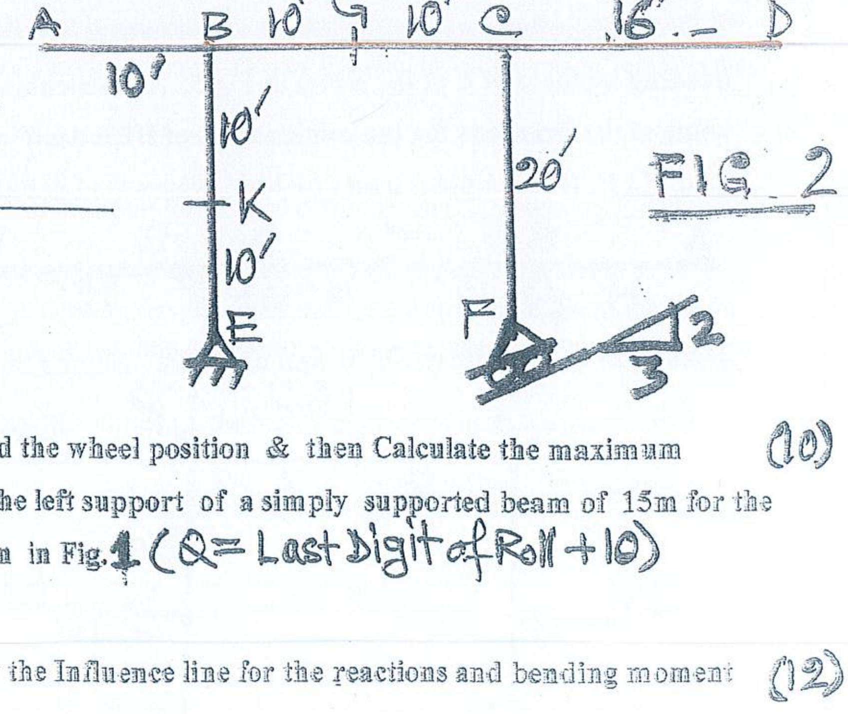


FIG 2

3. draw the Influence line, find the wheel position & then Calculate the maximum bending moment at 4m from the left support of a simply supported beam of 15m for the wheel load arrangement shown in Fig.1 (Q = Last Digit of Roll + 10) (10)

4. For the frame in Fig.2 draw the Influence line for the reactions and bending moment at the section k and G. (12)

5. Draw the Influence line for the force in U3U4 and U4L3 of the truss in Fig. 3 Calculate the maximum value of tension and/or compression in the bars for the combination of UDL dead load of 8 k/ft, moving UDL live load of 12k/ft and a point load of P kips, where P= Last digit of Roll + 10 (12)

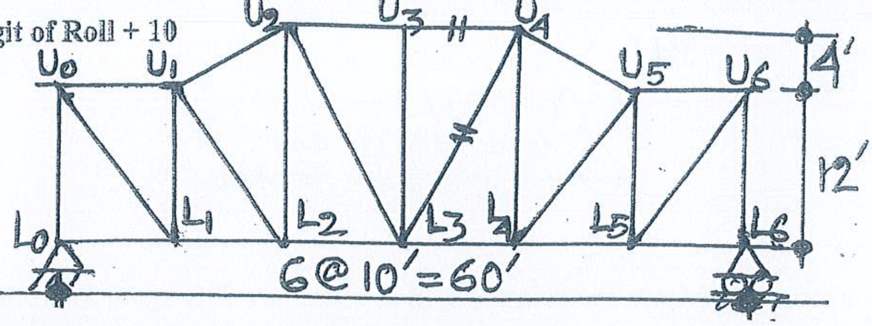


Fig. 3

6. The girder supports a floor system as shown in Fig.4 Draw influence line for :
(i) Bending Moment at PP- E & (ii) Shear in Panel B-E. .... Also calculate the maximum shear force in Panel B-E for a UDL dead load of 8 k/ft, moving UDL live load of 12k/ft and a point load of P kips, where P= Last digit of Roll + 10 (12)

...... ***SHOW the EQUATIONS & DIFFERENT STEPs of DRAWING I.Lines***

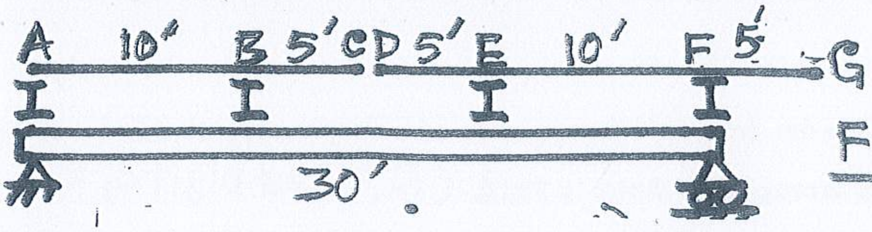


FIG4

7. Draw the influence lines for (i) the reaction at D (ii) the shear force at E and (iii) the bending moment at E of the Beam in Fig.5. Also calculate the maximum [redacted] –ve value of the functions for the combination of UDL dead load of 8 k/ft, moving UDL live load of 12k/ft and a point load of P kips, where P= Last digit of Roll + 10 . (12)

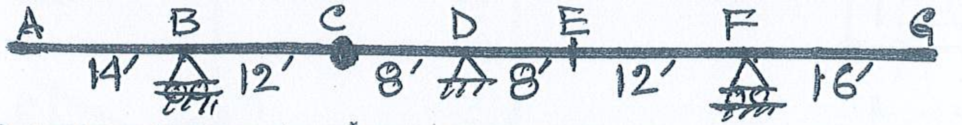


Fig.5

8. Analyze the Frame in Fig. 6 and draw the bending moment diagram. (12)

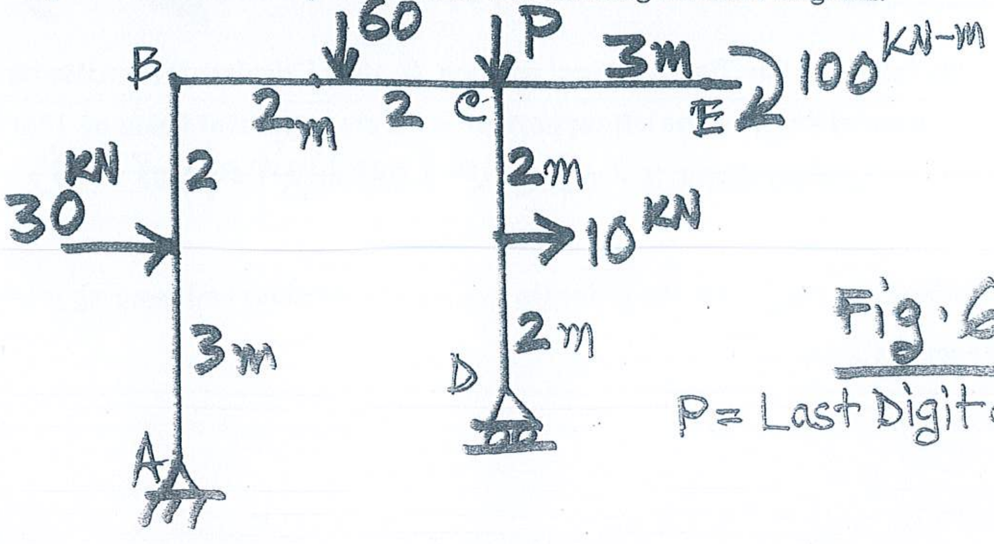


Fig.6

P= Last Digit of Roll +10

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021 (Set 2)
Program: B. Sc. Engineering (Civil)

Course Title: Design of Concrete Structures I | Credit Hours: 3.0 | Course Code: CE 315
Time: 3 hours | Full Marks: 100 (= 10 × 10)

PART A

[Answer **any 7 (seven)** of the following 10 questions]

[Given: f_c' = (3 + 0.01R) ksi, f_y = 20f_c', f_{call} = 0.45f_c', f_{sall} = 0.4f_y, R = Last two digits of Registration #]

1. For the RC section shown in Fig. 1, calculate the
   (i) Allowable tensile force
   (ii) Positive and negative cracking moment.

2. For the RC section shown in Fig. 1, calculate the
   (i) Allowable compressive force
   (ii) Allowable positive and negative bending moment.

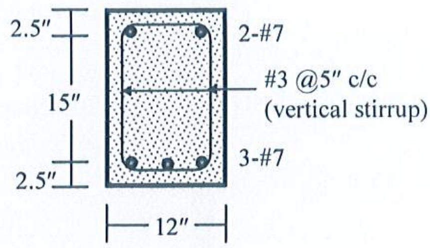


Fig. 1

3. Fig. 1 shows section *c* obtained by USD of the beam *abcd* loaded as shown in Fig. 2. Use BMD of the beam to
   (i) Calculate the corresponding live load *F* (neglecting beam self-weight).
   (ii) Design (by USD) section *b* of the beam for the load calculated in (i).
   (iii) Show the reinforcements in the longitudinal profile of the beam.

4. Fig. 1 shows section *c* obtained by WSD of the beam *abcd* loaded as shown in Fig. 2. Use SFD of the beam to
   (i) Calculate the corresponding live load *F* (neglecting beam self-weight) for the stirrup spacing shown in Fig. 2.
   (ii) Calculate (by WSD) the stirrup spacing at section *a* and *b* of the beam for the load calculated in (i).
   (iii) Show the shear reinforcements in the longitudinal profile of the beam.

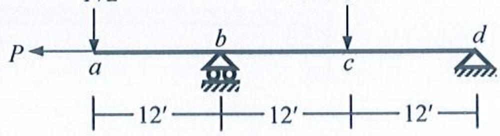


Fig. 2

5. Fig. 1 shows section *c* obtained by USD of beam *abcd* (shown in Fig. 2). Calculate (by USD) the
   (i) ACI Code prescribed shear force carrying capacity (V_c) of the section without shear reinforcement (if the axial force P = 0).
   (ii) Axial Force *P* required to make V_c = 0, and corresponding live load *F* (neglecting beam self-weight) for the stirrup spacing shown in Fig. 2.
   (iii) Stirrup spacing at section *a* and *b* of the beam for the load calculated in (iii), assuming V_c = 0.

6. For the simply supported beam shown in Fig. 3 (with the T-section shown), use USD to
   (i) Calculate the shear forces required to cause flexure-crack crack and web-shear crack of the section.
   (ii) Calculate the maximum shear force the section can possibly take with shear reinforcement, as well as the corresponding value of live load *F*.
   (iii) Design (with neat sketch) 45° inclined stirrups for the beam subjected to loads calculated in (ii).

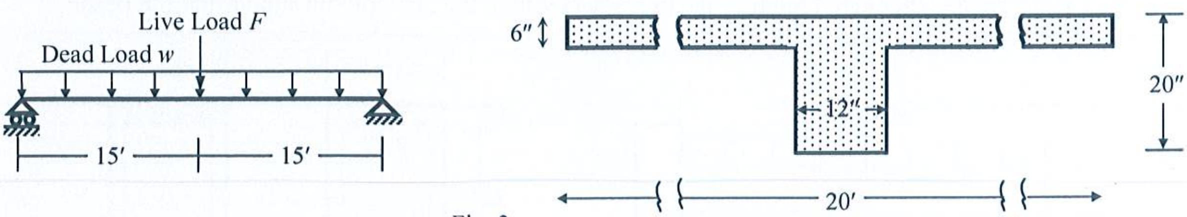


Fig. 3

7. Fig. 4 shows the plan view of a slab-beam system. Use the USD to calculate the
   (i) Maximum steel area (A_s) required for Beam B to behave like a rectangular beam (i.e., $c = t$) and the corresponding ultimate distributed load (w_{u1}) on it.
   (ii) Required steel area in Beam B if the distributed load (w_u) on it is 1.5 times the distributed load (w_{u1}) calculated in (i) (i.e., $w_u = 1.5w_{u1}$).

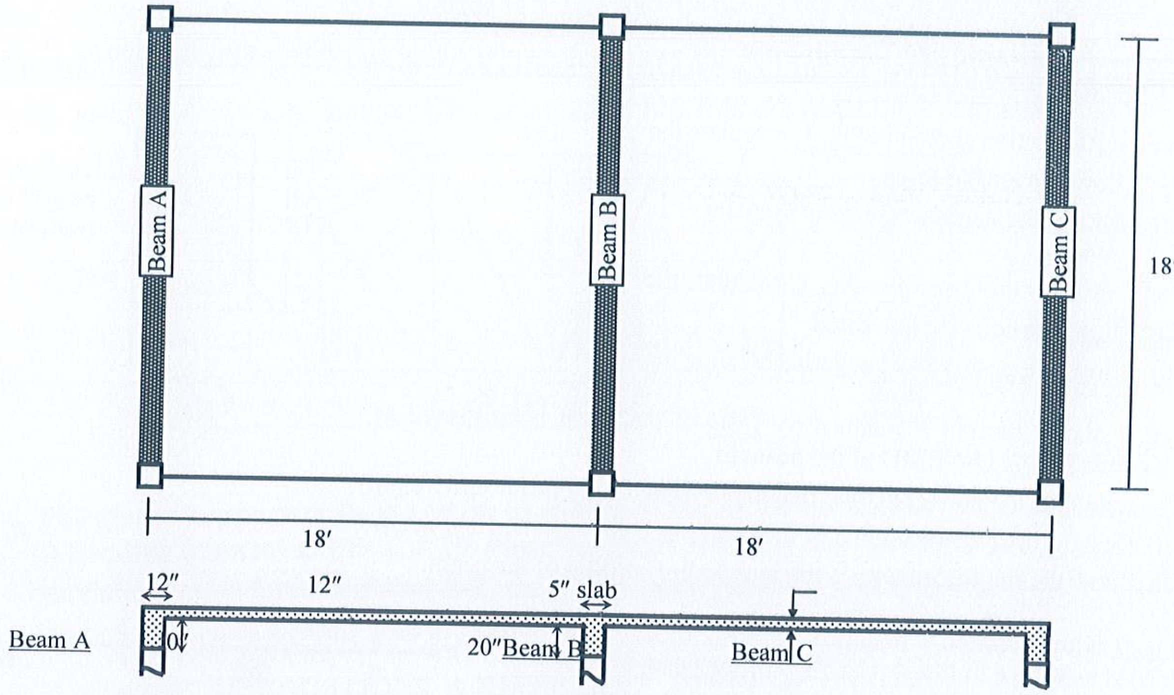


Fig. 4

8. Fig. 4 shows the floor plan of a 5″-thick RC slab. In addition to the slab self-weight, floor loads also include working floor finish = 30 psf and random wall = 60 psf.
   (i) Calculate the allowable bending moment (using WSD) for this slab thickness and the corresponding allowable live load (LL) on the slab.
   (ii) Design the slab (with neat sketch of section) for the given and calculated loads
   [Given: ACI moment coefficients (−1/24, +1/14, −1/9) at (exterior support, midspan, interior support)].

9. Fig. 5 shows the side elevation of a RC wall supporting 12′ high water.
   (i) Design the wall (by USD) for bending moment
   (ii) Check the wall designed in (i) for shear force
   (iii) Show the wall reinforcements with neat sketch
   [Given: Unit weight of water = 62.5 lb/ft³].

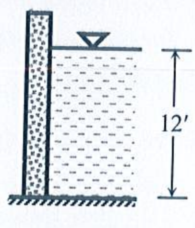


Fig. 5

10. For the cantilever beam ab shown in Fig. 6, use the WSD to
   (i) Calculate the distance from the end b where 2 top bars can be cut off (as shown in section a)
   (ii) Check the development length of the beam bars within the 20″-column supporting the beam.

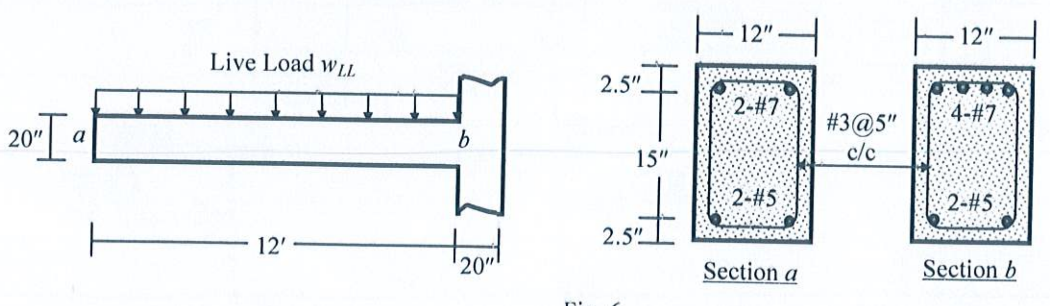


Fig. 6

PART B

[Answer **any 3 (three)** of the following 4 questions]

11. (i) What is the minimum steel ratio used in RC beam design? Explain why it is used.

    (ii) Show the variations of stress and strain over an RC section as it is stressed gradually from uncracked to cracked and ultimate failure condition.

12. (i) What is balanced steel ratio (ρ_b)? Why does ACI recommend a maximum steel ratio less than ρ_b?

    (ii) Explain the differences between flexural stress distribution over T-beam and rectangular beam (and their effects on design).

13. (i) Explain the effects of Web Reinforcement on the shear resistance of RC beams.

    (ii) Mention the distinctive features of the shear design for members in tension and compression.

14. (i) Narrate the ACI code provisions for choosing the minimum thickness of one-way slabs. Explain why the required thickness of slabs increases with the yield strength of reinforcing steel.

    (ii) What are bar splices? Distinguish between lap splices in tension and compression.

List of Useful Formulae for CE 315

Fundamentals

* Tensile strength of concrete $f_t \fallingdotseq 6\sqrt{f_c'}$ $E_c = 57500\sqrt{f_c'}$ $E_s = 29 \times 10^6$ psi   Modular ratio, $n = E_s/E_c$

* Within elastic limit, Flexural stress $f_c = M\,\bar{y}/\bar{I}$

* Steel Ratio $\rho_s = A_s/bd$ Minimum Steel Ratio $\rho_{min} = 3\sqrt{f_c'}/f_y$, often taken as $= 200/f_y$

WSD

* 'Cracked' elastic section   Analysis: $k = -n\rho_s + \sqrt{[2n\rho_s + (n\rho_s)^2]}$ $j = 1 - k/3$

  Design: $k = n/(n + r)$ [where $r = f_{s(all)}/f_{c(all)}$] $j = 1 - k/3$

* Singly Reinforced Beam: $M_s = A_s f_s jd$ and $M_c = (f_c kj/2)\,bd^2 = R\,bd^2$

* Balanced Stress Steel Ratio $\rho_{sb} = k/2r$, when $M_s = M_c$

* Doubly Reinforced Beam: $M_1 = Rbd^2$, $A_{s1} = M_1/(f_s jd)$

  $M_2 = M - M_1$, $A_{s2} = M_2/[f_s(d-d')]$ and $A_s' \fallingdotseq M_2/[f_s'(d-d')]$, where $f_s' \fallingdotseq 2f_s(k-d'/d)/(1-k)$

USD

* $\alpha = 0.72 - 0.04\,(f_c' - 4)$, and $0.56 \leq \alpha \leq 0.72$, while $\beta = 0.425 - 0.025\,(f_c' - 4)$, and $0.325 \leq \beta \leq 0.425$

* Balanced Steel Ratio $\rho_b = (\alpha f_c'/f_y)\,\{87/(87+f_y)\}$ and Maximum Steel Ratio $\rho_{max} = 0.75\rho_b$

* Design conditions: $M_u < \phi M_n$, $V_u < \phi V_n$, $P_u < \phi P_n$ [$\phi = 0.90$, $\phi = 0.85$ for shear, $\phi = 0.70$ or 0.75 for axial forces]

  To calculate M_u, V_u, P_u, overload factors for DL and LL can be set as 1.2 and 1.6, 1.7, 1.87.

* Singly Reinforced Analysis: If $\rho_s < \rho_b$ $a = A_s f_y/(0.85 f_c' b)$ $M_n = A_s f_y(d - a/2) = \rho_s f_y(1 - 0.59\,\rho_s f_y/f_c')\,bd^2$

  If $\rho_s > \rho_b$ $m = 87/\alpha f_c'$

  $c = d\,[-(m\rho_s/2) + \sqrt{\{(m\rho_s/2)^2 + m\rho_s\}}]$, $a = (\alpha/0.85)\,c$, $M_n = A_s f_y(d - a/2)$

* Doubly Reinforced Analysis:

  $a = A_{s1} f_y/(0.85 f_c' b)$ [where $A_{s1} = A_s - A_{s2}$, and can be taken as $= A_s - A_s'$ to begin with]

  $A_{s2} = A_s' f_s'/f_y$, where $f_s' = 87\,(c - d')/c \leq f_y$

  from which A_{s1} can be revised as $= A_s - A_{s2}$ and a can also be revised accordingly

  $M_n = A_{s1} f_y(d - a/2) + A_{s2} f_y(d - d')$

* Design: Singly Reinforced if $M_n < M_{max}[= \rho_{max} f_y(1 - 0.59\,\rho_{max} f_y/f_c')\,bd^2]$

  $a = d\,[1 - \sqrt{\{1 - 2\,M_n/(f_c bd^2)\}}]$, $A_s = (0.85 f_c' ab)/f_y$

  Doubly Reinforced $M_1 = M_{max}$ $A_{s1} = \rho_{max}\,bd$,

  $M_2 = M_n - M_1$ $A_{s2} = M_2 / f_y(d - d')$

  $c = A_{s1} f_y/(\alpha f_c' b)$ $f_s' = 87\,(c - d')/c \leq f_y$ $A_s' \fallingdotseq M_2/\{f_s'(d - d')\}$

* T-beam b_{eff} is the minimum of $L/4$, $(16t + b_w)$, and (c/c distance between adjacent beams)

  L-beam b_{eff} is the minimum of $(L/12 + b_w)$, $(6t + b_w)$, and (b_w + half the clear distance between adjacent beams)

* USD Analysis: $A_{sf} = 0.85 f_c'(b_{eff} - b_w)t / f_y$ $M_{nf} = A_{sf} f_y(d - t/2)$

  $A_{sw} = A_s - A_{sf}$ $a = A_{sw} f_y/(0.85 f_c' b_w)$ $M_{nw} = A_{sw} f_y(d - a/2)$ } $\boxed{M_n = M_{nf} + M_{nw}}$

  Design: $A_{sf} = 0.85 f_c'(b_{eff} - b_w)t / f_y$, $M_{nf} = A_{sf} f_y(d - t/2)$; while A_{sw} can be obtained from $M_{nw} = M_n - M_{nf}$

Shear Design

* $v_{crf} = 1.9\sqrt{f_c'}$ and $v_{crw} = 3.5\sqrt{f_c'}$ (in psi)

* $v_{cr} = 1.9\sqrt{f_c'} + 2500\rho_s\,(Vd/M) \le 3.5\sqrt{f_c'}$, often approximated as $v_{cn} = 2\sqrt{f_c'}$ [and = $1.1\sqrt{f_c'}$ in WSD]

* $S = A_v f_v\, d/(V_{ext} - V_{cr}) = A_v f_v / \{(v_{ext} - v_c)\, b\}$ for vertical stirrups, and

$S = A_v f_v\, d\,(Sin\ \alpha + Cos\ \alpha)/(V_{ext} - V_c) = A_v f_v\,(Sin\ \alpha + Cos\ \alpha)/\{(v_{ext} - v_c)\, b\}$ for inclined stirrups

Summary of ACI Shear Design Provisions (Vertical Stirrups)

	WSD	USD	Additional Provisions
Design Shear Force	V_w	$V_n = V_u/\phi$ [$\phi = 0.75$]	Calculated at d from Support face
Min^m Section Depth	$V_w/5\sqrt{f_c'}b_w$	$V_n/10\sqrt{f_c'}b_w$	$f_y \le 60$ ksi
Concrete Shear Strength v_c	$1.1\sqrt{f_c'}$	$1.9\sqrt{f_c'} + 2500\rho_s\,(Vd/M)$ OR $2\sqrt{f_c'}$	$\sqrt{f_c'} \le 100$ psi $Vd/M \le 1.0$
No Stirrup	$V_w \le V_c/2$	$V_n \le V_c/2$	
Max^m Spacing	$d/2$, 24" $S = A_v f_y/50b_w$	$d/2$, 24" $S = A_v f_y/50b_w$	To be halved if $V_n \ge 6\sqrt{f_c'}b_w d$ OR $V_w \ge 3\sqrt{f_c'}b_w d$ in WSD

Effect of Axial Force on Shear Strength

* *Axial Compression*

$v_c = 1.9\sqrt{f_c'} + 2500\rho_s\,(V_u d/M_u)$, except that a modified moment $M_m = M_u - N_u\,(4h-d)/8$ is taken for M_u

The upper limit of $3.5\sqrt{f_c'}$ is replaced by $v_c \le 3.5\sqrt{f_c'}\sqrt{(1 + N_u/500A_g)}$

As an alternative $v_c = 2\sqrt{f_c'}\,(1 + N_u/2000A_g)$

* *Axial Tension*

$v_c = 2\sqrt{f_c'}\,(1 + N_u/500A_g)$, but not less than zero (N_u is negative for tension). As an alternative $v_c = 0$

One-way Slab

* $t_{min} = L_n/20$ (Simply supported), $L_n/24$ (One end continuous), $L_n/28$ (Both end continuous), $L_n/10$ (Cantilever)

[All these are to be multiplied by $(0.4 + f_y/100)$]

* (ACI) $A_{s,\,temp} = 0.0020\,bt$ [f_y = 40 or 50 ksi], and = $0.0018 \times (60/f_y) \ge 0.0014$ [$f_y \ge 60$ ksi]

* (BNBC) $A_{s,\,temp}$ at least 50% higher for brick aggregates, and $A_{s,\,temp} \ge 0.0025\,bt$ in Bangladesh

Development Length

For tension bars without anchorage

* $l_d/d_b = (3/40)\,(f_y/\sqrt{f_c'})\,(\alpha\beta\gamma\lambda)/\{(c + K_{tr})/d_b\}$ [where, α=1.0 or 1.3, λ = 1.0 or 0.8]

For tension bars with anchorage

* $l_d/d_b \ge 0.02\,(\beta\lambda)\,(f_y/\sqrt{f_c'})$

For compression bars

* $l_d/d_b \ge 0.02\,(f_y/\sqrt{f_c'})$ OR $0.0003\,f_y$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering I | Course Code: CE 331

Time: 3.00 Hours | Credit Hour: 3.00 | Full Mark: 120

Answer all the questions in both of the sections. (36+24+36+24= 120)
(Necessary formulae are attached; Assume reasonable data if necessary)

SECTION – A

1 (a) Explain why groundwater is a preferred source for drinking purposes? (6)

(b) If you need to design an intake, explain the considerations that you need to take into account for the design. Illustrate which qualities would you desire while choosing pressure pipes? While you use metal pipes for conveyance, provide pointers on how you can prevent the pipe from galvanic corrosion? (15)

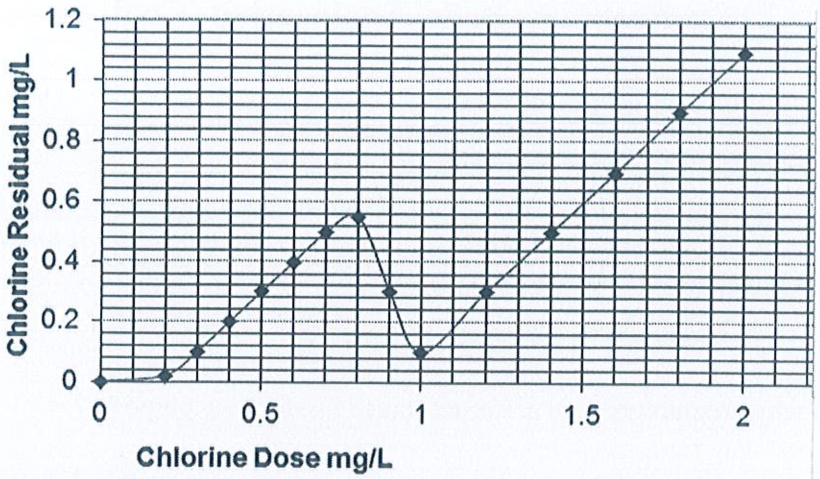
(c) If you are planning to design a water supply system, provide details on each of the "Elements" that need to be considered in the system. (8)

(d) Explain your understanding on the formation of the cone of depression and apply the reasoning to explain the interference of well and ways to avoid it. (7)

2(a) A **45 m^3/hour** drinking water treatment plant is being designed for a small community. The plant needs a settling tank for chemical precipitation followed by disinfection. (8)

Design (indicate diameter and depth in meters) a **circular** settling basin for the plant using an overflow rate of $0.5 m^3/m^2$-hr. The detention time is 3 hours.

(b) The disinfection chlorine demand curve for the river water used in the plant is presented below.



i) What is the chlorine dose at Break Point? ____________ mg/L (2)

ii) What is the chlorine dose for maintaining a Free Residual of 0.3 mg/L? ________ (2)

iii) What type of residuals is formed during the chlorine doses ranging from 0.2 to 0.8 mg/L? What compound reacts with chlorine in this region? (3)

iv) Why does the chlorine residual decrease during the chlorine doses ranging from 0.8 to 1.0 mg/L? (3)

(c) Explain the importance/relevance of mixing/stirring in coagulation and flocculation processes. (6)

OR

Provide a comparative analysis between Rapid Sand Filtration and Slow sand Filtration.

SECTION – B

3 (a) When is filter packing required for a well? What is the function of the blank pipe at the bottom of the strainer? (6)

(b) Design the appropriate details of a well following the given steps and according to the data provided below: (12)

i) Find out the water-bearing/most productive part of the aquifer (depth range) from the given grain size distribution summary at different depths showing suitable reasoning

Sample Depth (ft)	D_{10}	D_{30}	D_{60}	U = D_{60} / D_{10}	FM	% Course Sand	% Medium Sand	% Fine Sand
170-210	0.12	0.195	0.3	2.50	1.26	3	67	30
210-220	0.15	0.21	0.33	2.20	1.41	4	70	26
220-270	0.17	0.28	0.3	1.76	1.63	6	77	17
270-310	0.17	0.28	0.31	1.82	1.69	11	72	17
310-370	0.17	0.24	0.38	2.24	1.5	5	75	20
370-410	0.17	0.29	0.395	2.32	1.63	5	80	15
410-430	0.15	0.22	0.37	2.47	1.47	5	71	24

ii) Find out the length of the casing pipe considering static water level at 250 ft, the drawdown of 15 ft with water level declination of 2.5 ft per year, the design life of 30 years, and a safe distance of 10 ft. Assume 80% of the aquifer screening can be made and find out the length of the strainer.

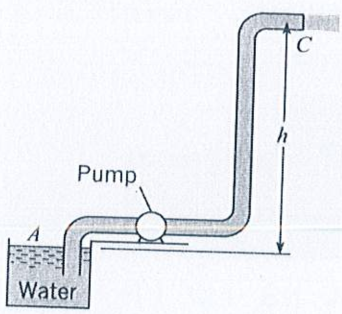
iii) Find out the yield from the well if a 40 slot strainer is used with a diameter of 4.5 inches. (Assume the minimum permissible velocity of 0.1 fps and factor of safety of 2.0). What is the yield per day from the well if it pumps water for 10 hours per day.

iv) If the well has to serve a community with 55,000 people with a water demand of 40 liter per capita per day, how many wells will be required to be installed?

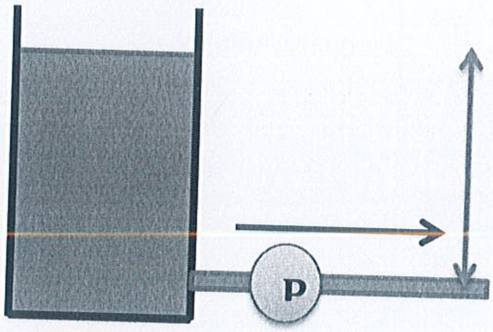
v) Provide the well log in a schematic **(BONUS MARKS = 3)**

(c) (6)

Derive the expression for the pump head for case I and case II



Case I



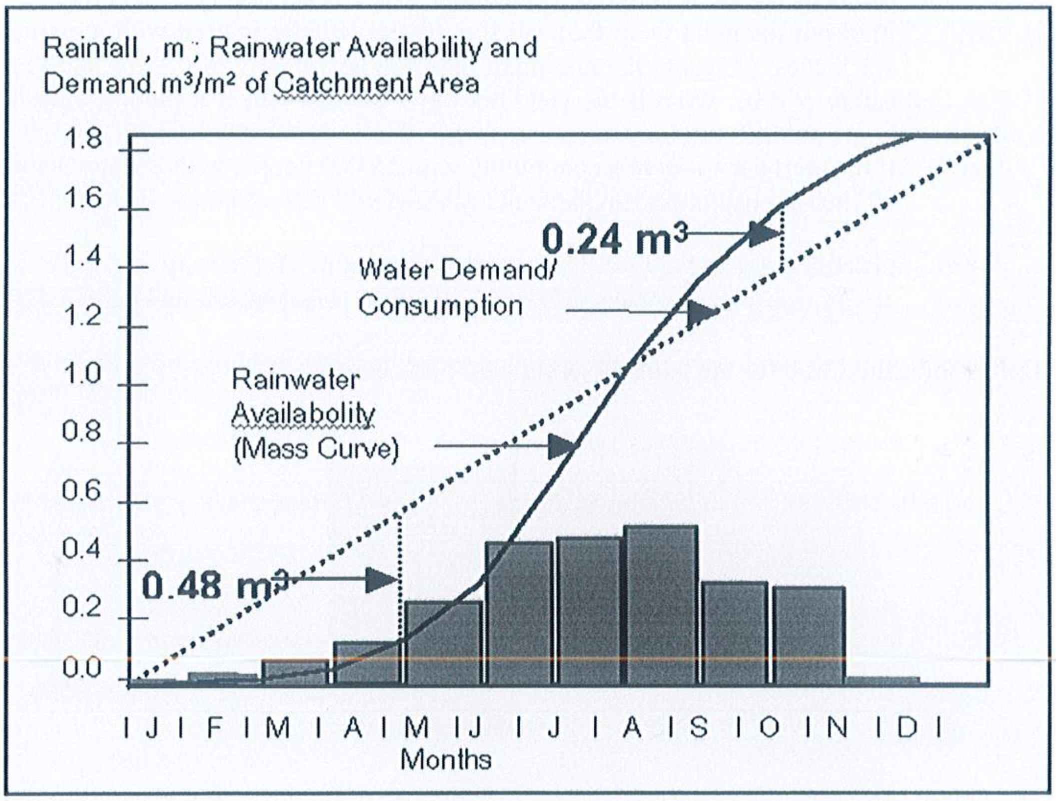
Case II

(d) Water is supplied at a rate of 35 gallons per capita per day for a city with a population of 50000. The pump house is located at 135 ft from the ground, and the treatment plant is located at 220 ft. The total length of the pipe has to be within 2500 ft, and the velocity through the pipe has to be maintained at 5 fps. The pump has to work for 10 hours daily at an efficiency of 65%. Design the transmission main (diameter of the pipe) and the pumping unit (working and break horse power). Assume friction factor, f = 0.01 (12)

OR

Evaluate how much power must be supplied by the pump to the flow if water ($\nu = 10^{-6}$ m^2/s) is pumped through the 300 mm steel pipe (ε = 0.046 mm, L = 140 m) from the lower tank (Elevation = 200 m) to the upper one (elevation = 235 m) at a rate of 0.314 m^3/s? [Assume, $K_{entrance} = 0.03$, $K_{bend} = 0.35$, $K_{exit} = 1$

4 (a) Below is given the rain water availability mass curve, which assumes that the cumulative consumption/demand at a constant rate is equal to the total available rainwater. From the figure, estimate the capacity of the storage tank for full utilization of the rainwater and therefore determine the fraction (f) of the total available rainfall that is stored. (8)



(b) For a water safety plan, if a system description has to cover all steps of the water supply system from source to consumer, provide a process flow diagram for **ONE** of the following systems: (8)
i) Dhaka city simulating an urban piped water supply system OR
ii) Your village simulating a hand tubewell rural water supply system

(c) For a tubewell-based community water supply system in a rural area, possible contamination of well water from leaching from pit latrines is considered to be a hazardous event. Estimate the "raw risk" score and risk category for this hazardous event, ignoring existing control measures (i.e., distance between latrine and tubewell). Reassess the risk score and category for a situation where the pit latrine is positioned far away (>30m) from the tubewell – this could be considered a "control measure" preventing fecal contamination of tubewell water. (8)

Use the attached tables for semi-quantitative approach and provide suitable justification for choosing the likelihood and impact categories.

OR

Drinking water is supplied to a pourashava from groundwater extracted via deep tubewells (DTWs) and through a piped distribution system recently constructed with good quality control measures in place. The groundwater contains high concentrations of both dissolved iron (10 mg/L) and arsenic (1.0 mg/L). Water supply is intermittent as DTW pumps are operated for only a few hours each day; so there is a risk of entry of contaminants when there is low/no pressure in the system. Ignoring any control measure, calculate the "raw risk" score and category for these three hazardous events : (i) high Fe concentration in groundwater, (ii) high As concentration in groundwater; and (iii) entry of contaminants to the distribution system. Use the attached tables for semi-quantitative approach and provide suitable justification for choosing the likelihood and impact categories.

Given Formulae

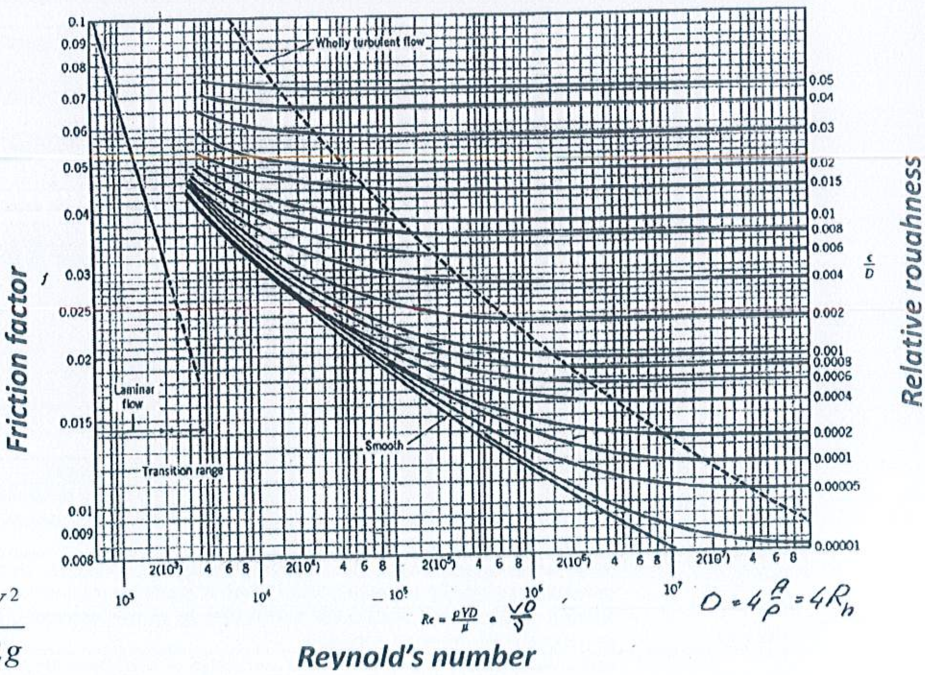
Surface Overflow rate = Q/Surface Area ; Detention time = Q/V

I. Water Horse Power of pump = (w. Q. H) / 75
Where, w = Specific weight of water in kg/m^3
Q = Pump discharge in m^3/sec

II. Brake Horse Power of pump = Water Horse Power * 100 / (efficiency of pump)

$Q = \pi D L(0.01p) v_c$

Moody's diagram



Head loss due to friction $= f \frac{L}{D}\frac{V^2}{2g}$

Risk = Likelihood × Impact

Estimation of "Risk Score" and Risk Categorization:

		Impact				
		Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Likelihood	Almost Certain (5)	5	10	15	20	25
	Likely (4)	4	8	12	16	20
	Possible (3)	3	6	9	12	15
	Unlikely (2)	2	4	6	8	10
	Rare (1)	1	2	3	4	5

Risk Severity		
High	Medium	Low
>15	15-5	≤5

Semi Quantitative Estimation of Risk Score: Risk Matrix

Estimation of "Risk Score" and Risk Categorization (semi-quantitative approach):

Likelihood	
Rating	Description
Almost Certain (5)	Is expected to occur in most circumstances; has been observed regularly in the field; confirmed by water quality data.
Likely (4)	Will Probably occur in most circumstances; has been observed occasionally in the field; confirmed by water quality data.
Possible (3)	Might occur at some time; has been observed occasionally in the field; no significant water quality data trends that confirm risk.
Unlikely (2)	Could occur at some time; has not been observed in the field; no water quality data trends that confirm risk.
Rare (1)	May occur in exceptional circumstances; has not been observed in the field; water quality data do not indicate any risk.

Estimation of "Risk Score" and Risk Categorization (semi-quantitative approach):

Impact	
Rating	Description
Insignificant (1)	Negligible impact on water quality, service delivery or normal operations.
Minor (2)	Minor water quality impact for a small percentage of customers; some manageable disruptions to operation; corrective action required for service delivery; rise in complaints not significant.
Moderate (3)	Minor water quality impact for a large percentage of customers; clear rise in complaints; community annoyance; minor breach of regulatory requirement; regulator interest; significant but manageable modification to normal operations; increased operational costs; increased monitoring.
Major (4)	Major water quality impact for a small percentage of customers; large number of complaints; significant level of customer concern; significant breach of regulatory requirement; regulatory interest and investigation; systems significantly compromised with abnormal operation if at all; high level of monitoring.
Catastrophic (5)	Major water quality impact for a large percentage of customers; illness in community associated with the water supply; litigation by customers; major regulatory.

University of Asia Pacific

Department of Civil Engineering

Final Examination, Fall 2021

Program: B.Sc. Engineering (Civil)

Course Title: Geotechnical Engineering I — Course Code: CE 341

Time: 3 hours — Credit Hour: 3.00 — Full Marks: 120

Answer all the questions below. For necessary additional information, check the appendix attached with the question.

(1) For a soil, the following information are given. Plastic limit of the soil=15.

Number of blows (N)	Moisture content (%)
15	37
18	35.2
27	31.8
35	29.3

(a) Determine the plasticity index of this soil. Compare the result with the plasticity index determined by the one-point method (by any given data). Given, $\beta = 0.125$. **[10+5]**

(b) Write the equation of A-line and U-line (to determine PI). What will be the natural moisture content of the given soil, if the consistency index is 1.25? **[5]**

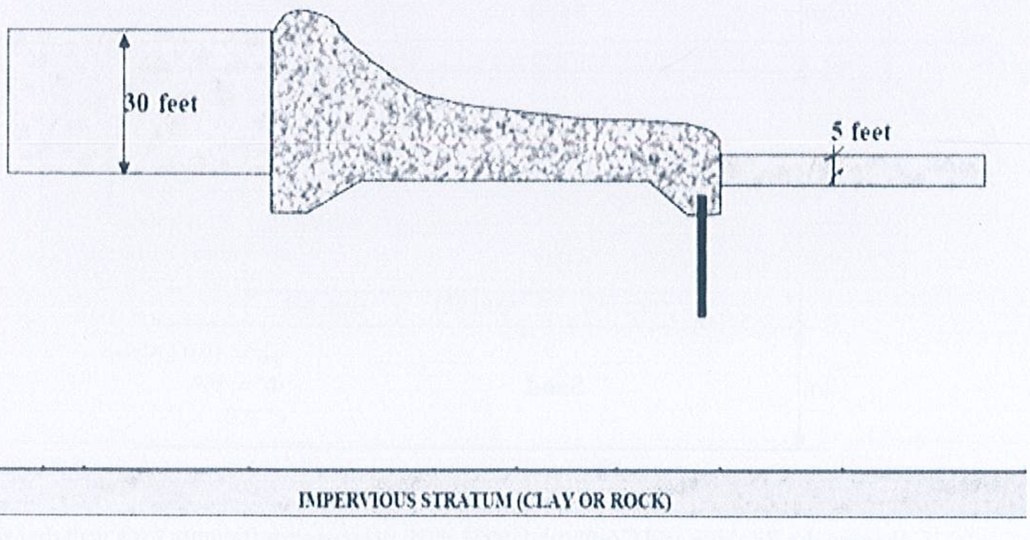
(c) Outline the basic states of soil. Calculate the flow index from the given data. **[5]**

(d) Determine the shrinkage limit of the soil. Given, **[5]**
Initial volume of soil in a saturated state = 0.00089 ft^3
Final volume of soil in a dry state = 0.00057 ft^3
Initial mass in a saturated state = 0.124 lb
Final mass in a dry state = 0.078 lb

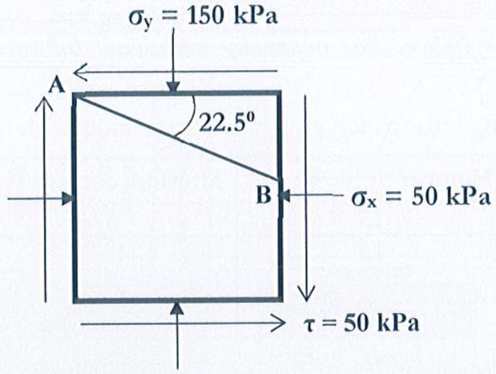
(2) Seepage takes place around a dam.

(a) Write down the boundary conditions for constructing a flow net. **[5]**

(b) Draw the flow net for the figure shown below. The hydraulic conductivity of the soil underneath and is 3.3×10^{-3} cm/s. Calculate the rate of seepage under the dam. **[10+5]**



(3) A stressed soil element at failure is shown in the following figure.



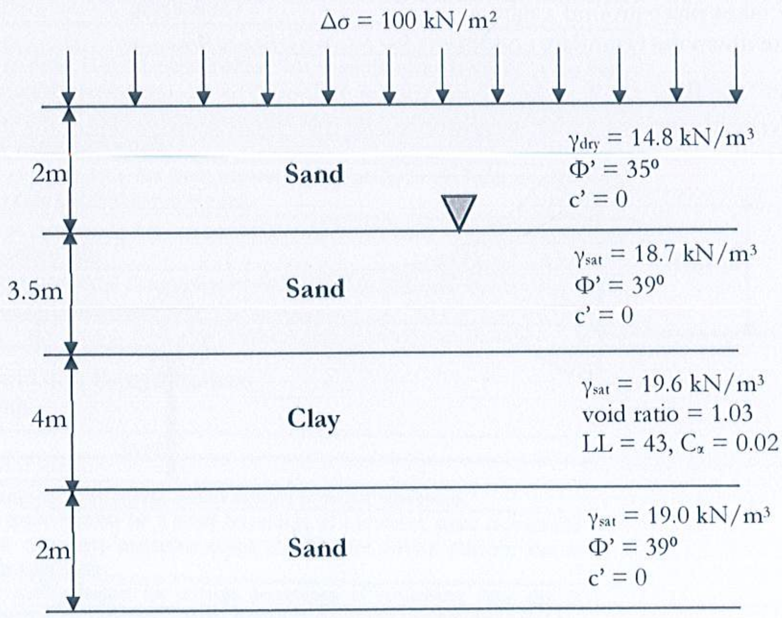
(a) Using pole method, determine the Major principal stress, Minor principal stress, Normal and shear stresses on the plane AB. **[15]**

(b) Estimate the angle of internal friction for the soil sample. **[5]**

(4)

(a) Explain normally consolidated and over-consolidated soil. Illustrate the correlation between liquid limit and compression index. **[5]**

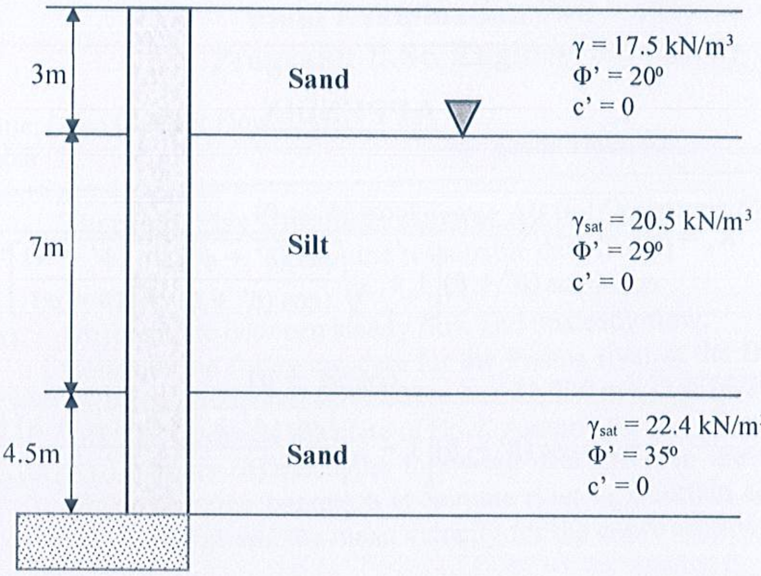
(b) For the soil profile shown in the figure below, σ'_c is = 150 kN/m^2. Calculate the total consolidation settlement (primary+secondary) on the clay layer 8 years after the completion of the primary consolidation settlement. [$C_S = C_C/5$; Time for completion of primary settlement = 3 years] **[15]**



(5)

(a) Compare the Rankine and Coulomb lateral earth pressure coefficients for a wall that retains a granular backfill soil with $\Phi = 36^o$, $\delta = 12^o$, $\theta = 0^o$, and $\alpha = 10^o$. **[5]**

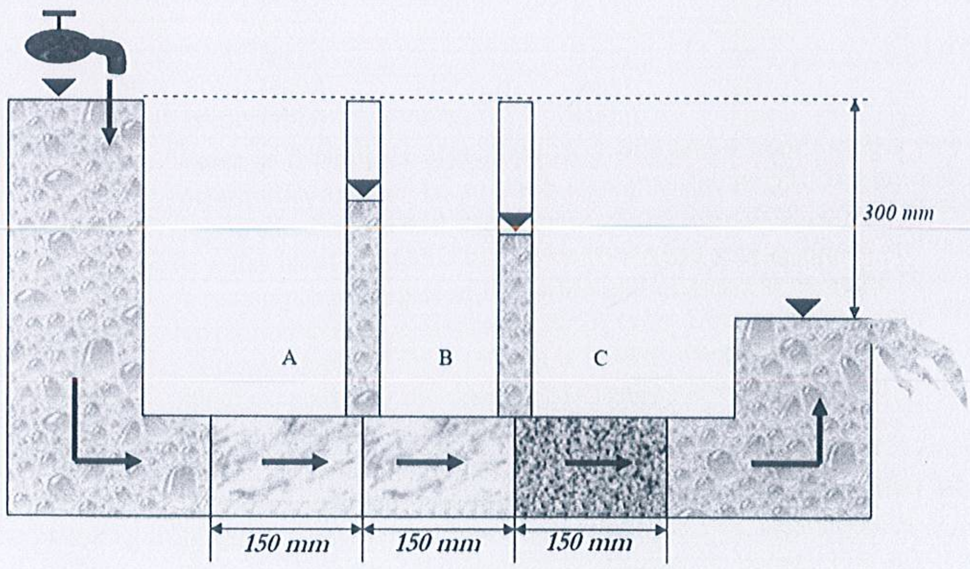
(b) For the retaining wall shown in the following figure, determine the force per unit length of the wall for Rankine's active state, and find the location of the resultant. [Assume all soils as normally consolidated] **[12+3]**



(6)

(a) Classify the types of standard triaxial test. State the differences within these. **[4]**

(b) The soil layers below have a cross section of 100 mm × 100 mm each. The permeability of each soil is: $k_A = 10^{-2}$ cm/sec, $k_B = 3\times10^{-3}$ cm/sec; $k_C = 4.9\times 10^{-4}$ cm/sec. Find the rate of water supply in cm^3/hr. **[6]**



APPENDIX

$$K_a = \frac{\cos^2(\phi' - \theta)}{\cos^2\theta \cos(\delta' + \theta)\left[1 + \sqrt{\dfrac{\sin(\delta' + \phi')\sin(\phi' - \alpha)}{\cos(\delta' + \theta)\cos(\theta - \alpha)}}\right]^2}$$

$$K_p = \frac{\cos^2(\phi' + \theta)}{\cos^2\theta \cos(\delta' - \theta)\left[1 - \sqrt{\dfrac{\sin(\phi' + \delta')\sin(\phi' + \alpha)}{\cos(\delta' - \theta)\cos(\alpha - \theta)}}\right]^2}$$

Values of K_a for $\theta = 0°, \alpha = 0°$

	δ' (deg) →					
↓ ϕ' (deg)	0	5	10	15	20	25
28	0.3610	0.3448	0.3330	0.3251	0.3203	0.3186
30	0.3333	0.3189	0.3085	0.3014	0.2973	0.2956
32	0.3073	0.2945	0.2853	0.2791	0.2755	0.2745
34	0.2827	0.2714	0.2633	0.2579	0.2549	0.2542
36	0.2596	0.2497	0.2426	0.2379	0.2354	0.2350
38	0.2379	0.2292	0.2230	0.2190	0.2169	0.2167
40	0.2174	0.2089	0.2045	0.2011	0.1994	0.1995
42	0.1982	0.1916	0.1870	0.1841	0.1828	0.1831

Values of K_p for $\theta = 0°, \alpha = 0°$

	δ' (deg) →				
↓ ϕ' (deg)	0	5	10	15	20
15	1.698	1.900	2.130	2.405	2.735
20	2.040	2.313	2.636	3.030	3.525
25	2.464	2.830	3.286	3.855	4.597
30	3.000	3.506	4.143	4.977	6.105
35	3.690	4.390	5.310	6.854	8.324
40	4.600	5.590	6.946	8.870	11.772

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall – 2021
Program: B.Sc. Engineering (Civil)

Course Title: Open Channel Flow Course Code: CE 361
Time: 3 hour Credit Hour: 03 Full Marks: 150

There are Five Questions. Answer All the Questions *(30*5 = 150)*
[Assume reasonable data if any]

1. a) Differentiate between steady flow and unsteady flow.
Consider the following data for the Padma river at the Baruria station in Faridpur on the 2nd July, 2021: A = 33,500 m^2, Q = 56,200 m^3/s and B = 3820 m. Compute the state of flow. Assume the river is wide. [15]

b) An engineer collected the following data given in the table during the stream-gauging operation at Jamuna river in a certain section. Compute the discharge and the mean velocity for the entire section.

Distance from left bank (m)	Total Depth, (m)	Meter depth (m)	Velocity (m/s)
0	0	0	
2	1.5	0.90	0.54
6	5.5	4.40	1.36
		1.10	1.81
9	7.5	6.00	1.51
		1.50	1.72
13	2.2	1.30	1.16
15	0	0	

[15]

2. a) Water is flowing at a velocity of 2 m/s and a depth of 2.5 m in a long rectangular channel 4.5 m wide. Compute the height of a smooth upward step in the channel bed to produce critical flow. Also, compute the change in water level produced by the step. Neglect energy losses and take $\alpha = 1$. [15]

b) A rectangular channel of 6 m wide and inclined at an angle of 5^0 with the horizontal carries a discharge of 20 m^3/s. Determine the jump type if the upstream depth of flow section is 0.30 m when the tail water depth is 3.20 m. Also, compute the energy loss in the jump if the length of the jump is 3 m.

OR,

Suppose, you are studying hydraulic jump in a horizontal trapezoidal channel. The channel has a base width of 5 m, side slope of 1:1 and Q = 30 m^3/s. Calculate the sequent depth and the energy loss involved in the jump. [15]

3. a) You are an Engineer in a firm and you are required to design a channel that conveys maximum discharge. You are working on a project to construct a trapezoidal channel carrying 20 m^3/s of discharge. The channel will be built with non-erodible bed that has a slope of 1 in 2500 and n = 0.012. Make necessary evaluations to design the channel so that it conveys the maximum discharge. Consider side slopes = 1. [15]

b) "The best hydraulic section is not necessarily the most economic section"- Explain why.
As an engineer, you need to construct a stable alluvial channel. The channel carry a discharge of 25 m^3/s through 1.5 mm sand. Design the channel using the Lacey's method. [15]

4. a) Illustrate the possible flow profiles in the following serial arrangements of channels or conditions. The flow is from left to right. (**Any Three**)
   (i) Adverse - steep
   (ii) Mild- Steep- Steeper
   (iii) Horizontal - Mild - Critical
   (iv) Critical - Adverse - Horizontal
   (v) Sluice gate in a steep slope channel [15]

   b) A flow profile of a wide rectangular river with a discharge of 1.8 m^2/s, $C = 45\ m^{1/2}/s$, and $S_0 = 0.0001$ is being tested by an engineer. He discovers that a weir raises the water level 0.50 m above its normal depth. Using the Bresse approach, calculate the length of the resulting flow profile between the weir site and the location where the depth is 2.8 m. [15]

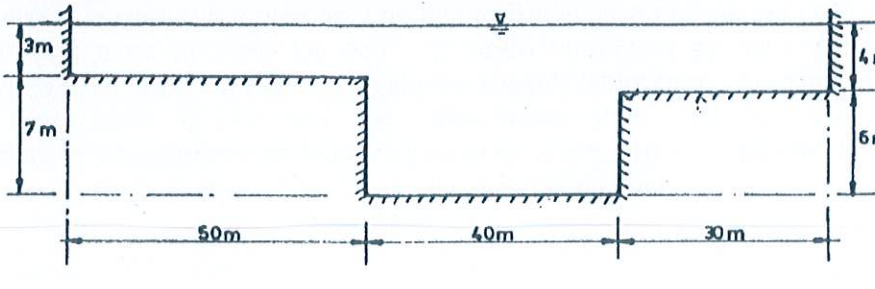
5. a) A rectangular channel with b = 6 m and n = 0.02 carries a discharge of 24 m^3/s. Evaluate the flow profiles produced in the channel for any three of the following changes in the bottom slope.(**Any Three**)
   i) $S_0 = 0.001$ to $S_0 = 0.0045$
   ii) $S_0 = 0.0095$ to $S_0 = 0.0075$
   iii) $S_0 = 0.0085$ to $S_0 = 0.001$
   iv) $S_0 = 0.0000$ to $S_0 = 0.0045$
   v) $S_0 = 0.0040$ to $S_0 = 0.0065$ to $S_0 = 0.0090$ [15]

   b) As an engineer, you must examine a flood-affected river with a 1000-meter length reach and a 0.85 meter drop in water surface (using slope-area method). Ignore the loss of eddy. Calculate the amount of water that will be discharged in the event of a flood. Make use of the following information:

Section	A(m^2)	P(m)	n	α
Upstream	12,000	2,150	0.03	1.15
Downstream	10,500	2,050	0.03	1.18

OR,

A channel consists of a main section and two side sections as shown below. Compute the total discharge, the mean velocity of flow and the Manning's n for the entire section when n = 0.025 for the main channel = 0.045 for the side channels and So= 0.0002. Also, compute the numerical values α and β for the entire section assuming that α = β = 1.00 for the main and the side sections.



[15]