Set A

University of Asia Pacific
Department of Civil Engineering
Final Examination-Spring 2022
Program: B.Sc. Engineering (Civil)

Course Title: Principles of Accounting | Credit Hour: 2 | Course Code: ACN 301
Time: 2 hours | Full Marks: 50

Instructions:

I. **Answer All of the following questions.**
II. **Figures in the right margin indicate full marks.**
III. **You are advised to submit your question paper along with the answer script.**

Q1(a): Orion Ltd. Is considering a proposal to install a new machine. The project will cost tk. 100000 and its expected life is 5 years. The estimated cash inflows before tax (CFBT) of the project are as follows:

Year	CFBT
1	25000
2	30000
3	35000
4	40000
5	45000

The Tax rate of the company is 50% and charges depreciation on straight line basis. You are required to calculate:

1. Pay Back Period
2. Average rate of return
3. NPV at 10% discount rate
4. IRR with 10% and 12% trial
5. Profitability Index at 10% discount rate.

Q1(b): Describe the scope of the capital budgeting. What are the challenges that come with using the capital budgeting method? **(Mark=7 + 3)**

Q2(a): A joint stock company's most recently monthly contribution format income statement are as follows:

	Amount	% of sales
Sales	80000	100%
Variable Expenses	32000	40%
Contribution Margin	48000	60%
Fixed Expenses	38000	
Net Operating Income	10000	

1. Compute the company's degree of operating leverage
2. Using the DOL, estimate the impact on net income of a 5% increase in sales.
3. Verify your estimate from part 2 above by constructing a new contribution format income statement of the company assuming a 5% increase in sales.

Q2(b): Describe CVP Analysis. Examine the fundamental elements of cost volume profit analysis.

(Mark=7 + 3)

Q3: The comparative balance sheets of Taposhi corporation are presented below:

Assets	2016	2015
Current Assets	76000	80000
Property and Equipment	99000	90000
Intangibles	25000	40000
Total Assets	200000	210000
Liability and owners equity	2016	2015
Current Liabilities	45800	48000
Long term liabilities	138000	150000
Owners equity	16200	12000
Total liability and owners equity	200000	210000

Required: 1. Prepare a horizontal analysis of the balance sheet data using 2015 as a base.
2. Prepare a vertical analysis of the balance sheet data for the company.

(Mark = 10)

Q4: The following are the monthly budget of a manufacturing overhead of a concern for two levels of activity:

	Tk	Tk
Production Capacity %	60%	100%
Budgeted Production Units	600	1000
Indirect Wages	1200	2000
Consumable stores	900	1500
Maintenance	1100	1500
Power and Fuel	1600	2000
Depreciation	6000	6000
Insurance	2000	2000
The Sales Price per unit is 20 At 70% capacity Level, sales price will increase by 2% At 90% capacity level, sales price will decrease by 5%		

1. Indicate of which items are fixed, variable and semi-fixed?
2. Prepare a flexible budget for 70% and 90% activity level
3. Give your comment on the profitability **(Mark = 10)**

Q5(a): Monir Fashion house produces 9000 units in two shift of which cost are as follows:

Direct Material	126000
Direct Labor	81000
Factory Overhead	54000
Administrative Expenses	36000
Selling Expenses	31500

Other Information:

75% of factory overhead, 100% of administrative expenses and 70% of selling expenses are fixed. The company wants to start third shift to increase the production proportionately. If third shift is started, the cost of raw material reduced by 1%, direct labor of third shift will increase by 30%. Fixed factory overhead increase by tk 5000 and selling price will reduce from 45 to 42

Required: Should the third shift be started?

Q5(b): Discuss the rationale behind the various types of liquidity, profitability, and solvency ratios.

(Mark = 7 + 3)

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2022
Program: B. Sc. Engineering (Civil)

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

Course Code: CE 311
Full Marks: 100

Answer all the Questions
Assume any missing data reasonably.

1. A cable is suspended from the points A and B which are 100m apart horizontally and the ends are at 8m and 15m above the lowest point of the cable. The cable is carrying a UDL of w kN/m over the horizontal span. Calculate the reaction at the ends and the maximum & minimum tension in the cable. Also calculate the sag at the lowest point, where w= 20 kn/m, if roll is even or w= 30 kn/m, if the roll is Odd. (14)

2. Analyze the Frame in Fig. 1 and draw the bending moment diagram. Show the free body diagrams. (14)

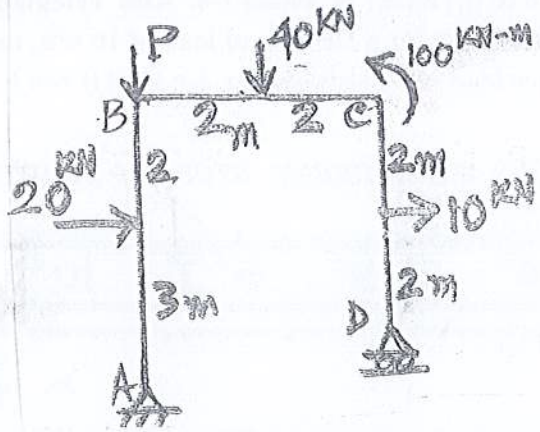


Fig. 1

P = 20 kN, if Roll = even,
P = 30 kN, if Roll = Odd.

3. Draw the Influence line, find the wheel position & then calculate the maximum shear force at a section 8m from the left support A of a simply supported beam of 30 m for the wheel load arrangement shown in Fig. 2, where P= 2, if roll is even or P= 3, if the roll is Odd. (14)

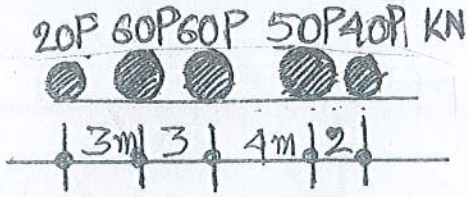


Fig. 2

4. Draw the Influence line, find the wheel position & then Calculate the maximum bending moment at 30m from the left support of a simply supported beam of 50m for the wheel load arrangement shown in Fig. 3, where P= 2, if roll is even or P= 3, if the roll is Odd. (14)

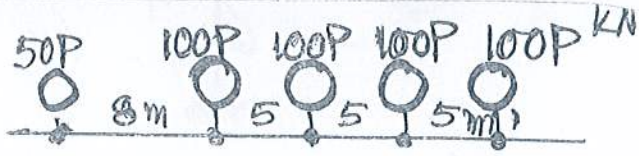


Fig. 3

5. Draw the Influence line for the force in members A,B &C of the truss in Fig. 4. Calculate the maximum value of the force in the bar C for the combination of UDL dead load of 16 k/ft, moving UDL live load of 24k/ft and a point live load of 50 kips, where where A= 12ft & H= 24Ft , if roll is even or A= 18ft & H= 36Ft , if the roll is Odd. (14)

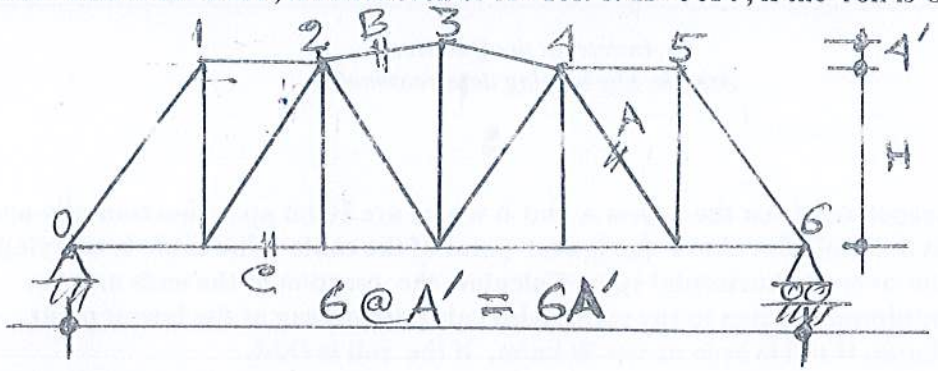


Fig.4

6. The girder supports a floor system as shown in Fig. 5. Draw influence line for : (15)
(i) Bending Moment at PP- 4 & (ii) Shear in Panel 3-4. Also calculate the maximum shear force in Panel 3-4 for a UDL dead load of 16 k/ft, moving UDL live load of 24k/ft and a point live load of 50 kips, where L= 12Ft if roll is even or L= 17Ft if the roll is Odd.

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

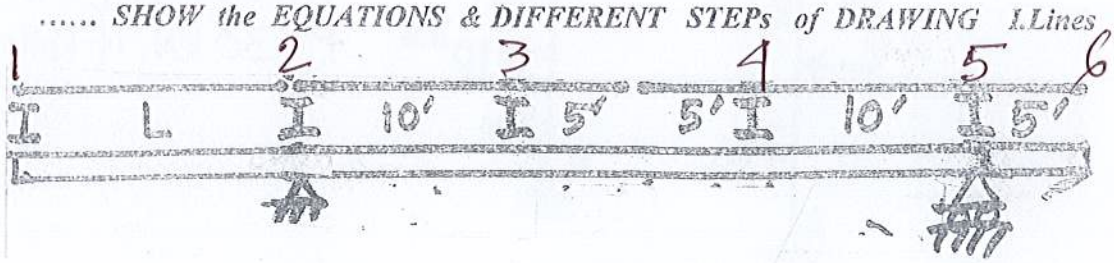


Fig.5

7. For the frame in Fig.6 draw the Influence line for the reactions and bending moment at the section k and G. (15)

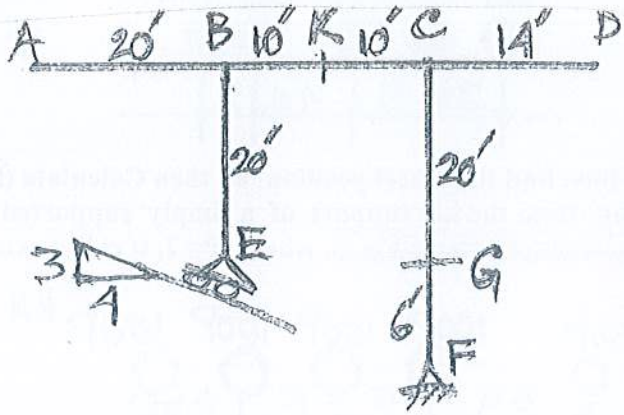


Fig.6

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2022 (Set 1)
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: $f_c' = (4 + 0.01R)$ ksi, $f_y = 15f_c'$, $f_{call} = 0.45f_c'$, $f_{sall} = 0.4f_y$, R_0 = Last two digits of Registration #]

1. Fig. 1(a) shows the maximum axial forces on the cross bar (beam) and side post (columns) of a football goal post (made of Reinforced Concrete) hit by a ball applying force P. The ± options are chosen to incorporate any direction of the force. Calculate the
   (i) Required dimensions (Width b = Depth h) of the square column, assuming steel ratio $\rho_{st} = 0.01$.
   (ii) Cracking moment of the section obtained in (i).

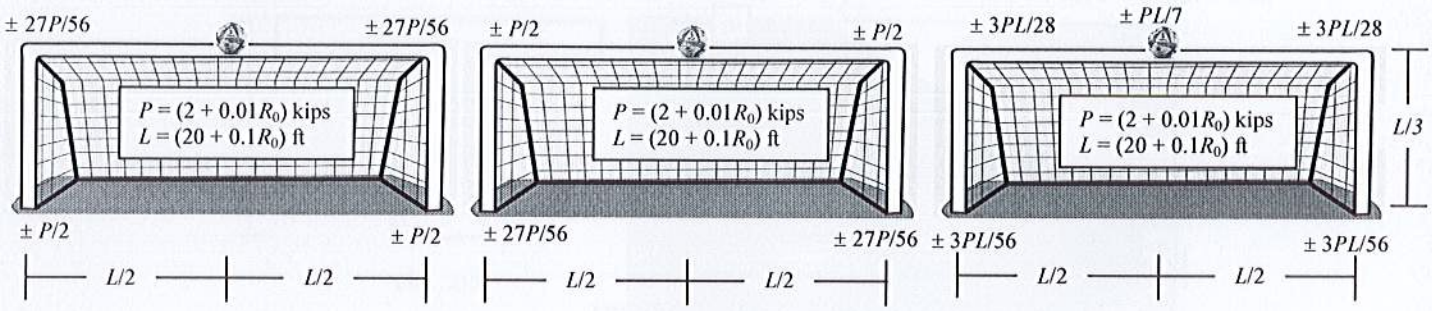


Fig. 1: (a) Axial Forces on Goal Post (b) Shear Forces on Goal Post (c) Bending Moments on Goal Post

2. Fig. 1(b) shows the maximum shear forces on the cross bar (beam) and side post (columns) of a football goal post (made of Reinforced Concrete) hit by a ball applying force P. The ± options are chosen to incorporate any direction of the force.

   For the applied force, design (by WSD method) the RC beam for shear; i.e.
   (i) Obtain the required dimensions ($b = h$) of the beam
   (ii) Design appropriate shear reinforcements for the beam
   Also sketch the longitudinal profile of the beam with shear reinforcements.

3. For the applied force, design (by USD method) the RC column for shear [Fig. 1(b)]; i.e.
   (i) Obtain the required dimensions ($b = h$) of each column
   (ii) Design appropriate shear reinforcements for a column
   Also sketch the longitudinal profile of the column with shear reinforcements.

4. Fig. 1(c) shows the maximum bending moments on the cross bar (beam) and side post (columns) of a football goal post (made of Reinforced Concrete) hit by a ball applying force P. The ± options are chosen to incorporate any direction of the force.

   For the applied force, design the RC beam for moment; i.e.
   (i) Obtain the required dimensions (using $b = h$) of the beam using WSD
   (ii) Design the beam by USD using dimensions ($b = h$) obtained in 4(i)
   Also sketch the longitudinal profile of the beam with appropriate longitudinal reinforcements.

5. For the applied force, design the RC beam for moment [Fig. 1(c)]; i.e.
   (i) Obtain the required dimensions (using $b = h$) of the beam using steel ratio ρ_{max} in USD
   (ii) Design the beam by WSD using dimensions ($b = h$) obtained in 5(i)
   Also sketch the longitudinal profile of the beam with appropriate longitudinal reinforcements.

6. Calculate the development length of 16^{mm}-diameter bars (confined by 10^{mm}-diameter ties @4″ c/c, using uncoated bars and normal-weight concrete) for
   (i) Tension for moment in (5″× 5″) Beam, (ii) Compression in Column [shown in Figs. 1(a)~(c)].

7. Fig. 2 shows a reinforced concrete gallery-slab of span $L = (20 + 0.1R_0)$ ft, in a football stadium.

   In addition to stairs with 10″ treads and 6″ risers, it is expected to carry live load $LL = (200 + R_0)$ psf.

   Use the WSD method to design the gallery as a simply-supported slab.

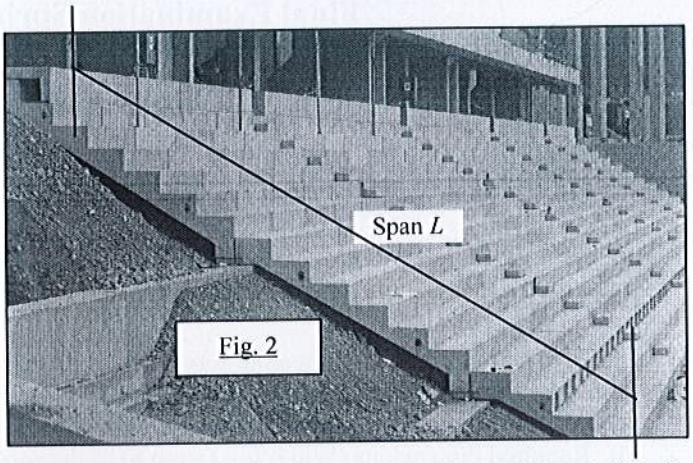


Fig. 2

8. Fig. 3(a) shows a reinforced concrete gallery-slab (in a football stadium) of span $L_{12} = (20 + 0.1R_0)$ ft and width $S = L_{12}/2$, supported on simply-supported L- and T-beams.

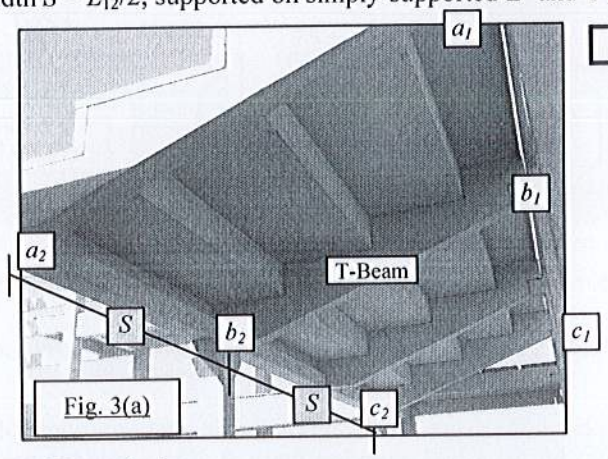


Fig. 3(a)

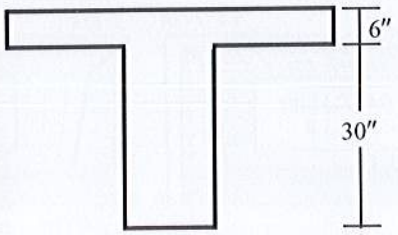


Fig. 3(b)

   Use the USD method to

   (i) Calculate the maximum steel area (A_s) required for the simply-supported central T-beam b_1b_2 [section shown in Fig. 3(b)] of span L_{12} supporting the reinforced concrete gallery-slab to behave like a rectangular beam (i.e., $c = t$) and corresponding maximum distributed load (w_1) on it.

   (iii) Calculate the required steel area in T-beam b_1b_2, if the distributed load (w) on it is 10% larger than the distributed load (w_1) calculated in (i) (i.e., $w = 1.1w_1$).

9. Use the USD method to design the simply-supported reinforced concrete gallery-slab (of span $S = L_{12}/2 = (10 + 0.05R_0)$ ft), assumed as 6″slabs shown in Fig. 3(b) if the live load LL on it is $= (200 + R_0)$ psf.

10. (i) Use ACI coefficients for maximum positive and maximum negative moment to design (by USD) the continuous (two-span) beam $a_2b_2c_2$ shown in Fig. 3(a) with span lengths $S = (10 + 0.05R_0)$ ft.

    (ii) Draw longitudinal profile of the reinforced beam showing the locations of standard bar curtailment.

PART B

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

11. (i) Explain which method between WSD and USD you would choose as a structural designer. Also mention when you might make exceptions to this choice.

    (ii) Identify the beam failure modes shown in Fig. 4(a) and Fig. 4(b). Also explain why the beams have failed in these modes.

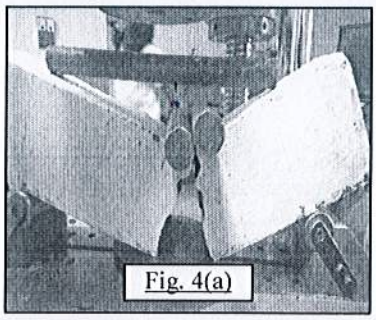


Fig. 4(a)

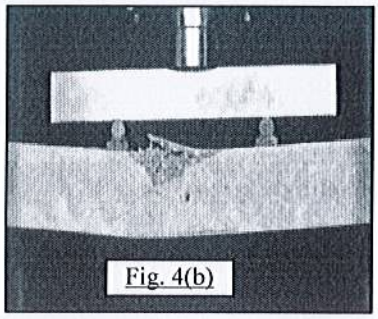


Fig. 4(b)

12. (i) Explain how to calculate the minimum depth (d_{req}) required for a RC section designed for shear
    (a) without Shear Reinforcement, (b) with Shear Reinforcement.

    (ii) Identify the beam failure modes shown in Fig. 5(a) and Fig. 5(b). Also explain why the beams have failed in these modes.

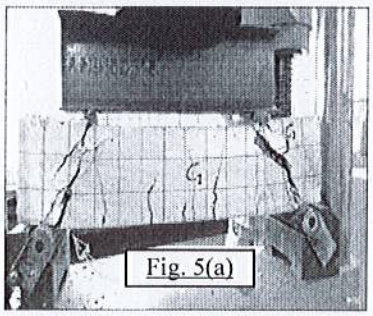


Fig. 5(a)

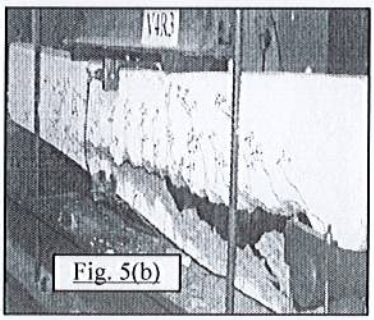


Fig. 5(b)

13. Explain what would happen
    (i) If a cantilever slab is made thinner than that prescribed by design code. Also explain what you would suggest should be done in this case.
    (ii) If a slab designer uses steel area smaller than that required as temperature/shrinkage reinforcement.

14. (i) Briefly explain why development length of reinforcing bars are influenced by
    (a) Cover Dimensions, (b) Transverse Reinforcements.

    (ii) What are bar splices? Show suitable zones for providing lab splices in a
    (a) Simply Supported Beam, (b) Continuous Beam.

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2022
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 water stability with respect to "scale forming water", "corrosive water," and the Bayliss curve. (8+12)

Comment on the stability of a raw water sample with the following characteristics:

Total alkalinity = 110 mg/L as $CaCO_3$; Hardness: 120 mg/L as C aCO_3; Calcium = 46 mg/L as Ca^{2+}; Magnesium = 1.2 mg/L as Mg^{2+}; TDS = 250 mg/L; pH = 8.2; Temperature = 30°C
Utilize the equation of the Langelier Saturation Index (LI) as follows:
$LI = pH - pH_s$
Where $pH_s = (pK_2 - pK_s) + pCa^{2+} + pAlk$
$pK_2 - pK_S$ = constants based on the ionic strength and TDS of water
pCa^{2+} = negative logarithm of Calcium ion in moles/liter
$pAlk$ = negative logarithm of total alkalinity in equivalents/liter
The necessary table is attached.

(b) Provide an account of the processes upon which Groundwater recharge and discharge. (8)

OR

Explain "Drawdown" in the light of Darcy's Law and Flow towards well. Provide reasoning on how the evaluation of Steady flow in a confined aquifer is different from the Steady flow in an unconfined aquifer.

(c) As an Environmental Engineer, you are required to study the feasibility of the groundwater and surface water sources as viable options for water supply. Make an evaluation of the problems of both sources if you are required to consider both groundwater development and surface water development. Provide your answer in bullet points in a table for both sources side by side. (8)

2(a) A **1,550m³/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}. (14)

Also, design a flocculator basin when the flow is evenly split between two flocculator trains each with three tanks; Detention time 25 minutes; Depth 3.5 m; Flocculator G for tanks: 70, 50 and 30 s^{-1} Assume that the absolute viscosity of the water is 8.91×10^{-4} Pascals.second. Include power calculations.

(b) Explain why and when you would choose roughing filters. Also, explain when you would prioritize rapid sand filters over slow sand filters in the light of suitability and feasibility of treatment considerations. Consider the filter beds have been clogged in your system, explain the process of cleaning these. (10)

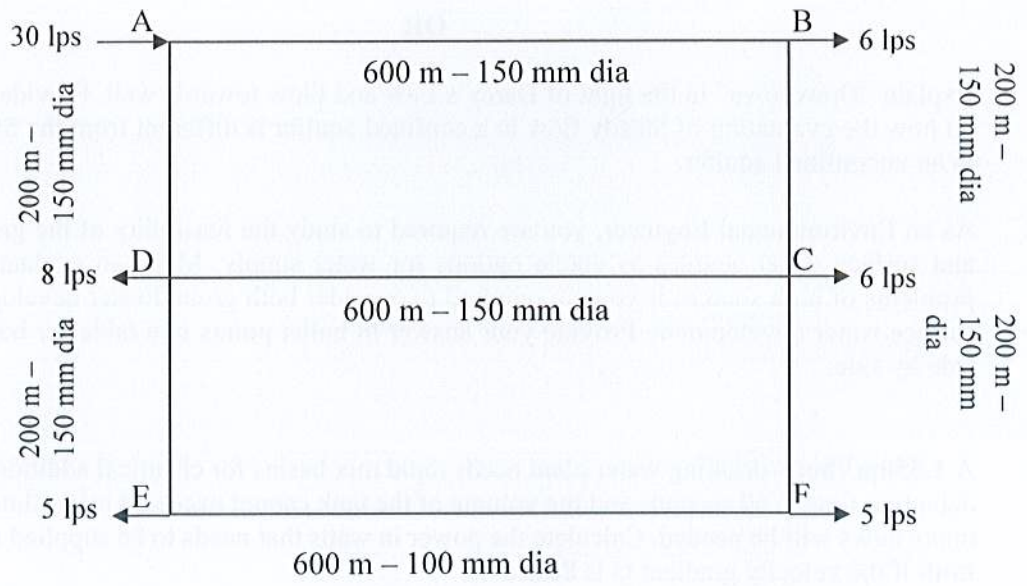
OR

Provide a brief account (preferably with figures) on how it is possible to determine the optimum coagulant dosage. Explain where (in the water treatment flow chart) and for what purpose you will use pre-chlorination, post chlorination, and break-point chlorination.

SECTION – B

3 (a) You are designing a water distribution network for your city and you want it to be easily expandable in future so that newly developed areas could be covered. Which network system would you choose? Compare between branch network and looped network. (5)

(b) Calculate the flow in each of the pipes in the following looped pipe network (using the Hardy Cross method and two trials are required): (15)



(c) What are the ways that the "Net Positive Suction Head" that is available in a pump could be adjusted/raised so that it is higher than the "Net Positive Suction Head" that is required? Show with a figure how the operating range for a pump can be obtained if the system head curves are given for minimum and maximum heads? (7)

OR

Express your understanding of "Well Development," by mentioning the methods. Provide certain pointers on the dispersing agents for well development and well maintenance.

(d) Water has to be pumped from an elevation of 25 ft to an elevation of 40 ft. The pump is located at an elevation of 32 ft. The pipe has a total length of 1200 ft (supply main, 200 ft and distribution main, 1000 ft), diameter = 10 inches, and friction faction = 0.01. The pump characteristics curve has to be plotted using the following data of flow versus head. (9)

Q, gpm	0	1000	2000	3000	4000	5000
H, ft	75	72	70	60	50	0

Find out the discharge of water in the system. [Assume: pipe entrance is well rounded i.e. r/D>0.2, $K_{entrance} = 0.03$, $K_{bend} = 0.35$, $K_{exit} = 1$]

4 (a) Which alternative water supply options can be adopted if the nearby pond water is required for drinking purposes? Explain the technologies in brief. (8)

OR

Explain with justification and features which kind of tubewell (among the ones of your knowledge for a given set of requirements) you would decide to install as a separate case for each of the following conditions:

i) Agricultural purpose
ii) For lower lifting head (water table remains within 10 m from ground surface)
iii) For an area with very fine sand

(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 **the water supply system that you studied or were involved in during your project work for CE 332.** (8)

(c) 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 Manganese (10 mg/L) and Iron (5 mg/L). Water supply is intermittent as DTW pumps are operated for only a few hours each day while leaks are detected frequently, 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 Mn concentration in groundwater, (ii) high Fe concentration in groundwater; and (iii) entry of contaminants to the distribution system. Use the attached tables for a semi-quantitative approach and provide suitable justification for choosing the likelihood and impact categories. Also, point out which control measures you would choose in order to solve all three problems? (8)

Given Formulae

$t_d = V/Q$; $G = \sqrt{(P/\mu V)}$

$$h_L = 1.39 \times 10^6 Q^{1.85} D^{-4.87} \quad \textit{(when C = 130)}$$

$$\Delta = -\frac{\sum H}{x \sum H / Q_a}$$

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

TDS, mg/L	$pK_2 - pK_s$ 0°C	10°C	20°C	30°C	40°C	50°C	80°C
	2.45	2.23	2.02	1.86	1.68	1.52	1.08
40	2.58	2.36	2.15	1.99	1.81	1.65	1.21
80	2.62	2.40	2.19	2.03	1.85	1.69	1.25
120	2.66	2.44	2.23	2.07	1.89	1.73	1.29
160	2.68	2.46	2.25	2.09	1.91	1.75	1.31
200	2.71	2.49	2.28	2.12	1.94	1.78	1.34
240	2.74	2.52	2.31	2.15	1.97	1.81	1.37
280	2.76	2.54	2.33	2.17	1.99	1.83	1.39
320	2.78	2.56	2.35	2.19	2.01	1.85	1.41
360	2.79	2.57	2.36	2.20	2.02	1.86	1.42
400	2.81	2.59	2.38	2.22	2.04	1.88	1.44
440	2.83	2.61	2.40	2.24	2.06	1.90	1.46
480	2.84	2.62	2.41	2.25	2.07	1.91	1.47
520	2.86	2.64	2.43	2.27	2.09	1.93	1.49
560	2.87	2.65	2.44	2.28	2.10	1.94	1.50
600	2.88	2.66	2.45	2.29	2.11	1.95	1.51
640	2.90	2.68	2.47	2.31	2.13	1.97	1.53
680	2.91	2.69	2.48	2.32	2.14	1.98	1.54
720	2.92	2.70	2.49	2.33	2.15	1.99	1.55
760	2.92	2.70	2.49	2.33	2.15	1.99	1.55
800	2.93	2.71	2.50	2.34	2.16	2.00	1.56

Risk = Likelihood × Impact

Estimation of "Risk Score" and Risk Categorization:

Likelihood	Impact: Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
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 Spring 2022
Program: B.Sc. Engineering (Civil)

Course Title: Geotechnical Engineering I | Course Code: CE 341
Time: 3 hours | Credit Hour: 3.0 | Full Marks: 120

*[There are **Eight** questions here. **Answer all** the questions. Related formulae, charts are given in the Appendix. Assume reasonable values of any data, if missing. Digits in the right margin inside the 1st parentheses indicates marks]*

1. a) Explain the following: (6)

i) Residual soil deposits
ii) At rest earth pressure
iii) Quick Sand

b) Classify the following two inorganic soils according to USCS: (9)

Soil A: % Finer No.200 sieve (0.075 mm) = 93
Liquid Limit = 58%
Plastic Limit = 23%

Soil B: % Finer No.4 sieve (4.75 mm) = 92
% Finer No.10 sieve (2.0 mm) = 60
% Finer No.40 sieve (0.425 mm) = 30
% Finer No.200 sieve (0.075 mm) = 10
Liquid Limit = 37%
Plastic Limit = 26%

2. a) What does it mean by peat soil? List the common rock forming minerals. (5)

b) A "T" shaped foundation is loaded with a uniform load of 100kN/m^2 as shown in **Fig.1.** Estimate the vertical pressure at a point which is 7.0 m below the point "G". (10)

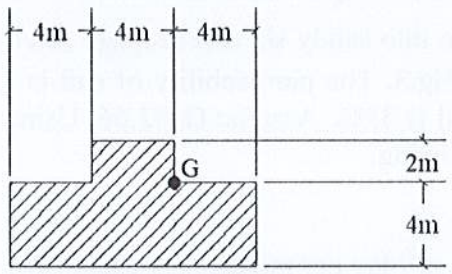


Fig. 1

OR

b) Calculate the magnitude of vertical pressure(ksf/ft) at "A" which is 21 feet below the ground level due to an embankment loading shown in **Fig.2**

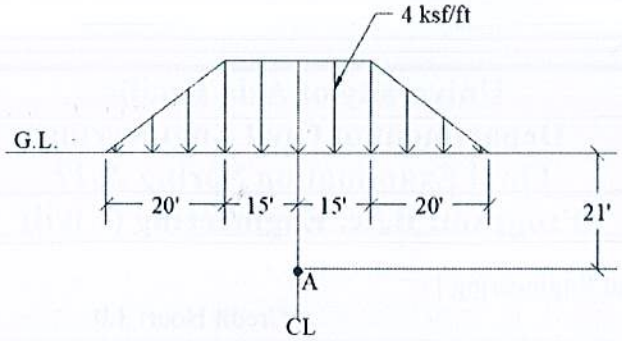


Fig. 2

3. **a)** Define shrinkage limit. Illustrate graphically the volume change behavior of soil at 4 different states or conditions depending on the water content. (5)

b) The following data were obtained in a shrinkage limit test: (10)
Weight of shrinkage dish = 11.85 gm
Volume of shrinkage dish = 17.29 cm^3
Weight of shrinkage dish + saturated soil = 40.78 gm
Weight of shrinkage dish + oven-dry soil pat = 32.46 gm
Weight of mercury displaced by oven-dry soil pat = 145.5 gm
Calculate the shrinkage limit, shrinkage ratio and specific gravity of soil solids (G_s). Assume unit weight of water at test temperature to be 0.99589 gm/cm^3.

OR

b) A sample of clayey soil was tested for liquid limit in a cone penetrometer and the following results were obtained:

Cone penetration (mm)	16	18	22	25	30
Water content (%)	33	40	54	63	83

Determine the liquid limit of the soil and also check the result for single point method using the relevant data.

4. **a)** Why is a filter used on the downstream side of an earth dam/embankment? How would you choose the material used for filter? (5)

b) A sheet pile is driven into sandy silt and seepage takes place under the head difference of 9.0 m as shown in **Fig.3.** The permeability of soil is given as $1.6x10^{-4}$cm/sec and the water content of the soil is 33%. Assume Gs=2.66. Using the flow net diagram shown in **Fig.3**, compute the following: (10)

i) Seepage flow in m^3/day per meter.
ii) Effective pressure and pore water pressure at point "A", and
iii) Factor of Safety with respect to soil heaving using Terzaghi's criterion.

[please attach the page-5 of your question paper at the end of your answer script]

5. **a)** Discuss about the drainage conditions and pore pressure at the end of two different stages of loading in 3 triaxial tests (UU, CU & CD). Also give examples at what situation you suggest which test. (6)

b) A specimen of saturated normally consolidated clay sample was fully consolidated in the triaxial cell under a cell pressure of 200 kN/m^2. Pore pressure within the specimen at the end of consolidation was zero. Deviator stress was then applied under undrained condition and increased until failure took place. The values of deviator stress and pore pressure at failure were found to be 150 kN/m^2 and 50 kN/m^2, respectively. A second specimen of the same sample was fully consolidated in the triaxial cell under a cell pressure of 300 kN/m^2. Pore pressure within this specimen at the end of consolidation was zero. Deviator stress was then applied under undrained condition and increased until failure took place. Calculate the following: (9)

(i) The values of effective angle of internal friction (ϕ') and undrained angle of internal friction (ϕ_u) of the sample.
(ii) The values of pore pressure at failure (u_f) and the pore pressure parameter A at failure (A_f) of the second specimen.

OR

b) The following results were obtained at failure in Consolidated Undrained (CU) triaxial compression tests conducted on three specimens of a clay sample:

Specimen No.	Cell Pressure (kN/m^2)	Deviator stress (kN/m^2)	Pore water Pressure (kN/m^2)
1	100	170	-15
2	200	260	-40
3	300	360	-80

Draw the Mohr-Coulomb Failure Envelope in a plain graph paper and hence estimate the values of effective shear strength parameters c' and Ø'. Also write down the Mohr-Coulomb equation for the effective stress failure envelope.

6. **a)** Starting from $\omega = \frac{Ww}{Ws}$, derive the expression $Se = \omega Gs$; where symbols have their usual meanings. (5)

b) A sample of sand above water table was found out to have a moisture content of 15% and a unit weight of 18.84 kN/m^3. Laboratory test on a dry sample indicated the values e_{min}= 0.50 and e_{max}= 0.85 for the densest and loosest states respectively. Compute the degree of saturation and the relative density. Assume G_s= 2.65. What will be the saturated density of sand in the field? (10)

OR

b) The data from a Modified Proctor compaction test on a soil (G_s=2.64) are given as:

Water Content (%)	9.3	12.8	15.5	18.7	21.1
Dry density (ton/m^3)	1.873	1.910	1.803	1.699	1.641

Plot the compaction curve along with zero air void line and find the optimum water content and the maximum dry density for this test.

7. **a)** From the e-logp' plot shown in **Fig-4**, find (using the attached figure) the value of pre-consolidation pressure by Casagrande graphical procedure_ (5)

[please attach the page-5 of your question paper at the end of your answer script]

b) A footing is placed on a sandy layer underlying a normally consolidated silty clay stratum, with properties shown in **Fig. 5**.

Calculate__ (10)

i. Primary consolidation settlement of the clay layer.
ii. Time required to attain 2.17 inch of settlement.
iii. Settlement after 6 months.

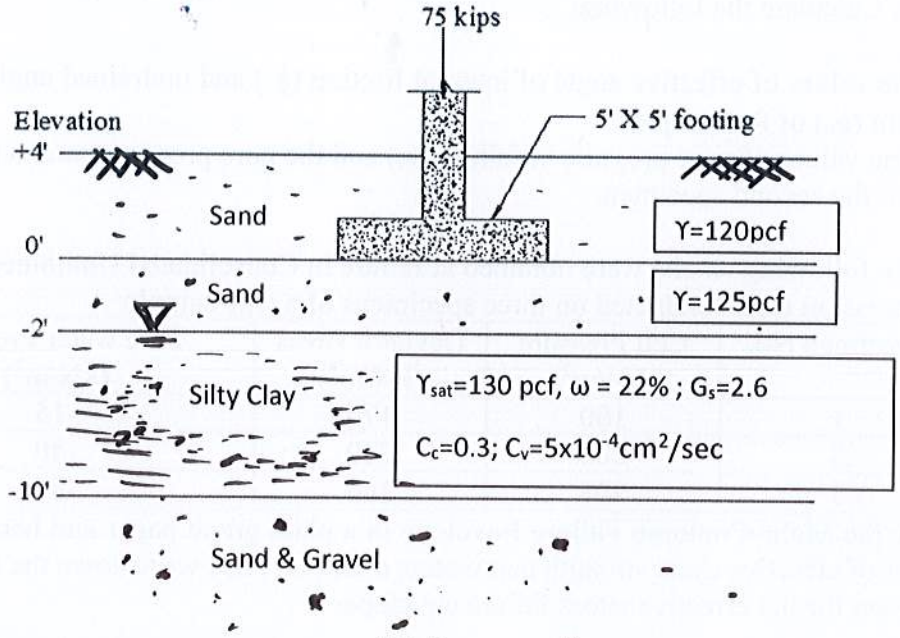


Fig. 5

8. a) Differentiate between __ (4)

i) Compaction and Consolidation
ii) Normally Consolidated clay and Over Consolidated clay.

b) For the retaining wall shown in **Fig.6**, determine the total force per unit length of the wall for Rankine's Active state. Also find the location of the total passive force. (11)

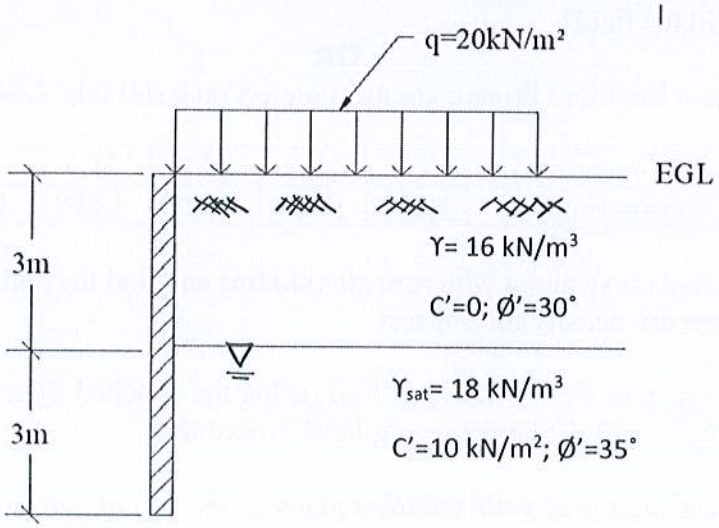


Fig. 6

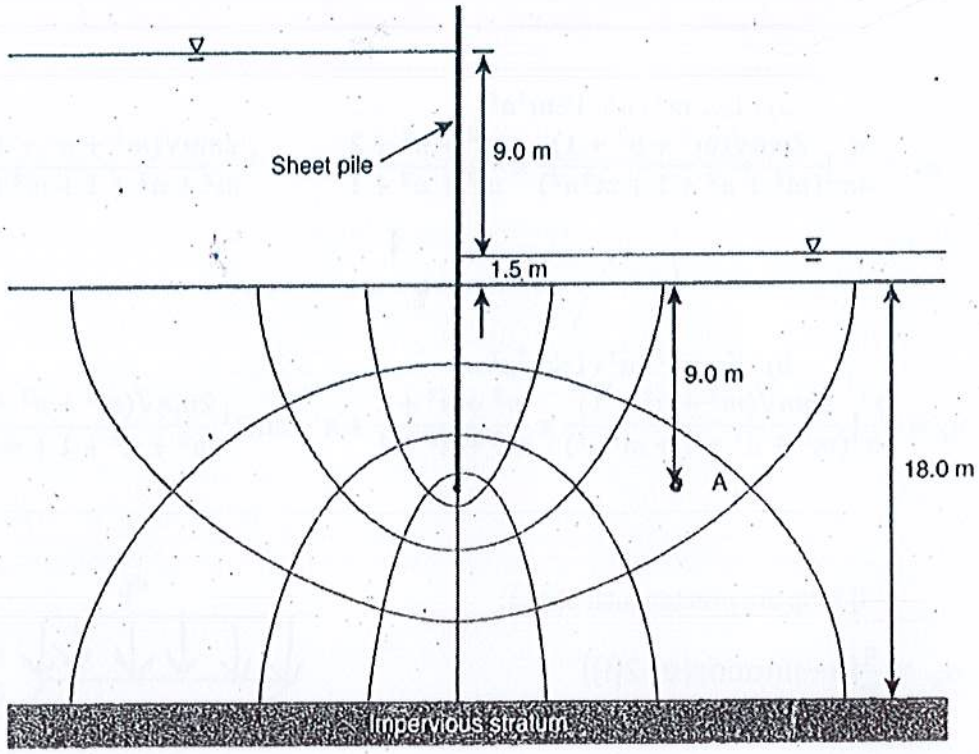

Sheet pile
9.0 m
1.5 m
9.0 m
A
18.0 m
Impervious stratum

Fig. 3

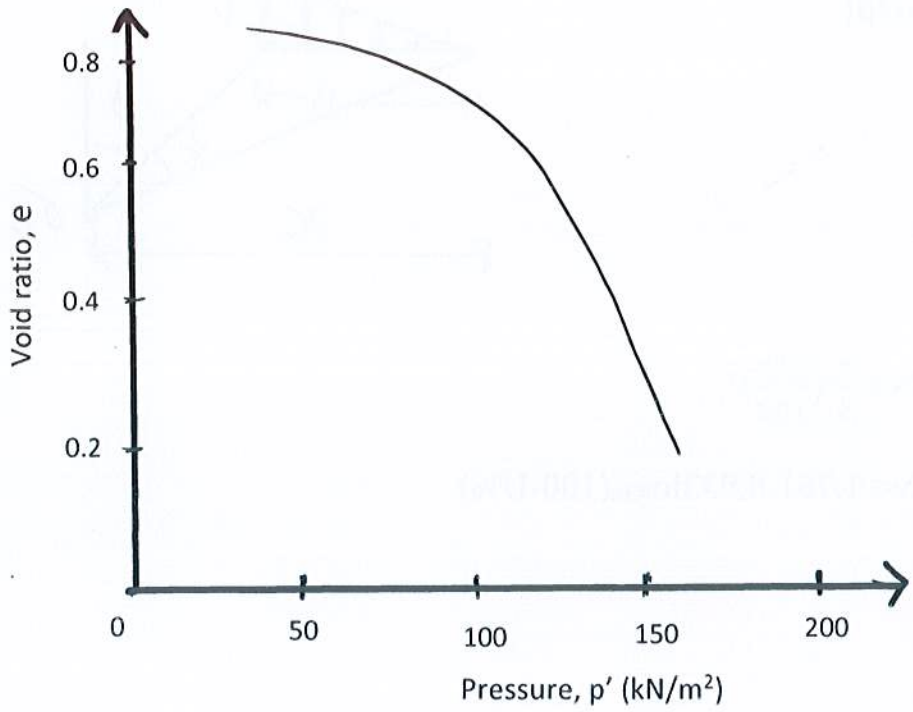

0.8
0.6
0.4
0.2
Void ratio, e
0
50
100
150
200
Pressure, p' (kN/m²)

Fig. 4

- a) For $\mathbf{m^2+n^2+1>m^2n^2}$

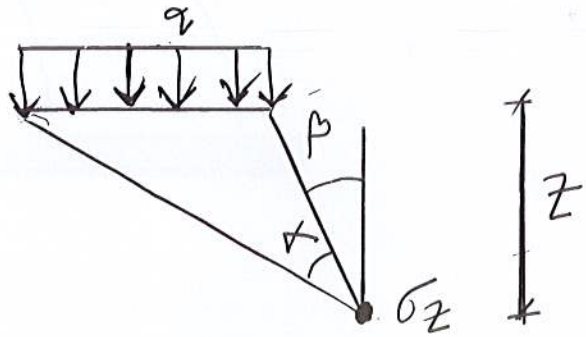
$$\sigma_z = \frac{q}{4\pi}\left[\frac{2mn\sqrt{(m^2+n^2+1)}}{(m^2+n^2+1+m^2n^2)} \times \frac{m^2+n^2+2}{m^2+n^2+1} + \sin^{-1}\frac{2mn\sqrt{(m^2+n^2+1)}}{m^2+n^2+1+m^2n^2}\right]$$

- b) For $\mathbf{m^2+n^2+1<m^2n^2}$

$$\sigma_z = \frac{q}{4\pi}\left[\frac{2mn\sqrt{(m^2+n^2+1)}}{(m^2+n^2+1+m^2n^2)} \times \frac{m^2+n^2+2}{m^2+n^2+1} + \pi - \sin^{-1}\frac{2mn\sqrt{(m^2+n^2+1)}}{m^2+n^2+1+m^2n^2}\right]$$

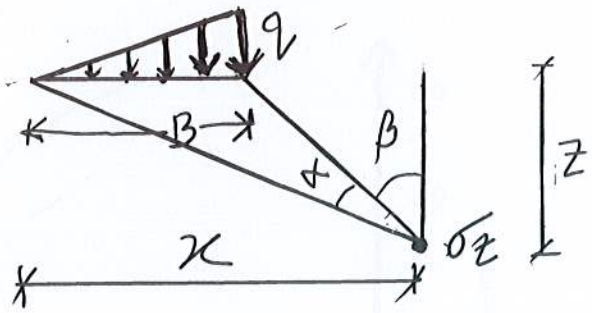
- i) Strip area rectangular shape:

$$\sigma_z = \frac{q}{\pi}[\alpha+\sin\alpha\cos(\alpha+2\beta)]$$



- ii) Strip area triangular shape:

$$\sigma_z = \frac{q}{2\pi}\left[\frac{2x}{B}\alpha\text{-}\sin 2\beta\right]$$



- For U≤60%; $Tv = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2$

  For U>60%; $Tv = 1.781-0.933\log_{10}(100-U\%)$

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring – 2022
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) In a wide channel the velocity varies along a vertical as $u = 1 + 3(z/h)^{1/2}$, where h is the depth of flow and u is the velocity at a distance z from the channel bottom. The river is 5 m deep.

i) Compute the discharge per unit width
ii) Estimate the state of flow
iii) Compute the velocity distribution coefficients (α and β). **[15]**

b) Explain how pressure distribution varies in curvilinear channels in comparison with parallel channel.
Padma bridge across the Padma river has its piers placed symmetrically at the upstream at the rate of 30 m center to center. Upstream of the bridge, the water depth is 10 m and the velocity is 4 m/s. When the flow has gone far enough downstream to even out the disturbance caused by the piers, the water depth is 9 m. Compute the thrust on each pier. Neglect the bed slope and the bed friction. Assume $\alpha = \beta = 1$. **[15]**

2. a) Calculate the bottom width and velocity in a trapezoidal channel with s = 1.5, n=0.020 and S_0=0.0002 which carries a discharge of 25 m^3/s at a normal depth of 2 m.

OR,

A broad-crested weir is built in a rectangular channel of width 1 m. The height of the weir crest above the channel bed is 0.60 m and the head over the weir is 0.40 m. Calculate the discharge. **[15]**

b) A hydraulic jump occurred in a horizontal rectangular channel of 6 m wide and 0.52 m depth. The length of the jump is found 29.56 m. Determine

i. Type of jump
ii. Efficiency of the jump
iii. Relative height of the jump **[15]**

3. a) An irrigation canal has to carry a discharge of 30 m^3/s through a course non-cohesive material having d_{50} = 2 cm, d_{75} = 3 cm and n = 0.025. The angle of repose of the perimeter material is 32^0. The canal is to be trapezoidal in shape having s = 2 and laid on a slope of 1 in 1000. Design section dimensions of the channel by following the step by step approach as detailed in Lane's method. **[15]**

b) A lined channel (n= 0.015) is to be laid on a slope of 1 in 2000. The side slope of the channel is to be maintained at 1.5:1. Construct a trapezoidal section with rounded corners to carry a discharge of 80 m^3/s when the maximum permissible velocity is 2 m/s. **[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)** Steep- Mild - Milder
- **(ii)** Mild – Critical – Steep (Sluice gate on the critical slope)
- **(iii)** Horizontal – Adverse – Steep – Free overfall
- **(iv)** Mild – Adverse - Horizontal **[15]**

b) An Engineer is experimenting with a rectangular testing channel which is 0.6 m wide and is laid on a slope of 0.1%. Discharge of the channel was obtained at 0.23 m^3/s and normal depth of flow was measured at 0.4 m when the channel bed and walls were made smooth of neat cement. Again the Engineer roughened the channel by cemented sand grains and obtained the discharge at 0.12 m^3/s and normal depth was measured at 0.35 m. Now investigate how the Engineer can determine the discharge through the same channel for a normal depth of 0.45 m if the walls are smooth and the bed is rough. **[15]**

5. a) A 6 m wide rectangular channel and having n = 0.025 has four reaches arranged serially. The bottom slopes of the reaches are 0.0016, 0.0150, 0.006 and 0.0090, respectively. For a discharge of 20 m^3/s through this channel, predict the resulting flow profiles and sketch those accordingly. **[15]**

b) Explain why "Uniform flow of an ideal fluid is impossible".
A rectangular channel is 6 m wide and laid on a slope of 0.25%. The channel is made of concrete (k_s = 2 mm) and carries water at a depth of 0.5 m. Compute the mean velocity of flow. **[15]**