3-1

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall-2018
Program: B. Sc in Civil Engineering (3rd Year/ 1st Semester)

Course Title: Principles of Accounting Course Code: ACN - 301 Credit: 2.00
Time: 2 Hours Full Marks: 50

Instructions: Answers should be brief, relevant, neat and clean. Different parts of a question must be answered in order of sequence.

Part –A

(Compulsory)

Question No. 1 **12+8=20**

Jeter Corporation is a large multinational corporation. The following data have been taken from the accounting records of Jeter Corporation for the year ended December, 2018.

Particulars	01-01-2018 Amount ($) (in millions)	31-12-2018 Amount ($) (in millions)
Cash		1200
Equipment		800
Building		3000
Delivery Van		1000
Plant & Machineries		700
Raw materials	800	900
Work – in – process	1000	600
Finished Goods	500	200
Purchase of Raw materials		2050
Indirect materials		250
Freight-in		200
Purchase Return & Discount		450
Direct Labor		1250
Indirect Labor		500
Utilities		360
Plant leasing cost		25
Factory supervisor's salary		520
Rent – Factory		400
Office		350

Managing Director's Remuneration		20
Sales Commission		120
Bad Debts		10
Legal fee		12
Insurance on Plant & Machineries		36
Customer-service costs		30
Employee's Salary & Bonuses		90
Marketing promotions		50
Interest Expense		75
Sales		10000
Sales Discount		500
Sales Return		200

Additional Information:

1. Income Tax rate is 30%.
2. Utilities should be distributed to factory and office at 60% and 40% respectively.
3. Depreciation rate for Delivery Van 20%, Equipment 10%, Machineries 15% and building 5%. Building is consisted of 10 floors. First 3 floors are used for factory operation, the sales team used the 4th and 5th floor and 6th and 9th floor is used for business operation and top floor of the building is used by managing director of the company.

Requirement:

a) Prepare a cost of goods sold statement for Jeter Corporation for the period ended 31 December, 2018.

b) Prepare an income statement for Jeter Corporation for the period ended 31 December, 2018.

Part – B

(Answer any three questions)

Question No. 2 2+8=10

a) Briefly discuss the accounting equation and its components.

b) Nordtown Company is a marketing firm. The company's account balances on August 31, 2018 as follows. Cash $10,590; Accounts Receivable $5,500; Office Supplies $610; Office Equipment $4,200; Accounts Payable $2,600; Capital $18,300;

During the month of September, the company completed the following transactions:

Sept. 2 Paid rent for September $650.

3 Received cash from customers on account $2,300.

7	Ordered supplies, $380.
10	Billed customers for services provided, $2,800.
14	Received the supplies ordered on September 7 and agreed to pay for them in 30 days, $380.
24	Incurred utility bill for September, $250.
26	Received a bill, to be paid in October, for advertisements placed in the local newspaper during the month of September to promote Nordstrom Company, $700.
30	Paid salaries for September, $3,800.
30	Owner made withdrawal of supplies of $200.

Requirements:

You are required to show the effects of the transactions on the accounting equation through tabular analysis using the following column headings -

Cash, Accounts Receivable, Supplies, Equipment, Accounts Payable, Notes Payable, Capital, Drawings, Revenues, and Expenses.

Question No. 3 **10**

Speedy Laundry Company, Inc., entered into the following transactions in August 2018:

August 1	Invested cash by owners to start the business, $400,000
6	Performed laundry services for $2,000 cash.
8	The company prepaid $6,000 cash for six months' rent for an office.
13	The company completed services for a client worth $20,000; $8,000 received in cash and $12,000 on account.
15	Received and paid a bill for $430 for supplies used in operations.
23	Cash collected from customers on account, $2,600.
25	Secured an order from a customer for laundry services and received cash of $7,000. The services are to be performed next month.
30	Paid $2,400 salaries to employees for August.
30	Received the electric and gas bill for August, $385, but did not pay it at this time.
31	Owners made cash withdrawal of $1,000.

Requirements:

Prepare journal entries for these transactions in the general journal.

Question No. 4 **3+7=10**

a) Identify the following costs as variable, fixed or mixed –

Direct material, factory rent, advertisement, sales commission, managing director's salary, Depreciation of building, bad debts, electricity bill and freight.

b) The owner of the Diamondhead restaurant in Honolulu would like to determine the fixed and variable components of the restaurant's utility expenses. The owner believes that the variable component of the utilities cost is driven by the number of meals served.

Month	Meals served	Utilities cost ($)
January	3,000	$450
February	4,000	$480
March	3,500	$490
April	4,500	$530
May	5,000	$570
June	6,000	$620
July	5,500	$560

Requirements:

i. Estimate the cost formula using high low method.

ii. What will be the total cost if meals served are 7,000?

Question No. 5 4+4+2=10

Superior Company has an option to invest $50,000 in 2019 in three projects, having 75,000 cash inflows from each. The cash inflow details are as stated in the followings

Year	Project ABC	Project XYZ	Project PQR
2020	18,000	15,000	9,000
2021	16,000	15,000	12,000
2022	20,000	15,000	15,000
2023	10,500	15,000	18,000
2024	10,500	15,000	21,000

Requirements:

a) Calculate the payback period for three projects.

b) Calculate the Net Present Value (NPV) for each projects assuming 12% required rate of return.

c) Suggest the company to choose one project.

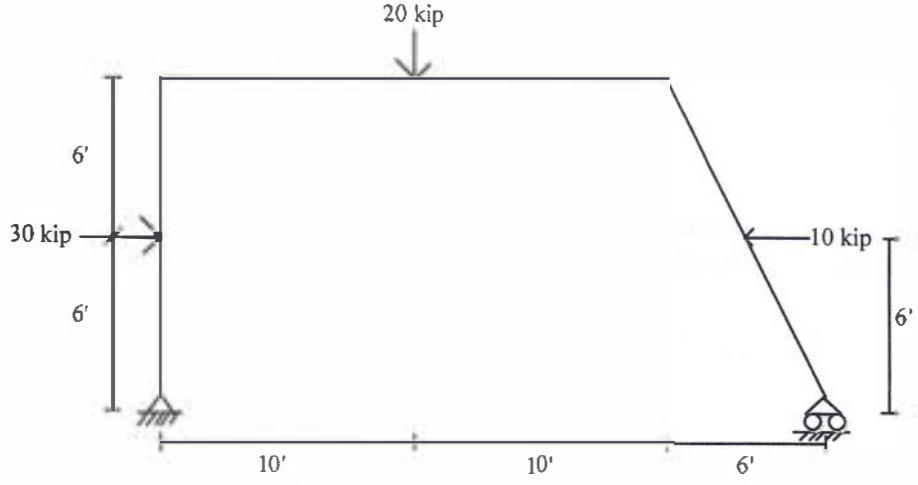
University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering I
Time: 3.00 Hours

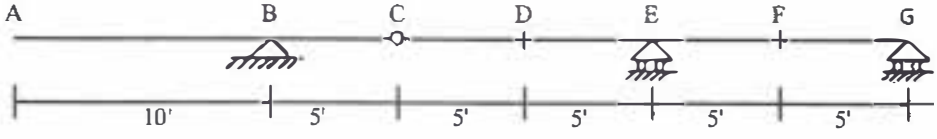
Course Code: CE 311
Full Marks: 100 (=10×10)

*There are **fourteen (14)** questions. Answer any **ten (10)**.*
Assume any missing data reasonably.

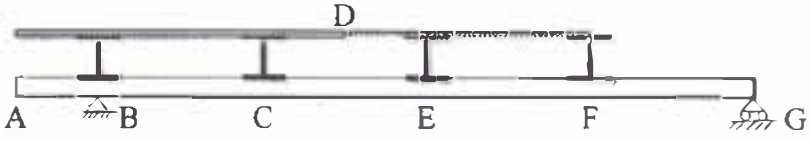
1. Draw the shear force and bending moment diagram for the structure shown in the figure below.



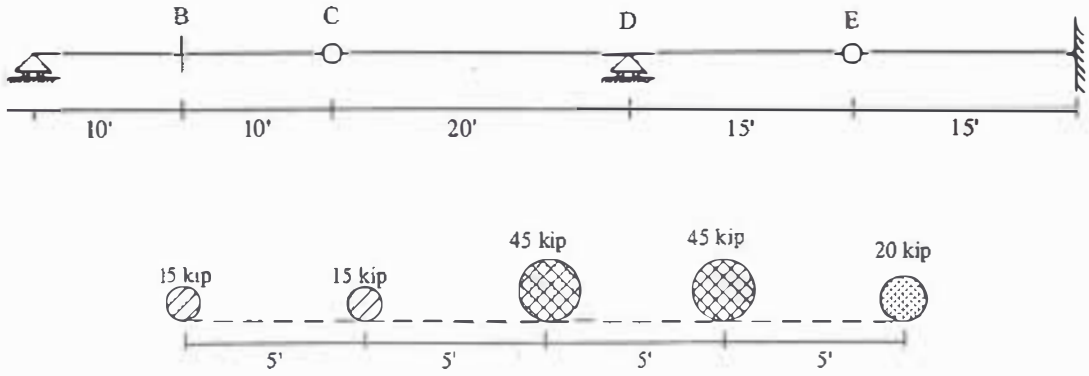
2. For the beam ABCDEFG carrying a dead load of 2 kip/ft and a moving live load of 3 kip/ft, calculate the following: (i) Maximum reaction at G, (ii) Maximum moment at E, (iii) Maximum shear at D, (iv) Maximum shear just right of E and (v) maximum shear just left of B.



3. Girder AG supports a floor system as shown in the figure below. Draw influence line for
(i) Support reaction at G
(ii) Floor beam reaction at panel point B and F
(iii)Bending moment at point E
(iv)Shear in panel CE

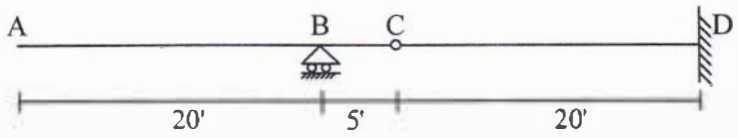


4. Calculate the maximum reaction at support D of the following beam for the wheel load arrangement shown below.



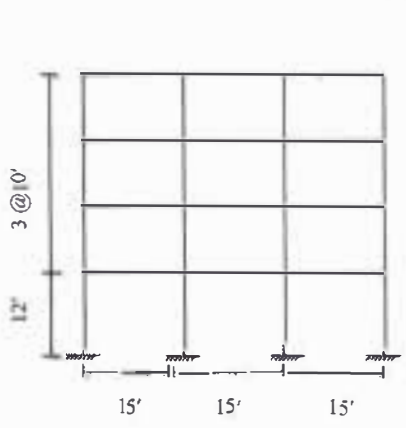
5. For the same beam and same wheel load arrangement shown in Question 4, calculate the maximum shear at point B.

6. Calculate the maximum moment at point B for the following beam. Use the same wheel load arrangement as shown in Question 4.

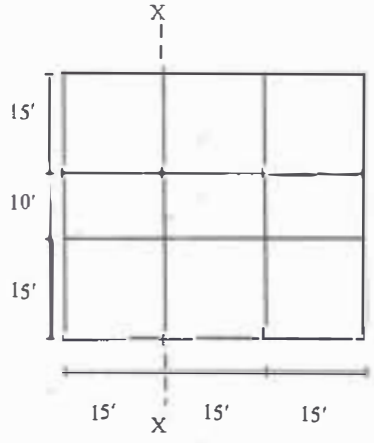


7. Compute the absolute maximum moment in a 30′ simply supported beam for the same wheel load arrangement as shown in Question 4.

8. Calculate the wind force at **story 3 and 4** of frame XX of the four-storied concrete made residential building (C_I=1) located at a hilly terrain (with H=15′, Lu=100′) in Chittagong (Basic wind speed= 160 mph). Wind direction is perpendicular to the front elevation of the building. Assume the structure to be subjected to Exposure C.



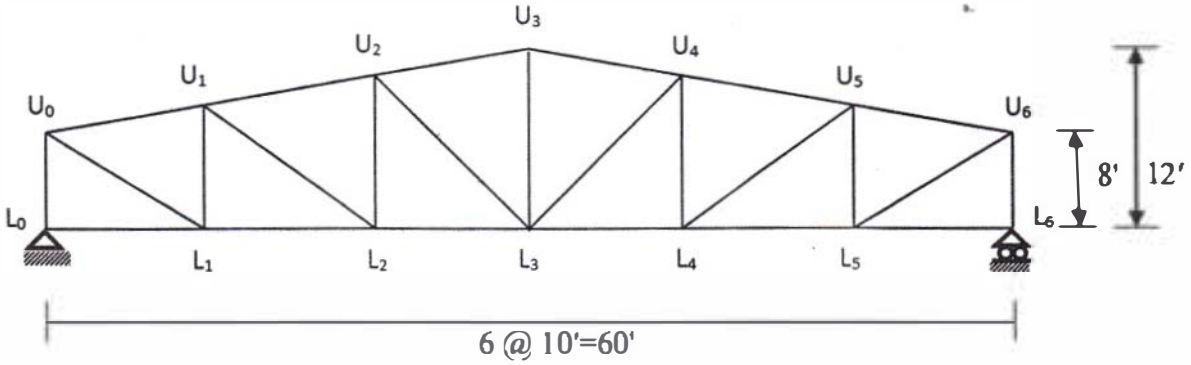
Front elevation



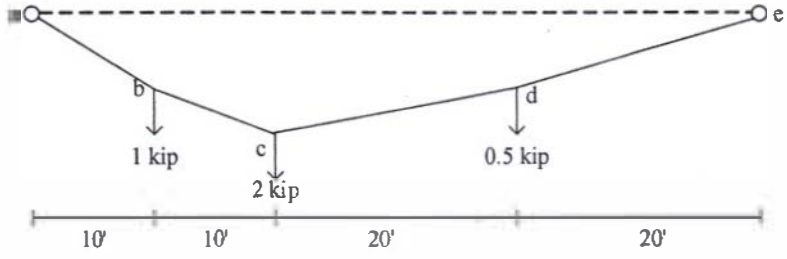
Plan

9. Calculate the seismic load at **story 3 and 4** of the same building shown in Question 6, located in Chittagong (Zone 2). Assume the structure to be Special Moment Resisting Frame (IMRF) built on soil condition S_2, carrying a Dead Load of 180 lb/ft^2 and Live load of 80 lb/ft^2.

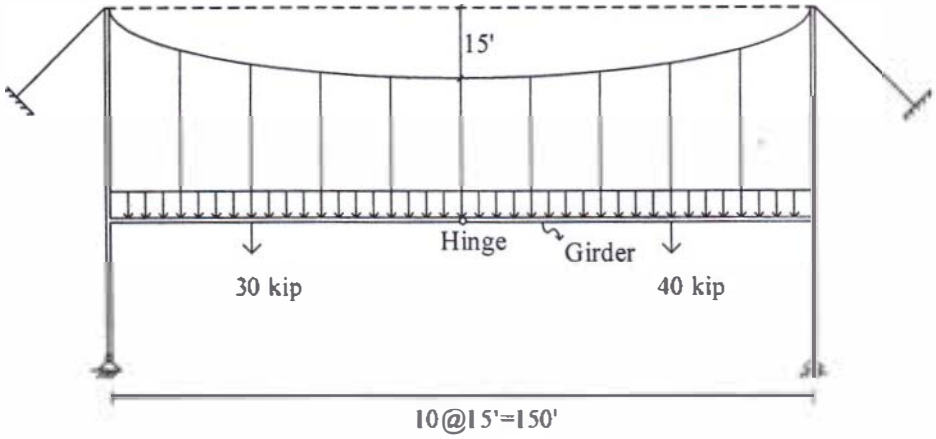
10. For the truss shown below, draw influence lines of bar U2U3, U2L3 and U2L2. Note, each bottom chord joint consists of a cross girder and load moves over the floor beam placed over the girders.



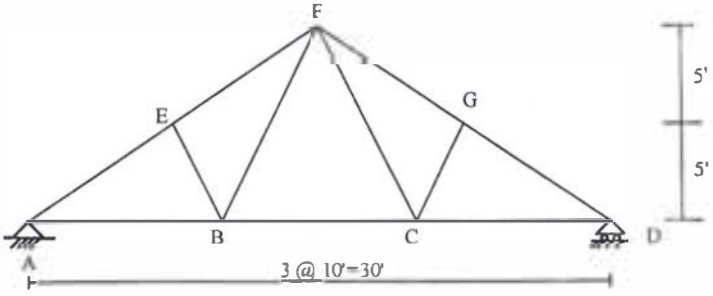
11. For the cable shown in the figure below, calculate sag at point b and d. Also calculate the maximum cable tension. Given that, sag at c = 10′



12. Draw bending moment diagram of the girder for the following figure.

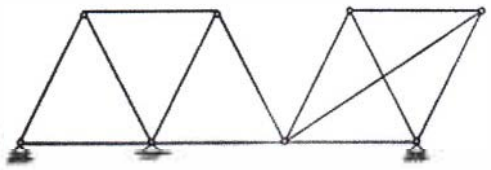


13. For the truss shown below, calculate the maximum axial force in member BF for a uniformly distributed dead load of 5 kip/ft and moving live load of 2 kip/ft.
[Note: There are floor beams over bottom chords]

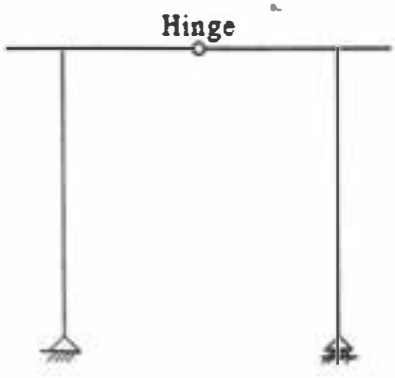


14. Determine whether the structures shown below are statically and geometrically stable or unstable. Also, calculate the degree of statical indeterminacy where applicable.

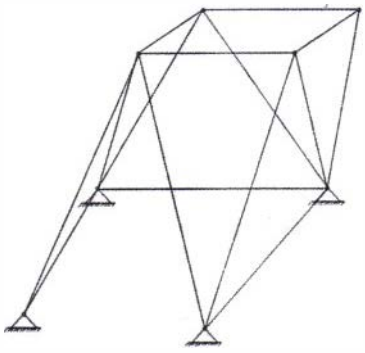
i.



ii.



iii.



iv.

Annexure

Wind load:

$q_z = 0.00256\ C_I\ C_z\ V_b^2$

$p_z = C_G\ C_t\ C_p\ q_z$

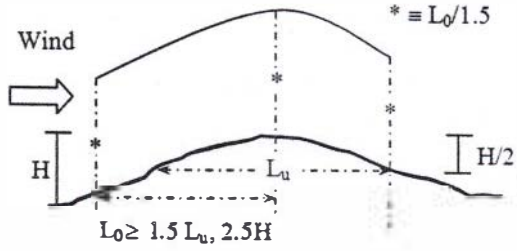
$Fz = B\ heff\ p_z$

Category	C_I
Essential facilities	1.25
Hazardous facilities	1.25
Special occupancy	1.00
Standard occupancy	1.00
Low-risk structure	0.80

Height z (ft)	C_z		
	Exp A	Exp B	Exp C
0~15	0.368	0.801	1.196
50	0.624	1.125	1.517
100	0.849	1.371	1.743
150	1.017	1.539	1.890
200	1.155	1.671	2.002
300	1.383	1.876	2.171
400	1.572	2.037	2.299
500	1.736	2.171	2.404
650	1.973	2.357	2.547
1000	2.362	2.595	2.724

The pressure coefficient C_p for rectangular buildings with flat roofs:

h/B	L/B					
	0.1	0.5	0.65	1.0	2.0	≥ 3.0
≤ 0.5	1.40	1.45	1.55	1.40	1.15	1.10
1.0	1.55	1.85	2.00	1.70	1.30	1.15
2.0	1.80	2.25	2.55	2.00	1.40	1.20
≥ 4.0	1.95	2.50	2.80	2.20	1.60	1.25



$H/2L_u$	C_t
0.05	1.19
0.10	1.39
0.20	1.85
0.30	2.37

Height z (ft)	C_G (for non-slender structures)		
	Exp A	Exp B	Exp C
0~15	1.654	1.321	1.154
50	1.418	1.215	1.097
100	1.309	1.162	1.067
150	1.252	1.133	1.051
200	1.215	1.114	1.039
300	1.166	1.087	1.024
400	1.134	1.070	1.013
500	1.111	1.057	1.005
650	1.082	1.040	1.000
1000	1.045	1.018	1.000

Earthquake Load:

$V = (ZIC/R)\ W$

$Z = 0.075$, 0.15 and 0.25 for Seismic Zones 1, 2 and 3 respectively

$C = 1.25\ S/T^{2/3}$, The value of C need not exceed 2.75, The minimum value of the ratio C/R is 0.075

$T = C_t\ (h_n)^{3/4}$

$C_t = 0.083$ for steel moment resisting frames, 0.073 for RCC moment resisting frames, and eccentric braced steel frames, 0.049 for all other structural systems

$V = F_t + \sum F_i$

$F_t = 0.07\ TV \leq 0.25V$ when $T > 0.7$ second, and $= 0$, when $T \leq 0.7$ second

$F_j = (V - F_t)\ [w_j\ h_j / \sum w_i\ h_i]$

Category	C_I
Essential facilities	1.25
Hazardous facilities	1.25
Special occupancy	1.00
Standard occupancy	1.00
Low-risk structure	0.80

Site Coefficient, S for Seismic Lateral Forces

Soil Type	S
S_1	1
S_2	1.2
S_3	1.5
S_4	2

Response Modification Coefficient, R for Structural Systems

Basic Structural System	Description Of Lateral Force Resisting System	R
Moment Resisting Frame System	Special moment resisting frames (SMRF)	
	(i) Steel	12
	(ii) Concrete	12
	Intermediate moment resisting frames (IMRF), concrete	8
	Ordinary moment resisting frames (OMRF)	
	(i) Steel	6
	(ii) Concrete	5

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B.Sc. in Civil Engineering

Course Title: Design of Concrete Structures I — Course Code: CE 315
Time: 3:00 hours — Full Marks: 120

Answer all questions
The symbols have their usual meanings.
[Assume Reasonable Values for Any Missing Data]
For all problems $f_c' = 4000$ psi and $f_y = 60{,}000$ psi.

1. a) Briefly explain the fundamental assumptions for reinforced concrete behavior. [5]
   b) Calculate the ACI design moment capacity ϕM_n for the beam with necessary checks for Figure 1 [15]

2. a) What is doubly reinforced RC beam? Explain how it differs from a singly reinforced section. [5]
   b) Calculate the steel area required for a 18 feet simple span beam with dimension of 10″ × 20″ which carry a service live load of 2.47 kips/ft and calculate dead load of 1.05 kips/ft. [15]

3. a) Explain the effective flange width for a T-beam and what are the criteria for it? [5]
   b) Analyze the section of beam shown in Figure 2 to obtain the design moment strength of the section. [15]

4. a) Explain the differences between USD and WSD. [5]
   b) Design a T beam for a floor system for which $b_w = 12$″, $d = 18$″ and $h_f = 4$″. Beams are spaced at 10′ c/c. $M_D = 80$ ft-k and $M_L = 100$ ft-k. Simple span is 20 ft. [15]

5. a) Explain about ρ_b, ρ_{max} and ρ_{min}. [5]
   b) A simply supported beam 14′ span beam is subjected under 4 k/ft dead load and 6 k/ft live loads. The section of beam is shown in Figure 3. Design the beam for shear. Use #3 stirrups. [15]

6 a) Explain 'development length' and the factors influencing 'development length' [5]
   b) A footbridge is to be built as one-way slab spanning 16′ between masonry abutments. A service live load of 100 psf must be carried. A 2″ thick asphalt wearing surface will be used, weighing 20 psf. Prepare a design for the slab. [15]

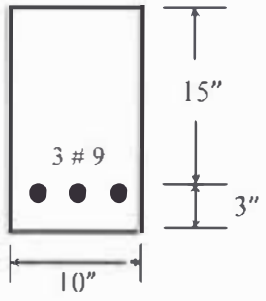


Figure 1

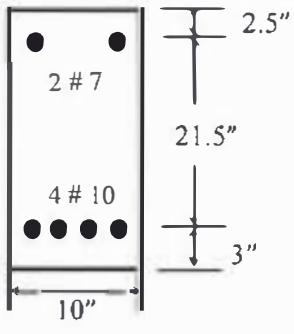


Figure 2

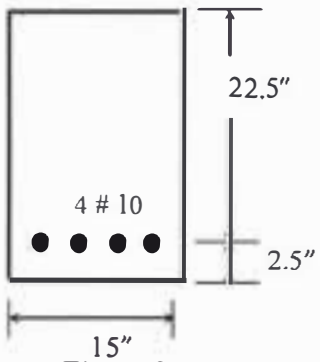


Figure 2

Formula sheet

$$P = f_c A_c + f_s A_{st}$$

$$P = f_c[A_g + (n - 1) A_{st}]$$

$$P_n = 0.85 f_c' A_c + f_y A_{st}$$

$$M = \frac{f_c}{2} kjbd^2$$

$$k = \sqrt{(\rho n)^2 + 2\rho n} - \rho n$$

$$M_n = \rho f_y bd^2 (1 - 0.59 \frac{\rho f_y}{f'_c})$$

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

$$c = \frac{\epsilon_u}{\epsilon_u + \epsilon_y} d$$

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

$$\beta 1 = 0.85 - 0.05 \frac{f_c' - 4000}{1000}$$
$$for\ 0.65 \leq \beta 1 \leq 0.85$$

$$\rho_{0.005} = 0.85 \beta_1 \left(\frac{f_c'}{f_y}\right) \frac{\epsilon_u}{\epsilon_u + 0.005}$$

$$Mn = A_s f_y (d - \frac{a}{2})$$

$$a = \frac{Asfy}{0.85 f_c' b}$$

$$l_d = \frac{3}{40} \frac{f_y}{\lambda \sqrt{f_c'}} \frac{\psi_l \psi_e \psi_s}{\frac{c_b + K_{tr}}{d_b}}$$

$$As, min = 3 \frac{\sqrt{f_c'}}{fy} b_w d \geq 200 \frac{b_w d}{fy}$$

$$M_{n1} = As' fy (d - d')$$

$$M_{n2} = (As - As') fy (d - \frac{a}{2})$$

$$a = \frac{(As - As') fy}{0.85 fc' b}$$

$$M_n = M_{n1} + M_{n2}$$

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

$$M_{n1} = A_{sf} f_y (d - \frac{hf}{2})$$

$$a = \frac{(As - A_{sf}) f_y}{0.85 fc' b_w}$$

$$M_{n2} = (A_s - A_{sf}) f_y (d - \frac{a}{2})$$

$$Av, min = 0.75 \sqrt{f_c'} \frac{b_w s}{f_{yt}} \geq \frac{50 b_w s}{f_{yt}}$$

$$s = \frac{\phi A_v f_{yt} d}{Vu - \phi Vc}$$

$$s = \frac{\phi Avfytd (\sin\alpha + \cos\alpha)}{Vu - \phi Vc}$$

$$s_{max} = \frac{A_v f_{yt}}{0.75 \sqrt{f_c'} b_w} \leq \frac{A_v f_{yt}}{50 bw}; \frac{d}{2}; 24 \text{ in}$$

$$\emptyset = 0.483 + 83.3\epsilon_t$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering I
Time: 3.0 hours

Course No: CE 331
Full Marks: 100

Answer all the questions. Assume any missing data.

1. (a) What are the main considerations for the selection of water sources? What are the possible challenges for selecting ground water as the source of water supply systems in Bangladesh? [5+5]

   (b) Explain the factors affecting water demand in an area. Predict the population from the following data to design a piped water supply system with a design period of 50 years from 2011: [5+5]

Year	1981	1991	2001	2011
Population (million)	12	14	18	21

OR

2. (a) What alternative water supply technologies are available in Bangladesh? Discuss the different components of a No. 6 handpump tubewell used in Bangladesh. [5+5]

   (b) With a schematic diagram explain the differences between: i) Confined aquifer and ii) Unconfined aquifer. A 100mm diameter tube well is sunk to withdraw water from a 10 m thick confined aquifer having K=0.75 lps/m^2. The drawdown is 2m in the tube well while pumping. Calculate the tube well discharge when radius of circle of influence is 30 m. [5+5]

3. (a) With a schematic diagram show different zones of a sedimentation tank. Explain different types of settling that take place in a sedimentation tank. [5+5]

   (b) Compare between slow sand filter and rapid sand filter in terms of i) filter bed ii) filtration efficiency iii) cost iv) filter cleaning v) suitability. [10]

4. (a) Explain water disinfection method by chlorination. Bangladesh experiences flood every year that cause inundation of shallow tubewell. As an Environmental Engineer how would you disinfect such contaminated tubewell to ensure safe supply of drinking water? [5+5]

   (b) With schematic diagram, explain the method of water transmission and distribution systems in Dhaka city. Using a flow chart show where and how water loss occurs in a piped water supply system. [5+5]

5. (a) Explain the objectives of a water safety plan (WSP). How can you achieve those objectives for a large piped drinking-water supply system? [5+5]

(b) Write short notes on: i) Controlling wastage of water ii) Per capita demand iii) Water demand variation iv) Water demand management. [2.5*4=10]

6. (a) Compare the continuous and intermittent systems of supplying water to consumers with respect to i) mode of supply ii) contamination of water and iii) reliability. As a water supply engineer, while distributing water through piped water supply system, which factors would you consider for making the water distribution system effective? [5+5]

(b) Calculate the corrected flows in the various pipes of the upper loop of the distribution network as shown in following Fig. 1 (a). The diameters and lengths of the pipes used are given against each pipe. Use the following graph (Fig. 1 b) if required. Two trials are required. [10]

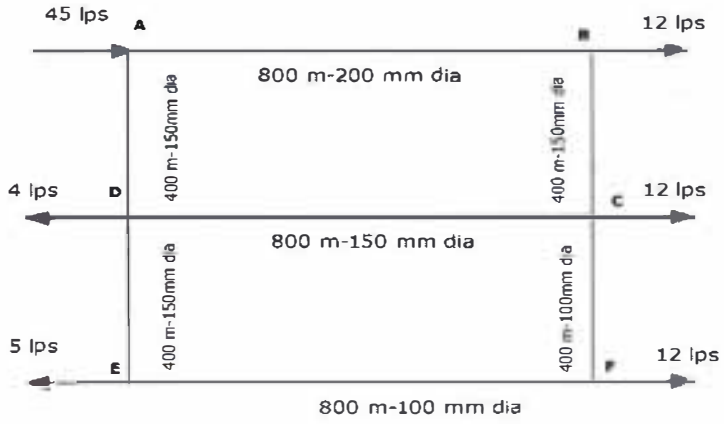


Fig. 1 (a)

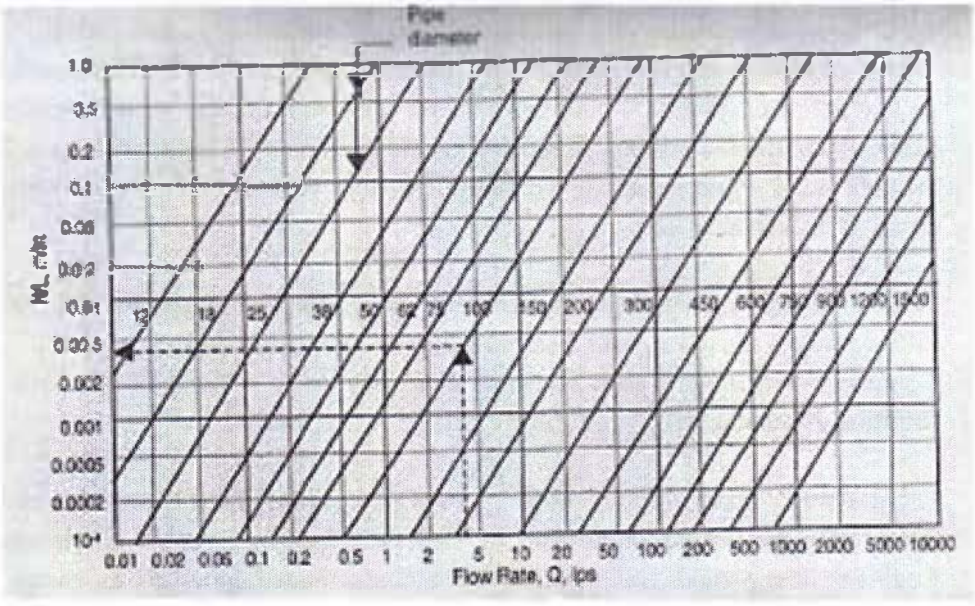


Fig. 1 (b)

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B.Sc. Engineering (Civil)

Course Title: Geotechnical Engineering I
Time: 3 hours

Course Code: CE 341
Full Marks: 100

Answer the following questions.

1. A liquid limit test was carried out on a fine-grained soil and the data is given in Table 1. Classify the following soil according to Unified Soil Classification System (USCS). Given that plastic limit is obtained 39%. 10

Table 1: Cassagrande's Liquid Limit Test

Test No.	No of Blows	Water content (%)
1	19	62
2	23	56
3	37	38

2. Apply Rankine's theory of lateral earth pressure for the following questions:

   (a) Given that the backfill soils push the retaining wall and the depth of tensile crack zone is 2.6 m. Compute the magnitude of lateral force (per unit length of the wall) acting on the earth retaining structure, shown in Fig. 1. Consider up to the dredge line. 10

   (b) Calculate the difference in the lateral force in active case, if cohesion of both the soil layers is 15 kPa. The depth of water table remains unchanged. 5

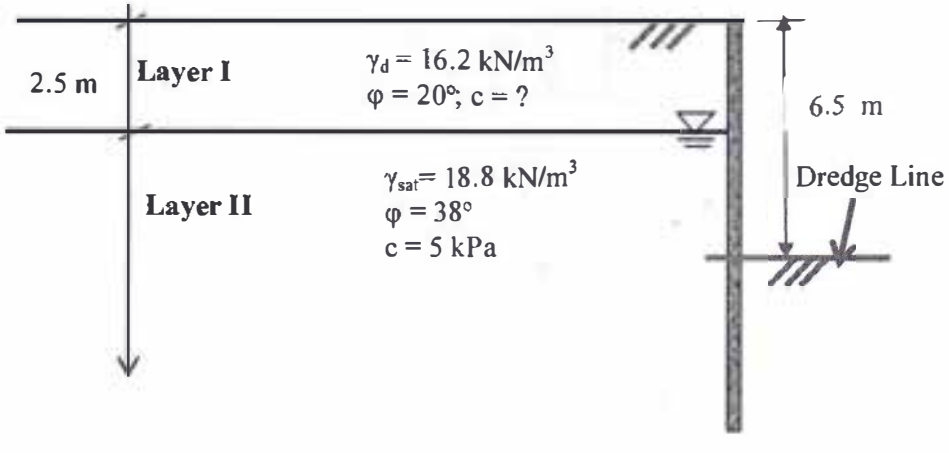


Fig.1

3(a) The L-shaped loaded area (Fig. 2a) exerts a uniform pressure of 300 kN/m^2 to the soil. Determine vertical stress increase due to uniform pressure, at a point of 4 m directly under; (a) point A, (b) point B. **8**

(b) Estimate the over-consolidation ratio (OCR) for a soil element at the mid- depth of the clay layer-1 in situ condition (i.e., before increase in stress). Given that pre-consolidation pressure of the clay layer = 185 kPa. **2**

(c) Estimate the primary consolidation settlement of upper 1 m of both the clay layers (Fig. 2b) due to the foundation load and compare the results. Use 2:1 slope for calculating $\Delta\sigma$. **11**

(d) Predict the time for the clay layer-1 (Fig. 2b) to settle 7.8 mm due to the increase in stress from the footing, if the settlement is calculated 16 mm at the end of 100% consolidation. **4**
Given that coefficient of consolidation, $c_v = 0.35$ mm^2/s

$$T_v = \frac{\pi}{4}\cdot\left(\frac{U}{100}\right)^2$$

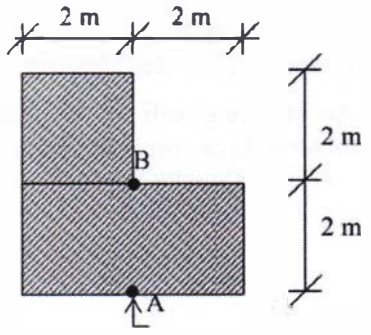


Fig. 2a

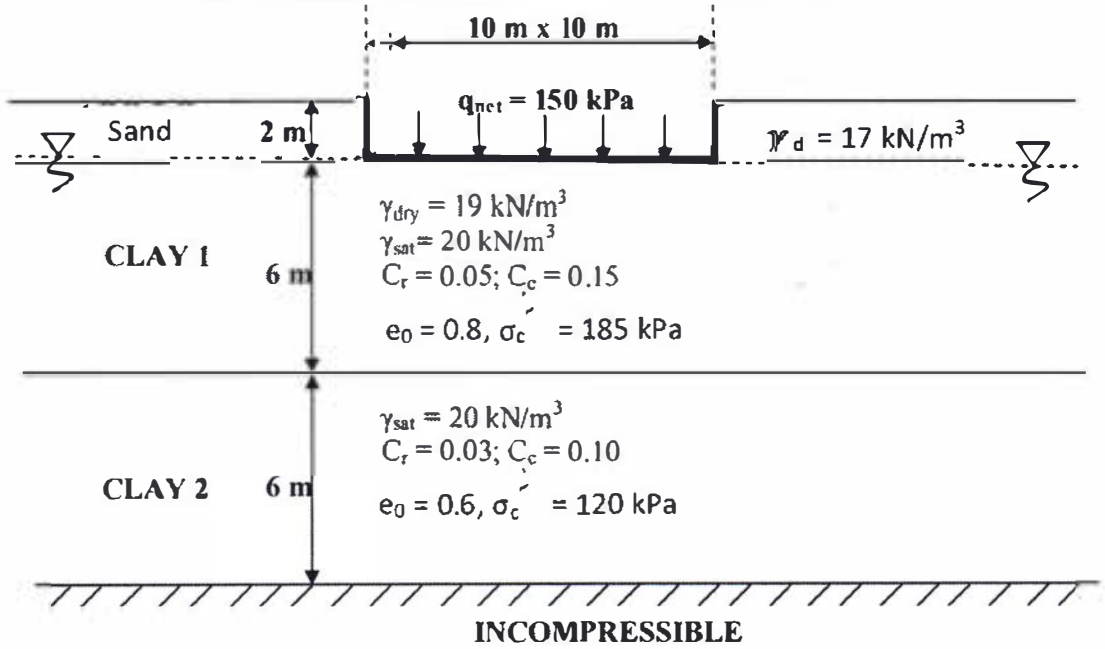


Fig. 2b

4. Three CU triaxial compression tests with pore-water pressure measurements were performed on three identical samples of clay.
The cell pressure, deviator stress at failure and pore-water pressure at failure obtained for each test specimen are shown in Table 2.

(i) Determine effective stress shear strength parameters 15
(ii) Find the stresses at the failure plane, if another specimen is tested under a cell pressure of 75 psi. 5

Table 2: Triaxial Test Result: At failure condition

Test No.	Cell Pressure (psi)	Deviator Stress (psi)	Pore-water Pressure (psi)
1	20	36.2	1.5
2	35	61.8	2.5
3	55	96.3	4.5

5.(a) A borrow material has a volume of 191,000 m^3 and void ratio of 1.2. After compaction its new void ratio is 0.7, find the corresponding volume. 4

(b) The results of an ASTM D698 compaction test for a SP soil are presented in Table 3. Calculate the relative compaction at the test locations (A1 – A3). Table 3 gives the field compaction test results. 3
Report whether 98% target compaction has been attained. Given that maximum dry unit weight is 112 pcf. 3

Table 3. Field Compaction Test Result

Location	Bulk Unit Weight (pcf)	Water Content (%)
A1	121.7	14.1
A2	123.6	11.2
A3	126.8	12.5

6. A dam is constructed on a permeable stratum underlain by an impermeable rock (Fig. 3).
A row of sheet pile is installed at the upstream face.
The permeable soil has a hydraulic conductivity of 150 ft/day.

(i) Estimate the seepage under the dam. 4

(ii) Apply the flownet technique to plot the uplift pressure diagram under the base of the dam. 10

(iii) Estimate weight of the dam per unit length, if factor of safety to be ensured is 2.5 against uplift. 6

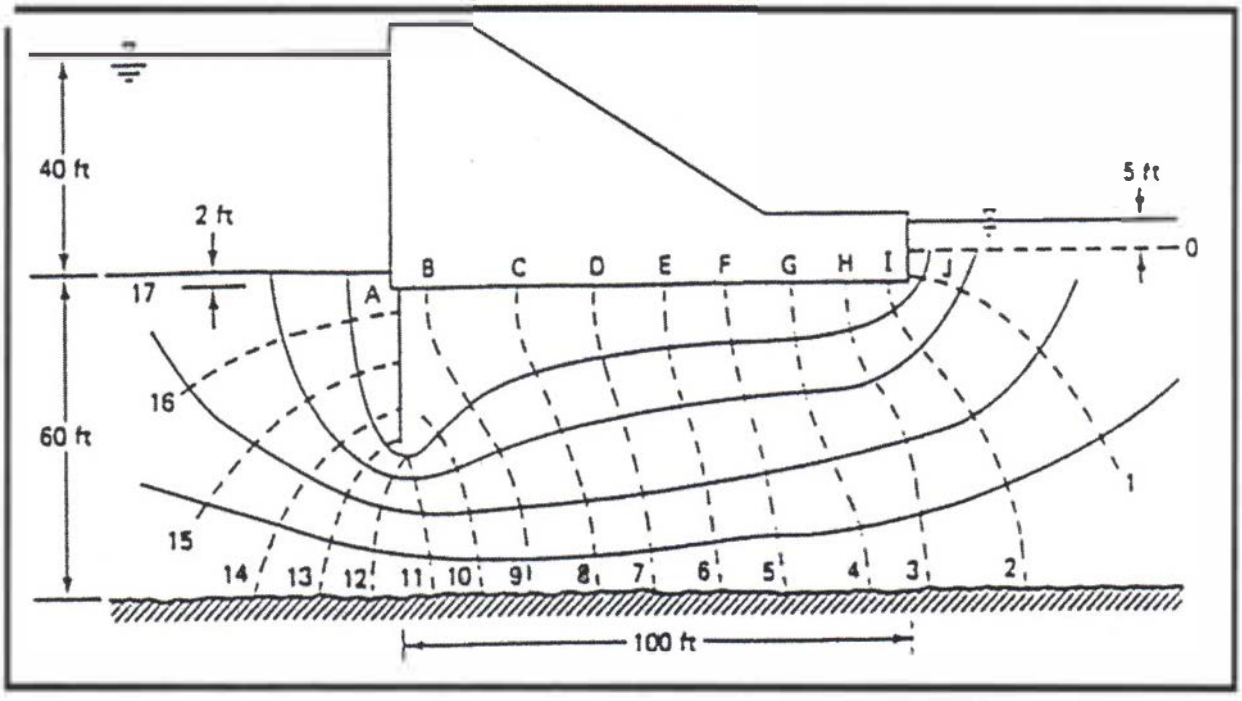


Fig. 3

Table 9.4. Influence factor K for vertical stress under corner of loaded rectangular area based on Boussinessq analysis (After New mark, 1935)

m	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4
0.1	0.00470	0.00917	0.01324	0.01678	0.01978	0.02223	0.02420	0.02576	0.02698	0.02794	0.02926	0.03007
0.2	0.00917	0.01790	0.02585	0.03280	0.03866	0.04348	0.04735	0.05042	0.05283	0.05471	0.05733	0.05894
0.3	0.01324	0.02585	0.03735	0.04742	0.05593	0.06294	0.06859	0.07308	0.07661	0.07938	0.08323	0.08561
0.4	0.01678	0.03280	0.04742	0.06024	0.07111	0.08009	0.08735	0.09314	0.09770	0.10129	0.10631	0.10941
0.5	0.01978	0.03866	0.05593	0.07111	0.08403	0.09472	0.10340	0.11034	0.11584	0.12018	0.12626	0.13003
0.6	0.02223	0.04348	0.06294	0.08009	0.09472	0.10688	0.11679	0.12474	0.13105	0.13605	0.14309	0.14749
0.7	0.02420	0.04735	0.06859	0.08735	0.10340	0.11679	0.12772	0.13653	0.14356	0.14914	0.15703	0.16199
0.8	0.02576	0.05042	0.07308	0.09314	0.11034	0.12474	0.13653	0.14607	0.15370	0.15978	0.16843	0.17389
0.9	0.02698	0.05283	0.07661	0.09770	0.11584	0.13105	0.14356	0.15370	0.16185	0.16835	0.17766	0.18357
1.0	0.02794	0.05471	0.07938	0.10129	0.12018	0.13605	0.14914	0.15978	0.16835	0.17522	0.18508	0.19139
1.2	0.02926	0.05733	0.08323	0.10631	0.12626	0.14309	0.15703	0.16843	0.17766	0.18508	0.19584	0.20278
1.4	0.03007	0.05894	0.08561	0.10941	0.13003	0.14749	0.16199	0.17389	0.18357	0.19139	0.20278	0.21020
1.6	0.03058	0.05994	0.08709	0.11135	0.13241	0.15027	0.16515	0.17739	0.18737	0.19546	0.20731	0.21509
1.8	0.03090	0.06058	0.08804	0.11260	0.13395	0.15207	0.16720	0.17967	0.18986	0.19814	0.21032	0.21836
2.0	0.03111	0.06100	0.08867	0.11342	0.13496	0.15326	0.16856	0.18119	0.19152	0.19994	0.21235	0.22058
2.5	0.03138	0.06155	0.08948	0.11450	0.13628	0.15483	0.17036	0.18321	0.19375	0.20236	0.21512	0.22364
3.0	0.03150	0.06178	0.08982	0.11495	0.13684	0.15550	0.17113	0.18407	0.19470	0.20341	0.21633	0.22499
4.0	0.03158	0.06194	0.09006	0.11527	0.13724	0.15598	0.17168	0.18469	0.19540	0.20417	0.21722	0.22600
5.0	0.03160	0.06199	0.09014	0.11537	0.13736	0.15612	0.17185	0.18488	0.19561	0.20440	0.21749	0.22632
6.0	0.03161	0.06201	0.09016	0.11541	0.13441	0.15617	0.17191	0.18496	0.19569	0.20449	0.21760	0.22644
8.0	0.03162	0.06202	0.09018	0.11543	0.13744	0.15621	0.17195	0.18500	0.19574	0.20455	0.21767	0.22652
10.0	0.03162	0.06202	0.09019	0.11544	0.13745	0.15622	0.17196	0.18502	0.19576	0.20457	0.21769	0.22654
∞	0.03162	0.06202	0.09019	0.11544	0.13745	0.15623	0.17197	0.18502	0.19577	0.20459	0.21770	0.22656

Table 9.4 (Continued)

m	1.6	1.8	2.0	2.5	3.0	4.0	5.0	6.0	8.0	1.0.0	∞
0.1	0.03058	0.03090	0.03111	0.03138	0.03150	0.03158	0.03610	0.03161	0.03162	0.03162	0.03162
0.2	0.05994	0.06058	0.06100	0.06155	0.06178	0.06194	0.06199	0.06201	0.06202	0.06202	0.06202
0.3	0.08709	0.08804	0.08867	0.08948	0.08982	0.09006	0.09014	0.09016	0.09018	0.09019	0.09019
0.4	0.11135	0.11260	0.11342	0.11450	0.11495	0.11527	0.11537	0.11541	0.11543	0.11544	0.11544
0.5	0.13241	0.13395	0.13496	0.13628	0.13684	0.13724	0.13736	0.13441	0.13744	0.13745	0.13747
0.6	0.15027	0.15207	0.15326	0.15483	0.15550	0.15598	0.15612	0.15617	0.15621	0.15622	0.15623
0.7	0.16515	0.16720	0.16856	0.17036	0.17113	0.17168	0.17185	0.17191	0.17195	0.17196	0.17197
0.8	0.17739	0.17967	0.18119	0.18321	0.18407	0.18469	0.18488	0.18496	0.18500	0.18502	0.18502
0.9	0.18737	0.18986	0.19152	0.19375	0.19470	0.19540	0.19561	0.19569	0.19574	0.19576	0.19577
1.0	0.19546	0.19814	0.19994	0.20236	0.20341	0.20417	0.20440	0.20449	0.20455	0.20457	0.20459
1.2	0.20731	0.21032	0.21235	0.21512	0.21633	0.21722	0.21749	0.21760	0.21767	0.21769	0.21770
1.4	0.21509	0.21836	0.22058	0.22364	0.22499	0.22600	0.22632	0.22644	0.22652	0.22654	0.22656
1.6	0.22025	0.22372	0.22610	0.22940	0.23088	0.23200	0.23235	0.23249	0.23258	0.23261	0.23263
1.8	0.22372	0.22736	0.22986	0.23336	0.23499	0.23617	0.23656	0.23671	0.23681	0.23684	0.23686
2.0	0.22610	0.22986	0.23247	0.23613	0.23782	0.23912	0.23954	0.23970	0.23981	0.23985	0.23987
2.5	0.22940	0.23336	0.23613	0.24010	0.24196	0.24344	0.24392	0.24412	0.24425	0.24429	0.24432
3.0	0.23088	0.23496	0.23782	0.24196	0.24394	0.24554	0.24608	0.24630	0.24646	0.24650	0.24654
4.0	0.23200	0.23617	0.23912	0.24344	0.24554	0.24729	0.24791	0.24817	0.24836	0.24841	0.24886
5.0	0.23255	0.23656	0.23954	0.24392	0.24608	0.24791	0.24857	0.24886	0.24907	0.24914	0.24919
6.0	0.23249	0.23671	0.23970	0.24412	0.24630	0.24817	0.24886	0.24916	0.24939	0.24946	0.24952
8.0	0.23258	0.23681	0.23981	0.24425	0.24646	0.24836	0.24907	0.24939	0.24964	0.24972	0.24980
10.0	0.23261	0.23684	0.23985	0.24429	0.24650	0.24841	0.24914	0.24946	0.24972	0.24981	0.24989
∞	0.23263	0.23686	0.23987	0.24432	0.24654	0.24846	0.24919	0.24952	0.24980	0.24989	0.25000

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B. Sc. Engineering (Civil)

Course Title: Open Channel Flow | Course Code: CE 361
Time: 3 hours | Full marks: 150

Answer all the questions in both of the sections. (25*6= 150)
(Necessary formulae are attached; Assume reasonable data if necessary)

SECTION – A

1 (a) Classify "Open Channels"(provide names only and one example of each). (8)

(b) How can you physically identify whether the flow in an open channel is laminar or turbulent? (6)

OR

How can you physically identify whether the flow in an open channel is subcritical, critical or supercritical?

(c) The depth and mean velocity upstream and downstream of a vertical sluice gate in a horizontal rectangular channel are 4 m and 1m and 2 m/s and 8 m/s respectively. The width of the channel is 6 m. Determine the state of flow both upstream and downstream of the gate. (11)

2(a) State the three basic equations to describe open channel flow. Also state the principles on which these are based. (6+6)

(b) Show the pressure distributions in curvilinear flow. Produce the expression for the pressure head correction for curvilinear flow. (13)

OR

The data collected during the stream-gauging operation at a certain river section are given in the following table. 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		
2	1.5	0.6	0.54
6	5.7	4.16	1.35
		1.04	1.6
9	6.8	5.04	1.36
		1.26	1.81
13	2.7	1.32	1.16
0	0		

3(a) Derive the general expression for the hydraulic exponent for critical flow computation M and then determine the numerical value of M for a triangular channel. (12)

OR

Prove that at the critical state of flow, i) the specific energy is minimum for a given discharge, and ii) the discharge is maximum for a given specific energy.

(b) A rectangular testing channel is 0.6 m wide and is laid on a slope of 0.1%. When the channel bed and walls were made smooth by neat cement, the measured normal depth of flow was 0.4 m for a discharge of 0.23 m^3/s. The same channel was then roughened by cemented sand grains and the measured normal depth was 0.35 for a discharge of 0.12 m^3/s. Determine the discharge for a normal depth of 0.45 m if the bed is roughened and the walls are made smooth. [Hint: obtain n for each condition, then apply Horton's formula for composite roughness] (13)

OR

Define "Laminar or viscous sublayer" and "Compound Cross-section". 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.

SECTION – B

4 (a) Define "angle of repose". Show that the best hydraulic triangular section is one-half of a square. (10)

OR

A trapezoidal channel carrying 20 m^3/s is built with non-efodible bed having a slope of 1 in 1000 and n = 0.025. Design the channel by the concept of best hydraulic section. [for best hydraulic trapezoidal section, $A = \sqrt{3}h^2$; $P = 2\sqrt{3}h$; $R = h/2$; $B = 4\sqrt{3}h/3$; $D = 3h/4$]

(b) An irrigation canal has to carry a discharge of 30 m^3/s through a course non-cohesive material having d_{50} = 2.5 cm, d_{75} = 3 cm and n = 0.025. The angle of repose of the perimeter material is 32°. The canal is to be trapezoidal in shape having s = 2 and laid on a slope of 1 in 1000. Determine section dimensions of the channel by following the step by step approach as detailed in Lane's method. (15)

5 (a) Examine the behavior of flow profiles when i) $h \rightarrow h_n$, ii) $h \rightarrow h_c$ and iii) $h \rightarrow 0$. (6+6)
Construct the possible flow profiles in **ANY TWO** of the following serial arrangements of channels or conditions. The flow is from left to right:

i) mild – milder mild; ii) steep-steeper mild; iii) critical-mild; iv) mild-critical

(b) Following the procedure for deriving qualitative flow profiles, show the procedure and draw the profile S2. (13)

A 6 m wide rectangular channel and having n = 0.025 has three reaches arranged serially. The bottom slopes of the reaches are 0.0016, 0.015 and 0.0064, respectively. For a discharge of 20 m^3/s through this channel, identify the resulting flow profiles.

OR

A wide rectangular channel with C = 47 $m^{1/2}/s$ and S_0 = 0.0001 carries a discharge of 2 m^2/s. A weir causes the water level to be raised by 0.50 m above the normal depth. Compute the length of the resulting flow profile between the weir site and the location where the depth is 2.9 m by the Bresse method. (drawing required).

6 (a) Sketch the definition diagram of hydraulic jump showing all its features. Indicate some practical applications of hydraulic jump. (10)

(b) Water flows at a velocity of 6.1 m/s and a depth of 1m in a 6.1 m wide horizontal rectangular channel. Find: (15)

i) the downstream depth necessary to form a hydraulic jump,
ii) the type of jump,
iii) the height of the jump,
iv) the length of the jump,
v) the horsepower dissipation in the jump, and
vi) the efficiency of the jump

Given Formulae

$\bar{U} = \frac{\int_0^A u\, dA}{A}$ $\alpha = \frac{\int_0^A u^3\, dA}{\bar{U}^3 A}$ $\beta = \frac{\int_0^A u^2\, dA}{\bar{U}^2 A}$	Trapezoidal channel $A = (b + sh)h$ $P = b + 2h\sqrt{1+s^2}$ $B = b + 2sh$ Triangular channel $A = sh^2$ $P = 2h\sqrt{1+s^2}$ $B = 2sh$	Circular Channel $h = \frac{d_o}{2}\left[1 - cos\frac{\omega}{2}\right]$ $\omega = 2cos^{-1}\left(1 - \frac{2h}{d_o}\right)$ $A = (\omega - sin\omega)\frac{d_o^2}{8}$ $B = d_o \sin\frac{\omega}{2}$ $P = \frac{\omega d_o}{2}$ *Note that ω is in radian*

1. **Hydraulically smooth surface:** $\frac{U}{u^*} = 5.75\, log\left(\frac{3.64u^*R}{\upsilon}\right)$
2. **Hydraulically rough surface:** $\frac{U}{u^*} = 5.75\, log\left(\frac{12.2R}{k_s}\right)$
3. **Transition regime:** $\frac{U}{u^*} = 5.75\, log\left(\frac{12.2R}{k_s + 3.35\frac{\upsilon}{u^*}}\right)$

$u^* = \sqrt{(gRS_0)}$; $K = AR^{2/3}/n$

$Z_c = \frac{Q}{\sqrt{g}/\alpha}$; $Z = A\sqrt{D}$; $Fr = U/\sqrt{(gD)}$; $Re = UR/v$;

Uniform flow formulae:

$U = CR^{1/2}S_f^{1/2}$; $U = \sqrt{(8g/f)}\, R^{1/2}S_f^{1/2}$; $U = (1/n)\, R^{2/3}S_f^{1/2}$

$Z = AR^{2/3}$; $Z = AR^{1/2}$

Governing equation for Gradually Varied Flow: $\frac{dh}{dx} = \frac{S_o - S_f}{1 - Fr^2}$

Bresse function: $\emptyset = \frac{1}{6}\ln\frac{u^2+u+1}{(u-1)^2} - \frac{1}{\sqrt{3}}tan^{-1}\frac{\sqrt{3}}{2u+1}$; Where $u = h/h_n$

$L = x_2 - x_1 = \frac{h_n}{S_0}[(u_2 - u_1) - (1 - \frac{h_c^3}{h_n^3})(\Phi_2 - \Phi_1)]$

For wide channel, $h_c = \sqrt[3]{\left(\frac{q^2}{g}\right)}$; $h_c = \sqrt[3]{q^2/C^2 S_o}$

$$\alpha = \frac{\alpha_1 K_1^3/A_1^2 + \alpha_2 K_2^3/A_2^2 + \alpha_3 K_3^3/A_3^2}{K^3/A^2}$$

$$\beta = \frac{\beta_1 K_1^2/A_1 + \beta_2 K_2^2/A_2 + \beta_3 K_3^2/A_3}{K^2/A}$$

$$n = \left(\frac{P_1 n_1^{3/2} + P_2 n_2^{3/2} + P_3 n_3^{3/2}}{P}\right)^{2/3}$$

Rectangular channel: $h_c = \sqrt[3]{\frac{\alpha Q^2}{gb^2}}$; $S_c = \left(\frac{nQ}{AR^{2/3}}\right)^2$

$Fr = U/\sqrt{(gD)}$; $Q = K\sqrt{S_f}$; $K = AR^{2/3}/n$

Lane Method: $\tau_b = 0.40\, d_{75}$

$$K = \frac{\tau_s}{\tau_b} = \sqrt{1 - \frac{\sin^2\Phi}{\sin^2\Psi}}$$

$1\ lb/ft^2 = 47.86\ N/m^2$

For Hydraulic Jump:

$$\frac{h_2}{h_1} = \frac{1}{2}\left(\sqrt{1 + 8F_{r1}^2} - 1\right)$$

$$h_L = \frac{(h_2 - h_1)^3}{4h_1 h_2}$$

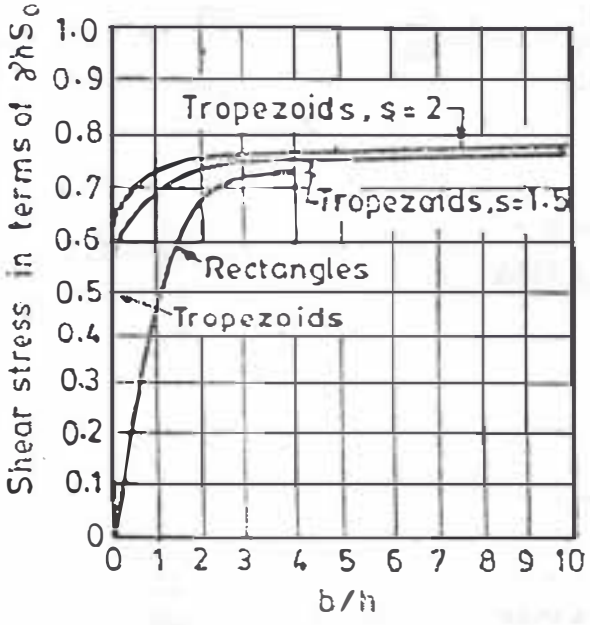
$$\frac{E_2}{E_1} = \frac{(1 + 8F_{r1}^2)^{3/2} - 4F_{r1}^2 + 1}{8F_{r1}^2(2 + F_{r1}^2)}$$

$$\frac{h_j}{E_1} = \frac{\sqrt{1 + 8F_{r1}^2} - 3}{2 + F_{r1}^2}$$

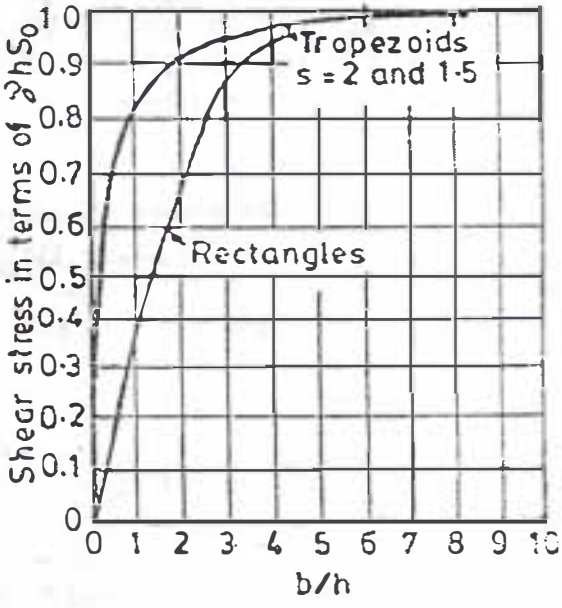
$$L_j = 9.75 h_1 (F_{r1} - 1)^{1.01}$$

Power dissipation = $\rho g Q h_L$

1 **hp** = 745.7 W



(a)



(b)