B.Sc. Engg. (CEE)/ 1st Sem. 17th May, 2019(Group A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM: Semester Final Examination WINTER SEMESTER: 2018-2019

COURSE NO.: CEE 4101 TIME: 3.0 Hours

COURSE TITLE: Introduction to Civil Engineering FULL MARKS: 100

There are 8 (Eight) questions. **Question No. 1 (One) is compulsory. Answer any 6 (Six) questions including Question No. 1.** Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. (a) What is meant by 'Foundation' of a structure? What are the purposes of providing Foundation? (3)

   (b) Define 'Bearing Capacity' of a soil and 'Settlement' of soil. (4)

   (c) Write down the difference between the following: (2.5+2.5)
   i. Spread Footing and Strap Footing
   ii. Combined Footing and Raft Foundation

   (d) Write in brief about the following: (8)
   (i) Road Rollers (ii) Pavers (iii) Crane (iv) Abutment
   (v) SPT (vi) GL (vii) RMC (viii) Box Culvert

2. (a) What is meant by 'Traffic Stream Parameters'? (2)

   (b) Discuss about different types and forms of 'Speed' with proper example. (6)

   (c) Discuss on different types of 'Deep Foundation' in detail. (8)

3. The 'Ministry of Environment and Forest (MOEF)' of Bangladesh is primarily responsible for environmental protection. Describe the actions that the MOEF has taken to control the environmental pollution of Bangladesh. (16)

4. (a) Brick is one of the most common civil engineering material. (4+4)
   i. Classify different types of "Bricks' with respect to their use in different civil engineering constructions.
   ii. Classify 'Bricks' according to their quality.

   (b) Differentiate between the following : (4+4)
   i. Lime and Cement
   ii. Load Bearing Structure and Framed Structure.

5. What is meant by 'Mean Speed', 'Modal Speed', 'Speed Limit' and 'Design Speed'? Formulate a 'Spot Speed Study' data sheet for 25 samples and find different kinds of speed for the traffic stream. (16)

6. (a) Draw a typical diagram of the basic parts of a 'Bridge'. (2)

(b) What is meant by 'Geotechnical Engineering'? Discuss about the branches and fields of Geotechnical Engineering. (6)

(c) The following figures contain the traffic volume count of an interstate highway throughout the year. Find out the different 'Daily Volume Parameters' from the figures given (8)

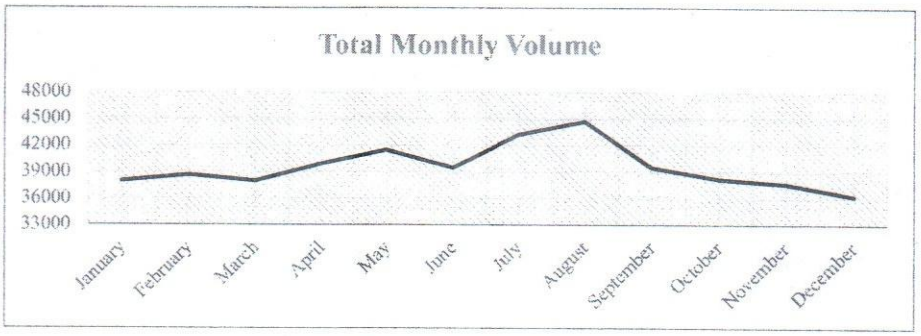

Fig:1 Total Monthly Volume

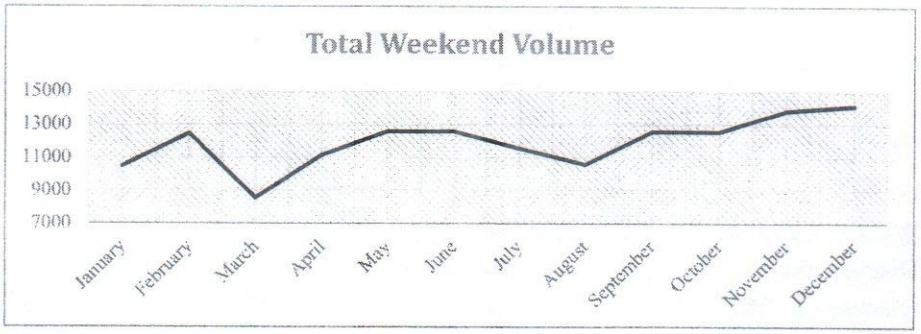

Fig:2 Total Weekend Volume

7. (a) Define the following environmental terminologies: (6)
(i) Ecology (ii) Biodiversity (iii) Species (iv) Ecosystem (v) Micro Organism (vi) Pathogens

(b) Write down the various 'Demand Sources of Water' and the two key factors by which the water requirement of any town/city is determined. (4)

(c) Write a short note on 'Water Supply System' with a schematic diagram. (3)

(d) Define 'Concrete'. Why is it widely used as a civil engineering material? (3)

8. (a) Explain the load types that an ideal structure resists. (3)

(b) What are the responsibilities of a structural engineer? Describe the four properties that a structure must possess to perform it's function? (2+6)

(c) What do you understand by 'Standard', 'Code' and 'Specification' in terms of Civil Engineering? (3)

(d) Why the study related to 'water quality' is important from environmental engineering perspective? (2)

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B. Sc. Engg. (CEE)/ 1st Sem. 15 May, 2019, Group-A

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination **Summer Semester: 2018-2019**
Course No.: CEE 4103 **Full Marks: 200**
Course Title: Surveying **Time: 3 Hours**

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1(a) The following observations were made with an anallatic tacheometer with the staff vertical: (20)

Instrument Station	Height of the Instrument axis(ft)	Staff Position	Vertical Angle	Stadia Readings
P	4.8	B. M.	- 5°30'	3.02, 5.76, 8.50
P	4.8	R	+ 3°24'	3.12, 5.58, 8.04
R	4.6	S	+ 6°12'	2.94, 6.46, 9.98

If the R. L. of the B. M. was 685.40 ft., calculate the horizontal distances PR and RS and also determine the elevations of P, R and S.

(b) Write down the functions of transition curve. Draw typical contour map of the following: $(4\frac{1}{3}+9)$
(i) Pond (ii) Overhanging Cliff (iii) River

2(a) What are the different sources of errors in case of following surveys: $(13\frac{1}{3})$
(i) Chain Survey
(ii) Levelling

(b) The following is a page of a level book, where some readings were missing. Calculate the missing data (indicated by "?") and the reduced levels of all the stations. Apply usual checks. (20)

Station	Staff Reading			Rise	Fall	R. L.	Remarks
	Back	Inter	Fore				
1	3.250					249.260	B. M.
2	1.755		?		0.750		T. P.
3		1.950					
4	?		1.920				T. P.
5		2.340		1.5			
6		?		1.0			
7	1.850		2.185				T. P.
8		1.575					
9		?					
10	?		1.895	1.650			T. P.
11			1.350	0.750			

Note: R. L.= Reduced level, B. M.= Bench Mark, T. P.= Turning Point

3(a) Write short notes on 'Record Keeping' in Chain Survey. A rectangular plot was measured with a 20 m chain which was found 12 cm too long. The lengths of the sides were recorded as 280m and 420m. Find the true area of the plot. (13 $\frac{1}{3}$)

(b) A closed traverse ABCDEA was conducted and due to difficulties in the field, the bearing of line EA and length of line DE could not be measured. From the remaining data of the traverse, find the missing quantities. (20)

Line	Length(m)	Bearing
AB	301.5	N $74^0$30' E
BC	288.4	S $60^0$15' E
CD	199.5	S $30^0$45' W
DE	Missing	N $82^0$15' W
EA	201.4	Missing

4(a) A railway embankment 500 m long is 20 m wide at the formation level and has the side slope 3 to 1. The ground levels at every 300 m along the centre line are as under: (20)

Distance(m)	0	300	600	900	1200
R. L. (m)	200	200	200	200	200

The formation level at zero chainage is 250m and the embankment has a falling gradient of 3 in 300. The ground is level across the centre line. Calculate the volume of earthwork by trapezoidal rule and prismoidal rule.

(b) Write a note on radiation method and intersection method of plane table surveying with figures. (13 $\frac{1}{3}$)

5(a) Calculate the reduced levels of the various points on a vertical curve connecting gradients of +2% and +1%. The chainage and reduced level at the intersection point are 3000 ft and 500 ft respectively. The allowable rate of change of grade is 0.2% per 100 ft. (20)

(b) Write applications of remote sensing elaborately. (13 $\frac{1}{3}$)

6(a) Based on the following information, calculate necessary data for setting out the transition and circular curve in the field. For simple circular curve, Degree of curve, D= 5°, Deflection angle, Δ = 48°, Design speed, V = 80 km/h., Maximum rate of super-elevation, e_{max} = 0.12, Max. rate of change of radial acceleration = 0.2 m/sec^3, Chainage of PI = 840 m. Tabulate the data for one transition curve and half of the circular curve using angular and offsets method. Use maximum peg interval = 20m. (20)

(b) The apex distance/External distance of a 3^0 degree circular curve is 82.45 m. Determine the deflection angle, tangent length and length of the long chord. (13 $\frac{1}{3}$)

7(a) An instrument was set up at A and the angle of elevation to a vane X meter above the foot of the staff held at B was 8°. The horizontal distance between A and B was known to be 1900 metres. The R. L. of the staff station B was 2812.262 m, given that the R. L. of the instrument axis was 2550. Determine the value of X. (13 $\frac{1}{3}$)

(b) What is transition curve? What is its usage? Define the following with proper diagram: (5+10)
(i) Ecliptic (ii) Eqinoctial Points (iii) Solstices (iv) Celestial Sphere

(c) What are the advantages and disadvantages of tacheometry surveying? (05)

8(a) Define Terrestrial and Aerial photogrammetry? Briefly describe the field works in Terrestrial Photogrammetry. (10)

(b) Write short notes on Crab and Drift with proper illustrations, The scale of an aerial photograph is 1 cm= 800 m. The photograph size is 30 cm x 30 cm. Longitudinal lap is 50% and the side lap is 25%. Determine the number of photographs required to cover an area of i) 1600 sq. km. ii) 30 km x 30 km. (5+10)

(c) Write down the differences between Plane Surveying and Geodetic Surveying. (08 $\frac{1}{3}$)

Equations' Table

1. $l = l'.\left(\frac{L'}{L}\right)$	18. $\Delta = \left(\frac{O_0+O_n}{2} + O_1 + O_2 + O_3 + \cdots + O_{n-1}\right) d$
2. $A = A'.\left(\frac{L'}{L}\right)^2$	19. $\Delta = \frac{d}{3}[(O_0 + O_n) + 4(O_1 + O_3 + \cdots + O_{n-1}) + 2(O_2 + O4 + \ldots + On-2)$
3. $V = V'.\left(\frac{L'}{L}\right)^3$	20. $V = d\left[\frac{(A_0+A_n)}{2} + A_1 + A_2 + \cdots + A_{n-1}\right]$
4. $C_t = \alpha(T_m - T_o)L$	21. $V = \frac{d}{3}[(A_0 + A_n) + 4(A_1 + A_3 + \cdots + A_{n-1}) + 2(A_2 + A4 + \ldots + An-2)$
5. $C_p = \frac{(P-P_0)L}{AE}$	22. A=h(nh+b)
6. $C_s = nC_{s1} = \frac{nl_1(wl_1)^2}{24P^2}$	23. $C_p = V_T - V_P$
7. $P_n = \frac{0.204w_1\sqrt{AE}}{\sqrt{P_n - P_0}}$	24. $C_c = \frac{d^2}{2R}$ (Subs)
8. Back Bearing = Force Bearing $\pm 180^o$	25. $C_R = \frac{1}{7}.\frac{d^2}{2R}$ (add)
9. B.B of AB = F.B of BA	26. $C_c = \frac{6}{7}.\frac{d^2}{2R}$
10. include angle=(2N-4)$\times 90^o$	27. $H = \frac{1}{2}[(h_a - h_b) + (h_a - h_b)]$
11. exclude angle=(2N+4)$\times 90^o$	28. $D = (b + s\cot\alpha_2)\frac{\tan\alpha_2}{\tan\alpha_1 - \tan\alpha_2}$
12. $\sum L = l_1\cos\theta_1 + l_2\cos\theta_2 + l_3\cos\theta_3 + \ldots = 0$	29. $h_1 = D\tan\alpha_1$
13. $\sum D = l_1\sin\theta_1 + l_2 sin\theta_2 + l_3\sin\theta_3 + \cdots = 0$	30. D=(KS+C)$\cos\theta + h\sin\theta$
14. $A = \sqrt{s(s-a)(s-b)(s-c)}$	31. H=L$\sin\theta = KS\ \sin\theta + C\ \sin\theta$
15. $A = \lvert\sum M_i L_i\rvert$	32. D=L$\cos\theta = KS\ (\cos\theta)^2 + C\ \cos\theta$
16. $M_i = M_{i-1} + \frac{D_{i-1}+D_i}{2}$	33. H=L$\sin\theta = KS\frac{\sin 2\theta}{2} + C\sin\theta$
17. $\Delta = \frac{O_1+O_2+O_3+\cdots+O_n}{n+1} \times L = \frac{L}{n+1}\sum O$	34. $\frac{Map\ Distance}{Photo\ Distance} = \frac{Map\ Scale}{Photo\ Scale}$

35.$R=\frac{5730}{D}=\frac{50}{\sin(\frac{1}{2}D)}$	49.$\delta \cong 1718.9\frac{C}{R}$
36.$l=\frac{\Pi R}{180^0}\Delta$	50.$e=\frac{Bv^2}{gR}$
37.$L=2R\sin\frac{\Delta}{2}$	51.$\tan\theta=\frac{v^2}{gR}$
38. $T=R\tan\frac{\Delta}{2}$	52.$\Delta=\Delta_c+2\Delta_s$
39.$E=R(\sec\frac{\Delta}{2}-1)$	53 . $L=\frac{v^3}{\alpha R}$
40.$M=R(1-\cos\frac{\Delta}{2})$	54.Total Tangent Length= $(R+S)\tan\frac{\Delta}{2}+\frac{L}{2}$
41. $O_o=R-\sqrt{R^2-(\frac{L}{2})^2}$	55.Length of Circular Curve $=\frac{\Pi R\Delta_c}{180}$
42.$O_x=\sqrt{R^2-x^2}-(R-O_0)$ (exact)	56.Length of Combined Curve $=\frac{\Pi R(\Delta-2\Delta_s)}{180}+2L$
43.$O_x=\frac{x(L-x)}{2R}$ (app)	57.$y=HT_2(\frac{x}{L})^2$
44.$CD=R(1-\cos\frac{\Delta}{2})=R-\sqrt{R^2-(\frac{L}{2})^2}$	58.$L=\frac{(g_1-g_2)}{r}$
45.$C_1D_1=R(1-\cos\frac{\Delta}{4})$	59.$\Delta_s=1719\frac{L}{R}$
46.$O_x=\sqrt{R^2+x^2}-R$ (exact)	60.$s=\frac{L^2}{24R}$
47.$O_x=\frac{x^2}{2R}$ (app)	61.$O_n=\frac{C_n}{2R}(C_{n-1}+C_n)$
48.$O_x=R-\sqrt{R^2-x^2}$ (exact)	

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B.Sc. Engg. (CEE)/ 1st Sem. **23 May, 2019**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : SEMESTER FINAL EXAMINATION — WINTER SEMESTER: 2018-2019
COURSE NO. : **PHY 4153** — TIME: 3.0 Hours
COURSE TITLE: **Physics I** — FULL MARKS: 150

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. (a) What do you understand by constructive and destructive interferences of light? **(04)**

   (b) Give a detailed analytical treatment of interference of two coherent light waves and obtain the conditions of their path difference for occurring constructive and destructive interferences. **(16)**

   (c) Two straight and narrow parallel slits 1 mm apart are illuminated by monochromatic light. Fringes are formed on a screen after the interference of light waves coming from the slits. If the screen is held at a distance of 100 cm from the slits, the fringe width becomes 0.5 mm. What is the wavelength of light used? **(05)**

2. (a) Distinguish between a thin parallel film and a thin wedge-shaped film. **(04)**

   (b) Light ray from an extended source falls obliquely on a thin film. Derive the expression $2\mu t\cos r = (2n+1)\frac{\lambda}{2}$, for constructive interference between a part of the ray reflected externally at the first surface and a part of it reflected internally at other surface of the film. **(16)**

   (c) A parallel beam of light of wavelength, $\lambda=5890\times10^{-8}$ cm is incident on a thin glass plate (refractive index, $\mu=1.5$) such that the angle of refraction into the plate is 60°. Calculate the thickness of the glass plate which will appear bright by 1st order reflection. **(05)**

3. (a) What are Newton's rings? **(04)**

   (b) Derive the expression for radius of curvature of a plano-convex lens in terms of diameters of the Newton's rings and wavelength of light. Also derive the relation of refractive index of a liquid in terms of diameters of the rings. **(16)**

   (c) In a Newton's rings experiment, fringes are observed in reflected light of wavelength, $\lambda=5.9\times10^{-5}$ cm. The diameter of the 10^{th} dark ring is 0.5 cm. Find the radius of curvature of the lens. **(05)**

4. (a) What do you mean by diffraction of light and what is Fraunhofer diffraction? **(04)**

   (b) In a Fraunhofer type of diffraction through a single slit, show that the intensity of the diffracted light on a screen is expressed by the relation: $I = I_o\frac{\sin^2\beta}{\beta^2}$. **(14)**

   (c) From the relation of question 3(b), find the condition of secondary maxima. Show how you will get these maxima graphically. **(07)**

5. (a) Distinguish between unpolarized and polarized lights. **(04)**

   (b) Discuss how white light can be plane polarized by reflection and refraction and explain this polarization by Fresnel's theory. **(16)**

   (c) A white light when incident upon a medium of refractive index 1.5 is completely polarized after reflection. What is the angle of refraction? **(05)**

6. (a) Write down the considerations that led Van der Waals to modify the ideal gas equation. **(04)**

   (b) Deduce the Van der Waals equation of state. **(16)**

   (c) Prove that the critical constant, $V_c = 3b$. **(05)**

7. (a) Define degrees of freedom, heat capacity and specific heat. **(06)**

   (b) State the first law of thermodynamics and use it to establish a relation between the specific heats of a gas at constant pressure and volume. **(15)**

   (c) Find the ratio of specific heats, $\gamma = \frac{C_p}{C_v}$, for a gas of tri-atomic molecules. **(04)**

8. (a) State and explain the second law of thermodynamics. **(04)**

   (b) Derive the relation of the efficiency of a Carnot engine. **(16)**

   (c) Find the efficiency of a Carnot engine working between 127°C and 27°C. **(05)**

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B.Sc. Egg. (CEE)/1st Sem. 28 May, 2019 (Gr. A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM: FINAL EXAMINATION **WINTER SEMESTER: 2018-2019**
COURSE NO. : Math 4153 **TIME: 3.0 Hours**
COURSE TITLE: Differential Calculus, Integral Calculus & Matrix **FULL MARKS: 150**

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this questions paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. **a)** A cubic function in x has a maximum value equal to 15, when $x=-3$ a minimum value is -17, when $x=1$, find the function. (8)

   b) Find ϕ for the curve $r^n = a^n \cos n\theta$. (6)

   c) Find the equations of the tangent and normal to the curve $f(x)=3x^2+5x-9$. (11)

2. **a)** Define gamma and beta function. Find a relation between gamma and beta function. (10)

   b) Prove that $\int_0^1 \frac{x^2 dx}{\sqrt{1-x^4}} \times \int_0^1 \frac{dx}{\sqrt{1+x^4}} = \frac{\pi}{4\sqrt{2}}$. (15)

3. **a)** Determine the perimeter of the loop of $3ay^2 = x^2(a-x)$. (13)

   b) Find the volume generated by revolving one loop of $y^2(a+x)=x^2(3a-x)$ about x-axis. (12)

4. **a)** Define symmetric matrix and skew-symmetric matrix. Every square matrix A can be expressed as the sum of a symmetric matrix and a skew-symmetric matrix. Explain. (2+6)

   b) Determine the values of α, β and γ, when $\begin{bmatrix} 0 & 2\beta & \gamma \\ \alpha & \beta & -\gamma \\ \alpha & -\beta & \gamma \end{bmatrix}$ is orthogonal. (10)

   c) If $A=\begin{bmatrix} 1 & 5 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}$, $B=\begin{bmatrix} 1 & 5 & 6 \\ 2 & 4 & 0 \end{bmatrix}$, show that $A^T + B = \left(A + B^T\right)^T$. (7)

5. **a)** If $A=\begin{bmatrix} -1 & 2 & -3 \\ 2 & 1 & 0 \\ 4 & -2 & 5 \end{bmatrix}$ and $B=\begin{bmatrix} 2 & 1 & -1 \\ 0 & 2 & 1 \\ 5 & 2 & -2 \end{bmatrix}$, find $A^{-1}B$. (13)

b) Solve the following system of equation by matrix method (12)

$$5x-6y+4z=15$$
$$7x+4y-3z=19$$
$$2x+y+6z=46$$

6. (14)

a) Find the canonical matrix of $A=\begin{bmatrix}2 & 7 & 3 & 5\\ 1 & 2 & 3 & 4\\ 3 & 8 & 1 & -2\\ 4 & 13 & 1 & -1\end{bmatrix}$ and find its rank.

b) Reduce the normal form of the following matrix: (11)

$$A=\begin{bmatrix}1 & 2 & 3 & 4\\ 2 & 1 & 4 & 3\\ 3 & 0 & 5 & -10\end{bmatrix}.$$

7. What is quadratic form of matrix? Give an example. (25)

Reduce the quadratic form

$$6x_1^2+3x_2^2+3x_3^2-4x_1x_2-2x_2x_3+4x_3x_1$$

to the sum of squares and the corresponding linear transformation. Also find the index and signature.

8. a) State and prove Cayley-Hamilton theorem. (8)

b) Define eigenvalues and eigenvectors. (2+15)

Find the eigenvalues and eigenvectors of the matrix

$$\begin{bmatrix}1 & 0 & -1\\ 1 & 2 & 1\\ 2 & 2 & 3\end{bmatrix}.$$

B.Sc. Engg. (CEE) 1st Sem. 20 May, 2019 (Group- A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Term Final Examination — **Winter Semester: 2018-2019**
Course No.: Chem- 4153 — **Full Marks: 150**
Course Title: Chemistry — **Time: 3.0 Hours**

There are 8 (EIGHT) questions. Answer any 6 (SIX) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1(a) Giving example explain how energy change in a chemical reaction takes place? (5)

(b) Derive different forms of Kirchoff's equation. (12)

(c) Calculate the heat of formation of ammonia at 450°C from the following data: (8)
i) The heat of formation of ammonia at 25°C = – 11.04 k cal.
ii) C_p (molar heat capacities) of NH_3; N_2 and H_2 are 10.5; 8.3 & 6.1 cal K^{-1} mol^{-1} respectively.

2(a) Write the mathematical expression of Gibb's phase rule. Define degrees of freedom of Gibb's phase rule. Based on your definition derive phase rule. (8)

(b) Draw the phase diagram of sulfur. (8)

(c) How many two phase and three phase equilibria in the phase diagram of sulfur? Describe them in brief. Mention the temperature and pressure of all the triple points of the diagram. (9)

3(a) What are reversible and irreversible reactions? Give at least one example of each of them. (8)

(b) State law of mass action. Explain the term 'active mass'. Derive the mathematical expression of K_C. Establish a relation between K_C & K_P of a gaseous reaction. (12)

(c) The equilibrium constant K_P for the reaction: $PCl_{5(g)} = PCl_3 (g) + Cl_2 (g)$ is found to be 95.0 at 200°C. If the equilibrium partial pressure of PCl_5 and PCl_3 are 0.80 atm. and 0.45 atm. respectively then what will be equilibrium partial pressure of Cl_2 at 200°C? (05)

4(a) What do you understand by rate of a reaction? Discuss with the help of a diagram. (8)

(b) Derive an equation for the rate constant of a first order reaction. (8)

(c) 25% of a first order reaction is completed in 30.0 minutes. Calculated the (i) rate constant, (ii) half life value and (iii) time required for completing 75.0% of the reaction. (9)

5(a) Define the terms (i) semi-permeable membrane, (ii) osmosis and (iii) osmotic pressure. State and explain laws of osmotic pressure. (8)

(b) Define freezing point of a liquid with reference to vapour pressure. Derive a mathematical expression correlating depression of freezing point and the molecular weight of solute of a solution. (8)

(c) Calculate the freezing point of an aqueous solution containing 1.5 g urea in 150 g water [K_f of water = 0.53]. (9)

6(a) Why does hydrogen atom give so many lines in its spectrum although there is only one electron in the H-atom? (5)

(b) Draw the sketches of p- and d-orbitals showing the directional characteristics. (4+6=10)

(c) Write a short note on electronic theory of chemical bonding with suitable examples. (6)

(d) Discuss the dependence of physical and chemical properties on bond types. (4)

7(a) Explain the term 'hydrogen bonding' and discuss its importance in human body. (3+3=6)

(b) Define the terms 'metallic bonding' and 'van der waals force'. (3+3=6)

(c) What is hybridization? Write the types of hybrid orbitals with suitable examples. (2+4=6)

(d) PCl_5 does exist while NCl_5 does not although N and P both are in the same periodic table. (4)

(e) What conditions should present in atomic orbitals to achieve strong bonding? (3)

8(a) Explain with molecular orbital diagrams, H-atom ($1s^1$) forms diatomic molecule while He atom has $1s^2$ electrons but it does not form diatomic molecule. (6)

(b) Draw the molecular orbital diagrams for O_2 and N_2 molecules. (4+4=8)

(c) Write the possible names of periodic properties of the elements. (4)

(d) Discuss the 'electropositive character' and 'ionization potential' for both grouping and periodic change. (7)

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B.Sc. Engg. EE/ HDEE (3rd Sem.), DTE (1st Sem.) Date: 21 May, 2019 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A.Y. 2018-2019
Course No.: EEE 4305/EEE 4391 — Time: 3 Hours
Course Title: Energy Conversion I — Full Marks: 150

There are **8 (eight)** questions. Answer **any 6 (six)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Assume suitable values for any missing data.

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1. a) A ferromagnetic core with a relative permeability of 1500 is depicted in Fig. 1(a) in which the values of all the dimensions have been incorporated. Because of the fringing effect, the effective area of each of the air gaps is 5% larger than their physical size. If $i = 1$ A, what are the flux values for left, center and right legs of the core? What is the flux density in each air gap? 20

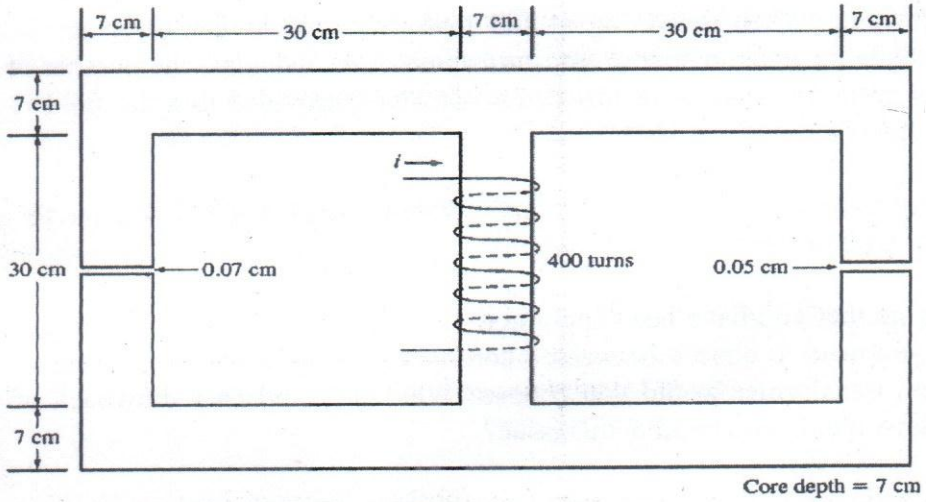

Fig. 1(a)

b) Sketch the total characteristic curve for a self-excited DC generator with accountings for all the components. 05

2. a) The following table provides the data for the O.C. test of a DC shunt generator at 300 rpm. 20

Field Amperes	0	2	3	4	5	6	7
Armature Volt	7.5	92	132	162	183	190	212

Plot the O.C.C. for 375 rpm and determine the voltage to which the machine will excite if field circuit resistance is 40 Ω.

i) What additional resistance would have to be inserted to the field coil to reduce the voltage to 200 V at 375 rpm?
ii) Without this additional resistance, determine the load current supplied by this generator when its terminal voltage is 200 V. Ignore armature reaction and assume that the speed to be constant. Armature resistance id 0.4 Ω.
iii) Determine the critical speed for this set-up.

b) What is back emf? Explain with necessary diagrams. Explain how does back emf help limiting the starting current of a DC motor? 05

3. a) Write a brief comparative analysis on the different characteristic curves of series and shunt DC motors with necessary diagrams. 10

   b) With appropriate diagrams, explain the process of voltage build up of a shunt DC generator. 10

   c) A long-shunt dynamo running at 1000 rpm supplies 22 kW at a terminal voltage of 220 V. The resistances of armature, shunt field and the series field are 0.05 Ω, 110 Ω and 0.06 Ω, respectively. Overall efficiency is 88%. Find out Cu loss, Iron and Friction loss. 05

4. a) Assume that you have been recruited as the chief engineer to repair the elevator of Star Cineplex. You identified that the speed control for the elevator is not operational and needs to be replaced. Which method of speed control you would replace it with? Explain its operation and reasons for your choice. 10

   b) What is the speed regulation of a DC motor? Briefly explain the interdependency between the torque and speed of a DC motor with proper equations and step by step analysis. 10

   c) A 4-pole DC generator supplies a current of 143 A. It has 492 wave-wound armature conductors. When delivering at full load, the brushes are given an actual lead of 10°. Calculate the demagnetizing amp-turns/pole. Also, calculate the number of extra shunt field turns needed to neutralize this demagnetization provided that the field is shunt connected and draws a current of 10 A. 05

5. a) Derive the expression for approximate voltage drop in a transformer for a lagging power factor with necessary vector diagrams. 10

   b) Imagine that you have been appointed as a transmission line engineer by your government and you need to choose between a core-type/shell-type transformer for an LV application. Which transformer would you choose? What is the primary drawback of this transformer and how would you combat this issue? 10

   c) Two series motor runs at a speed of 500 rpm and 550 rpm, respectively when both are taking 50 A at 500 V. Terminal resistance of each motor is 0.5 Ω. Calculate the speed of this combination when both of them are connected in series and coupled mechanically. The combined connection is drawing 50 A at 500 V. 05

6. a) A 5 kVA 200/1000 V, 50 Hz, single-phase transformer produced the following test results: 10
   O.C. Test (LV side): 2000V, 1.2 A, 90 W
   S.C. Test (HV side): 50 V, 5 A, 110 W
   Based on the test results obtained, calculate:
   i) The parameters of the equivalent circuit referred to the LV side.
   ii) The output secondary voltage when delivering 3 kW at 0.8 lagging power factor, the input primary voltage being 200 V.

   b) Sketch the vector diagrams for primary and secondary voltages, currents and emfs for the following load types: 10
   i) Capacitive load, incurs Cu loss, Iron loss and no leakage loss.
   ii) Inductive load, incurs Cu loss, Iron loss and leakage loss.

   c) Why do we represent the transformer rating in kVA? 05

7. a) What is the necessity of a starter circuit in a DC motor? Design and explain the operation of a DC motor starter circuit using counter-voltage sensing relays. 10

   b) Explain the chain of events which take place immediately after loading a transformer in the secondary. Attach appropriate circuit and vector diagrams to justify your explanation. 10

   c) Write down some applications of different types of motors. 05

8. a) The full load copper loss on HV side of a 100 kVA, 11000/317, 1-phase transformer is 0.62 kW and on the LV side is 0.48 KW. 10
      i) Calculate R_1, R_2 and R_2' in ohms
      ii) If total reactance is 4%, find X_1, X_2 and X_2' in ohms provided that the reactance is divided in the same ratio as the resistance.

   b) A 400 V shunt connected DC motor takes a total current of 3.5 A at no load and 59.5 A at full load. The field circuit resistance is 267 Ω and the armature resistance is 0.2 V. Voltage drop at brushes is 2 V. 10
      i) Determine the percentage change in speed from no load to full load if the armature reaction at full load weakens the flux per pole by 2%.
      ii) What resistance must be placed in series with the armature in question i) if the full load speed is to be reduced by 50% with the gross torque remaining constant? Assume that there is no change in flux.

   c) Write down the disadvantages of using rheostatic control method compared to the flux control method for speed control of a series DC motor. 05

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B.Sc. Egg. (CEE)/ 3rd Sem. 21 May 2019 (Gr. B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : FINAL EXAMINATION WINTER SEMESTER: 2018-2019

COURSE NO. : **CEE 4311** TIME : 3.0 Hours

COURSE TITLE: **Mechanics of Solids I** FULL MARKS: 150

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. (a) For the planar structures shown in Fig. 1, find the reactions and determine the axial force P, the shear V, and the bending moment M at section a-a caused by the applied load. (10)

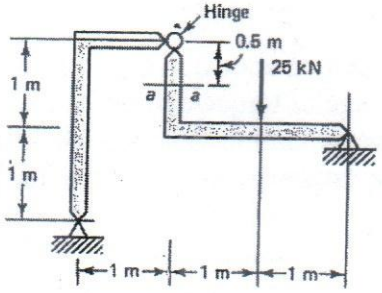

Fig. 1

(b) A circular steel shaft of the dimensions shown in Fig. 2 is subjected to three torques: $T_1 = 28$ k-in, $T_2 = -8$ k-in, and $T_3 = 10$ k-in. (i) What is the angle of twist of the right end due to the applied torques. (ii) Plot the angle-of-twist diagram along the shaft. Let $G = 12 \times 10^6$ psi. (15)

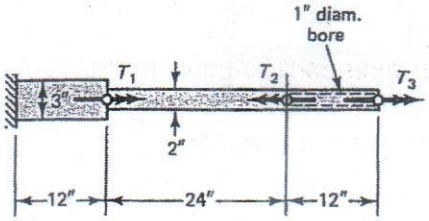

Fig. 2

2. (a) Compare the torsional strength and stiffness of thin-walled tubes of circular cross section of linearly elastic material with and without a longitudinal slot (see Fig. 3). (10)

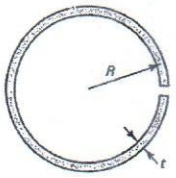

Fig. 3

(b) Draw shear force and bending moment diagrams of the beam shown in Fig. 4. (15)

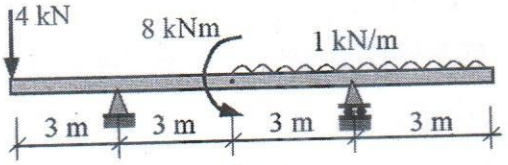

Fig. 4

3. (a) For a linearly elastic material, at the same maximum stress for a square member in the two different positions shown in Fig. 5, determine the ratio of the bending moments. Bending takes place around the horizontal axis. (10)

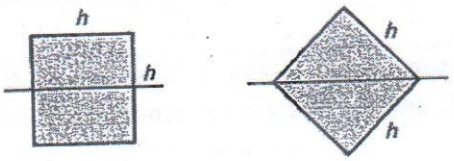

Fig. 5

(b) A shaft having the cross section shown in Fig. 6 is subjected to a torque T = 150 N.m. (i) Estimate the percentage of torque carried by each of the two cross-sectional components, and calculate the maximum shear stresses in each part, neglecting stress concentrations. (ii) Find the angle-of-twist per unit length caused by the applied torque. Let G = 25 x 10^3 GPa. (15)

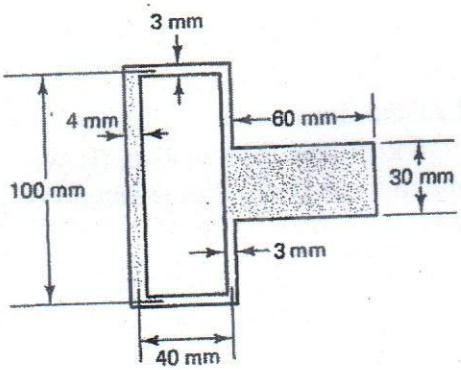

Fig. 6

4. (a) The magnitudes and sense of the stresses at a point are as shown in Fig. 7. Determine the stresses acting on the vertical and horizontal planes. (10)

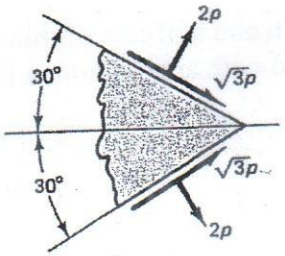

Fig. 7

(b) A bar having a 100 x 100 mm cross section subjected to a force F, as shown in Fig. 8. The longitudinal stresses on the extreme fibers at two sections 200 mm apart are determined experimentally to $\sigma_A = 0$; $\sigma_B = -30$ MPa; $\sigma_C = -24$ MPa; and $\sigma_D = -6$ MPa. Determine the magnitude of the vertical and horizontal components of force F. (15)

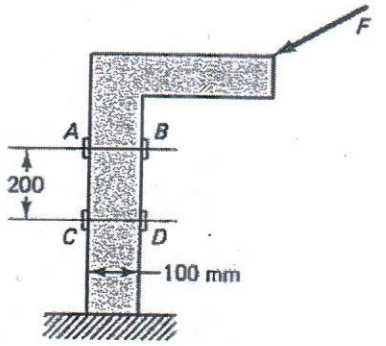

Fig. 8

5. (a) Using the moment-area method, determine the deflection and the slope of the elastic curve at point A due to the applied loads for the beams, as shown in Fig. 9. Specify the direction of deflection and of rotation for the calculated quantities. EI is constant. Let E = 29 x 10^3 ksi or 200 GPa. Prepare sketch of the elastic curve showing inflection points. (10)

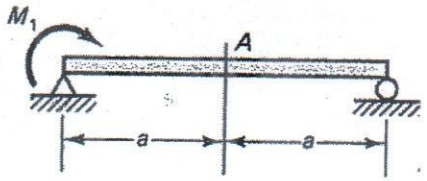

Fig. 9

(b) A 150 x 200 mm beam spanning 6000 mm is loaded in the middle of the span with an inclined force of 5 kN along the diagonal of the cross section, as shown in Fig. 10. Determine the largest stresses and locate the neutral axis. (15)

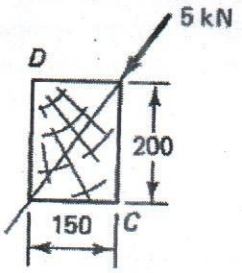

Fig. 10

6. (a) Determine the allowable bending moment around horizontal neutral axes for the composite beams of wood and steel plates having the cross-sectional dimensions shown in Fig. 11. Materials are fastened so that they act as a unit. $E_{st} = 30 \times 10^6$ psi and $E_w = 1.2 \times 10^6$ psi. The allowable bending stresses are $\sigma_{st} = 20$ ksi and $\sigma_w = 1.2$ ksi. (10)

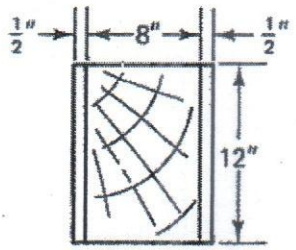

Fig. 11

(b) Using Mohr's circle, determine the angle between the right-hand face of the element shown in Fig. 12 and the plane or planes where the normal stress is zero. Show 'the stresses with proper sense on the rotated element(s). (15)

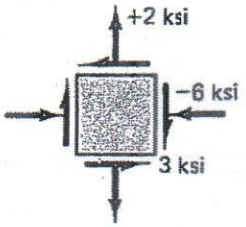

Fig. 12

7. (a) A 20m diameter spherical tank is to be used to store gas. The shell plating is 10 mm thick and the working stress of the material, that is, the maximum stress to which the material should be subjected, is 125 MPa. What is the maximum permissible gas pressure? (10)

(b) The shear diagram for the box beam supporting a uniformly distributed load is conservatively approximated for design by the stepped diagram shown in Fig. 13. If the beam is nailed together with 16d (16-penny) box nails from four full-sized pieces, as shown in the cross section, what nail spacing should be used along the span? Assume that each nail is good for 75 lb in shear. (15)

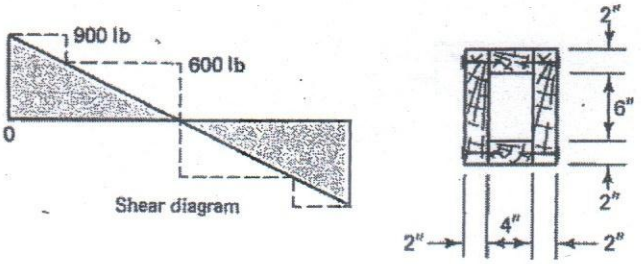

Fig. 13

8. (a) Determine the location of the shear center for the beam having the cross-sectional dimensions shown in Fig. 14. All members are to be considered thin-walled, and calculations should be based on the centerline dimensions. (10)

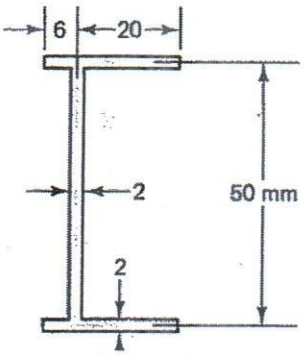

Fig. 14

(b) Determine the equations of the elastic curve for the beam shown in Fig. 15 due to the applied loading for the given boundary conditions. EI is constant. (15)

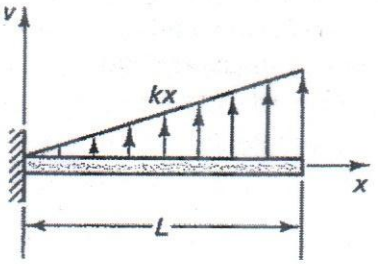

Fig. 15

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B.Sc. Engg. (CEE)/ 3rd Sem. 29th May, 2019 (Group-B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester: Semester Final Examination **Winter Semester: 2018-2019**
Course No.: GS 4351 **Full Marks: 150**
Course Title: Engineering Geology and Geomorphology **Time: 3.0 hours**

There are **8 (Eight)** Questions. Answer any **6 (Six)** questions. All questions carry equal marks. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning

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1 (a) Explain with diagram, the variation of the various morphological parameters of a river basin as it flows in the downstream direction. Explain these variations in the context of Bangladesh. (10)

(b) Describe different landforms of alluvial river floodplain with neat sketch. (12)

(c) Due to earthquake, folding took place in the land surface of an area and hence alternating bands of hard and soft rocks developed in that area. What kind of drainage pattern do you think will eventually develop in that area?
Also draw a neat sketch of that drainage pattern. (03)

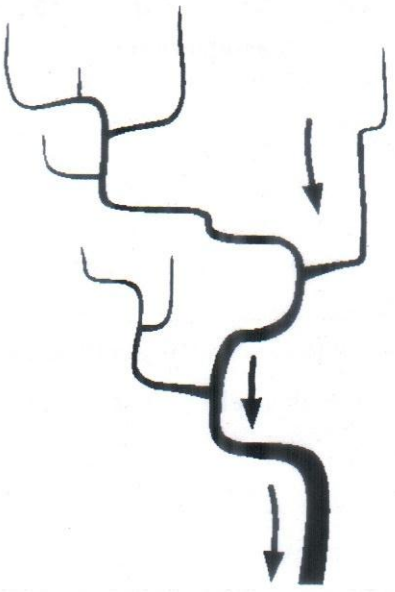
2 (a) Draw a schematic diagram showing the components of total flow. (03)

(b) Write down the name of the factors affecting runoff. (05)

(c) Write down the assumptions of rational method for estimation of runoff. (04)

(d) Write the differences between radially outward drainage pattern and annular drainage pattern with figure. (04)

(e) The stream network of a drainage basin is given below. What kind of drainage pattern does this stream network follow? (09)
Do the stream ranking for this network by both Horton's method and Strahler's method.
Calculate the Bifurcation Ratio for both the cases.
Which method do you think is more realistic?

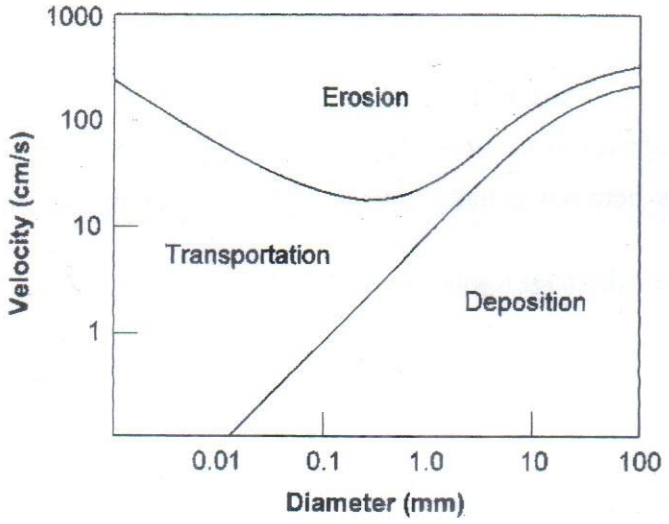


3 (a) There are two streams named "A" and "B". The streams have bifurcation ratios of 7 and 3 respectively. Observing the bifurcation ratio, answer the following questions: (10)

(i) In which category do the streams fall- headwater stream, medium stream or river?
(ii) Which stream will have higher discharge and mean flow velocity?
(iii) The basin containing which stream has more probability of flooding?
(iv) Draw the comparative hydrographs for the two basins for identical rainfall event.
(v) Comment on the type of formation of the surrounding landforms of the two streams.

(b) Three drainage basins A, B, C have drainage density of 10.5 km/km^2, 24.1 km/km^2 and 0.51 km/km^2 respectively and drainage area of 0.5 km^2, 1 km^2 and 2 km^2 respectively. Find the length of the channels, constant of channel maintenance and length of overland flow of the channels. (11)
Which stream is likely to have rapid stream response and which one is likely to have least stream frequency?

(c) A river has a mean flow velocity of 7 cm/s. A graph depicting the transportation power of the river is given below. (04)
Approximately 10 kg of khoas and 30 kg of surkhi from a nearby demolished building are dumped into the river and it was found that the former got deposited in the river bed whereas the later got carried by the course of the river. Using the given graph, find the probable size of the two types of loads.



4 (a) Derive the equation of longitudinal bed profile of a stream. (10)
The elevation above base level has been found to be 20 ft and 6 ft at the distances of 2 miles and 10 miles downstream from the source respectively. Find the elevation of the stream at a distance of 20 mile downstream from the source.
Also draw the longitudinal profile of the stream in a graph paper (use normal graph) using the derived equation and given data.

(b) Describe the effects of increase in bed load in an apparently graded stream. (05)

(c) With necessary diagrams, explain the channel cross-sectional changes during one flood season. (10)

5 (a) What is lithification? Explain the process of lithification of sedimentary rock. (05)

(b) Write down the effects of differential stresses on rock deformation. (05)

(c) What do you mean by metamorphic grade? Explain the effect of grading on the metamorphic rock with an example. (05)

(d) An earthquake causes an average of 2.5 m strike-slip displacement over an 80 km long, 23 km deep portion of a transform fault. Assuming that the rock soil has a modulus of elasticity of 25000 kPa, estimate the seismic moment and moment magnitude of the earthquake. Note that 1 MPa=10^7 dyne/cm^2. (10)

6 (a) Briefly describe the formation of the following with neat sketches: (15)

i. Foliation in metamorphic rock
ii. Ripple marks
iii. Dip and strike
iv. Isostatic setting
v. Recumbent fold

(b) What is the sedimentary structures? Briefly describe any three sedimentary structures with neat sketches. (5)

(c) Which one is more powerful in between the Great Indian earthquake (Magnitude=8.7) than the Moheskhali earthquake (Magnitude =5.2) in terms of magnitude? (5)

7 (a) Distinguish between the following with figure and examples where applicable: (15)

i. Reverse fault and Thrust fault
ii. Compression wave and Shear wave
iii. Syncline and Anticline
iv. Horizontal fold and Plunging fold
v. Magnitude and intensity of an earthquake

(b) Write down the geological problems associated with a dam site. (05)

(c) Write down the classification of earth movements. (05)

8 (a) Define clastic sediments. How is it converted to rock? (05)

(b) A seismograph recorded the arrival time of P wave and S wave travelled through the crust of the earth during an earthquake occurred on 5th January 2019. Determine the location of the seismograph from the epicenter based on the following information: (12)

Arrival time of P wave= 06:11:18.93

Arrival time of S wave= 06:12:26.27

Modulus of elasticity of the earth crust= 26000 kPa

Earth crust density= 18 kN/m^3

(c) Find out the Peak Ground Acceleration (PGA) of the following earthquakes: (8)

Earthquake Name	Magnitide	Intensity
Great Indian Earthquake (1897)	8.7	IX
Srimangal Earthquake (1918)	7.6	VI
Mexico Earthquake (1985)	8	X

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B.Sc. Engg. (CEE)/ 3rd Sem. May 18, 2019 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2018-2019
COURSE NO. : GS 4353 TIME : 3.0 Hours
COURSE TITLE: Numerical Methods and Computer Programming FULL MARKS: 150

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. (a) A mathematician has created the following functions within a ***Python 3.7.3*** script. The script has been provided to a user who is trying to evaluate 5^{16} calling **twoPower** function of this script by running it within the ***Python 3.7.3*** IDLE shell. (12)

```
def square(x):
    return x*x
def twoPower(x, n):
    while n > 1:
        x = square(x)
        n = n/2
    return x
```

i. What are the limitations of this script? Mention those limitations using specifications within the script.
ii. What will be the output of the users input as twoPower(5, 16) ? Show each iteration of calculations.

(b) The Maclaurin series expansion for e^x is (13)

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \cdots$$

Starting with the simplest version, $e^x = 1$, add terms one at a time to estimate $e^{0.5}$. After each new term is added, compute the true and approximate percent relative errors. Add terms until the absolute value of the approximate error estimate falls below an error criterion conforming to two significant figures.

2. (a) The story: (**Figure 1**) (16)
   - 3 tall spikes
   - Stack of 4 different sized discs – start on A spike
   - Need to move stack to Third (C) spike (at which point universe ends)
   - Can only move one disc at a time, and a larger disc can never cover up a small disc

i) Write a program to print out the right set of moves.
ii) What would be the least number of moves to complete the task? Show each iteration of calculations along with mentioning the moves.

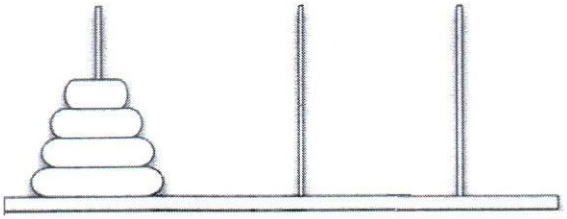

Figure 1

(b) A simply supported beam is loaded in such a way that the value of Shear force (kip) at a distance x from the beam is, (09)

$$V(x) = \frac{1}{6}Lw - \frac{w}{2L}x^2 \ (for\ x = 0\ to\ x = L)$$

L = length of the beam = 5 ft

w = maximum triangular load = 2 kip/ft

Hence, bending moment at the mid-span of the beam is $M = \int_0^{L/2} V(x)dx$

Use 4 areas for both trapezoidal and Simpson's rule to evaluate the bending moment at mid-span of the beam and compare the results. Also find the exact value of bending moment. (Given, at x = 0, bending moment M = 0)

3. (a) Use Newton-Raphson method to find the root of the equation $x^3 - x - 1 = 0$ using an initial guess of x = 1.5. ($\varepsilon_s = 10^{-7}\%$). Also, determine the true root of the equation. (13)

(b) Write a script in ***Python 3.7.3*** Shell for Question 3(a) which can solve the equation mentioned above. Also write down the output after running the script in ***Python 3.7.3*** Shell. (12)

4. (a) Write down the output of the following expressions in ***Python 3.7.3*** Shell. Also show the steps for calculation according to the operator precedence with proper explanations: (12)

i. `4+round(11/3,3)**3//7*int(11/3)`

ii. `"Something"[0:-5]+"Anywhere"[3:8]`

iii. `7**len('ijklmo qrst')//3%2`

iv. `53+(7!=4)**12-42>0`

(b) Use zero through third-order Taylor series expansions to predict $f(3)$ for (13)

$$f(x) = 25x^3 - 6x^2 + 7x - 88$$

Using a base point at $x_i = 1, h = 2$, compute the true percent relative error ε_t for each approximation.

5. (a) A programmer with civil engineering background has created two ***Python 3.7.3*** modules saving by the names "beam1.py" and "beam2.py" in same folder in D drive naming "python" regarding geometric properties of a square beam and a circular beam as shown below: (16)

i) **beam1.py** script

```
'This is a module for evaluating area & volume of a
square beam'
length = 1
def area(width_or_height):
    'It will return area of that beam section'
    return width_or_height**2
def volume(width_or_height, length):
    'It will return volume of that beam'
    return area(width_or_height)*length
```

ii) **beam2.py** script:

```
'This is a module for evaluating area & volume of a
circular beam'
length = 1
pi = 3.14159
def area(radius):
    'It will return area of that beam section'
    return pi*radius**2
def volume(radius, length):
    'It will return volume of that beam'
    return area(radius)*length
```

After that the programmer types the following expressions by running in ***Python 3.7.3*** IDLE Shell:

```
import sys
sys.path.insert(0,'D:/python')
import beam1
import beam2
area(2)
beam1.area(5)
beam2.area(5)
pi
from beam1 import*
pi
area(5)
beam2.volume(3,length)
length = 10
volume(3, length)
```

Write down the output of each expression mentioned above in a sequential manner by writing beside the expression.

(b) Write down a script using recursive algorithm in ***Python 3.7.3*** for the following series with appropriate specifications and assertions, which will generate summation upto n-th term: (09)

$$1+3+7+15+31+63+\cdots$$

6. (a) Experimentally observed value of deflection of a beam are shown in the **Figure 2**. Estimate the bending moment at points: -2, -1, 0, +1, +2. (10)

Given, $E = 29 \times 10^6\ psi,\ I = 1000\ inch^4$

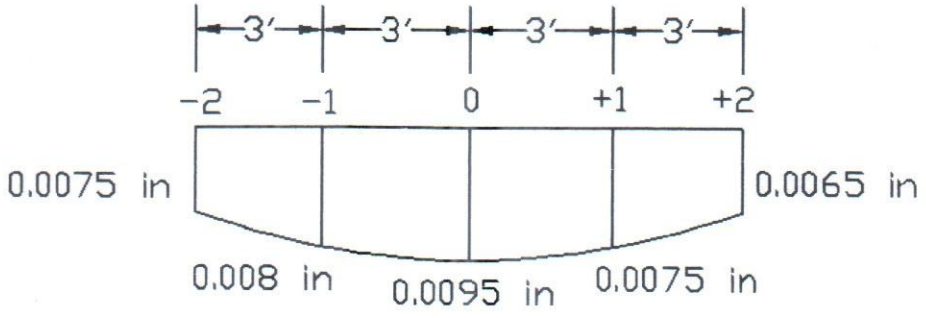

Figure 2

(b) Write down commands within a ***Python 3.7.3*** script which will convert any decimal number to its binary form. Use proper indentations within the script. The coding procedure will maintain the following concept: (15)

Firstly, it will ask for a decimal of floating type as input
Secondly, the floating number will be divided into two parts. The integer part and the fractional part.
Thirdly, the integer part will be converted to binary as per rules and saved as a string in Python. If the integer part is 0 then the outcome from the integer will also be 0 in binary as a string.
Fourthly, the fractional part will be converted to binary as per rules and saved as another string in Python, for example as '.101' i.e., without any '0' before '.' (dot) sign.
Finally, two strings will be added mutually and final binary form will be shown as output in a decorated form.

7. (a) Write down a script in ***Python 3.7.3*** which will search the root of 25 using the bisection method. (13)
(Use epsilon, $\varepsilon = 0.00000001$)

(b) Create a script in ***Python 3.7.3*** which will be able to find the common divisors of any two positive integers. In next, also mention the procedure that how it will be able to sum up those common divisors. (12)

8. Department of Civil and Environmental Engineering (CEE) of IUT has taken a scheme to develop a Python program to sum up students' obtained marks of lab reports for Python sessional course conforming to 1.5 credit hours/week, sum of which will be 50 marks in total using weightages of different assignments. These weightages are due to relative importance of different assignments. This Details information are provided below: (25)

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Sl. No.	Assignment No.	Weightage	Full Marks
1	01	0.1	10
2	02	0.2	10
3	03	0.2	10
4	04	0.2	10
5	05	0.3	10

Sometimes lab report marks could exist as Grades of which equivalent marks are shown below:

Report Grades	Equivalent Marks
A+	10
A	9
A-	8
B	6
C	5
D	4
F	0

Create a script inscribed by multiple functions in ***Python 3.7.3*** and also mention the output that it will display using the following instructions:

```
def getSubjectStats(subject, weights):
```

`subject` will be a List having the names of the student and ID as well as obtained marks according to the sequence shown above.
`weights` will be a List having the weightages shown above.
The function will return a List which is similar to the `subject` with one additional element i.e., summed up marks after applying weightage sum of those marks for every student.
Also allow exceptions for **`ZeroDivisionError`** to return 0.0 as students may be absent or haven't submitted any assignment, and also allow exceptions for **`TypeError`** for grades to convert into marks.
Write down a sample of **`subject`** and **`weights`** and the output after calling **`getSubjectStats(subject, weights)`** for those **`subject`** and **`weights`**.

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B.Sc. Engg. (CEE), 3rd Sem. May 16, 2019 (Group-B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

SEMESTER FINAL EXAMINATION **Winter Semester : 2018-2019**
Course No. : CEE 4361 **Time: 3 hours**
Course Title : Fluid Mechanics **Full Marks:150**

There are **8 (eight)** questions. Answer **any 6 (six)** of them. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Assume reasonable data if required.

---

1. (a) Draw a typical energy line diagram for a pipe flow in series, as showing in Fig 1. (05)
Consider diameters of pipe 1 and 3 are same.

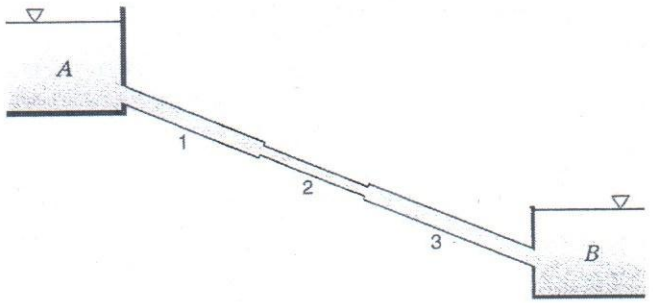


Fig. 1: Pipes in series.

(b) Derive an expression for the velocity profile in a conduit. (08)

(c) Two reservoirs are connected by 1 Km long commercial pipe of 30cm diameter (Fig. 2). In the pipeline, there are four elbows (K=0.9) and a gate valve (K=5). The water is flowing at a rate of 0.30 m^3/s. Find the difference of water levels between the two reservoirs. The frictional loss for the whole pipe is 0.014. What will be the difference in water level if water reservoir 1 is under pressure of 50 kN/m^2. (12)

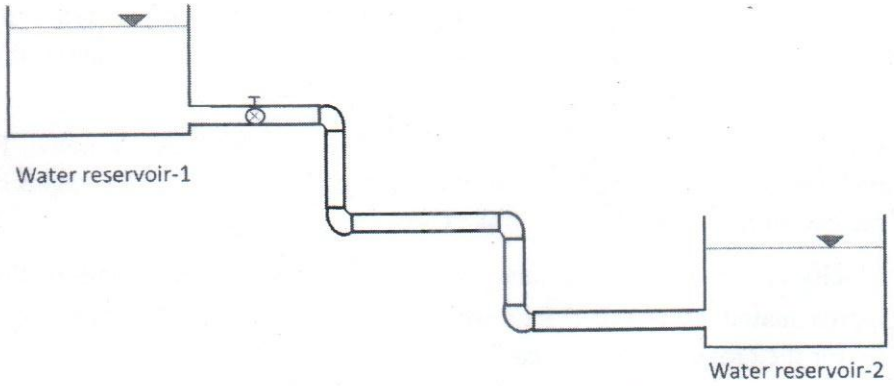


Fig. 2: Pipes in series with different fittings and valves.

2. (a) As a consultant, you are asked to design a spillway for a renowned company. How will you predict the performance of the hydro-structure? (03)

(b) What are the most important dimensionless or non-dimensionless number to study dynamic similarity for a hydraulic structure? Define all of them and express in mathematical terms. No derivation is required. (07)

(c) A pump (Efficiency=80%) is installed to deliver water from a reservoir of surface elevation zero to another elevation 60 m. The 30 cm diameter suction pipe (f=0.02) is 12 m long and the 25 cm diameter discharge pipe (f=0.032) is 1350 m long. Consider only major losses and all pressure atmospheric. The water rate within the pipe is 0.05 m^3/s. Answer the followings :- (15)

i. Draw the necessary sketch.
ii. Calculate power input in (hp).
iii. Calculate pressure head at the inlet and outlet of the pump if the surface elevation of pump is 20 m.

3. (a) Define laminar sublayer. (03)

(b) Write down the basic assumptions of Hardy cross method. (04)

(c) Determine the distribution of flow in the pipe network shown in Fig. 3 below using the Hardy cross method. (18)

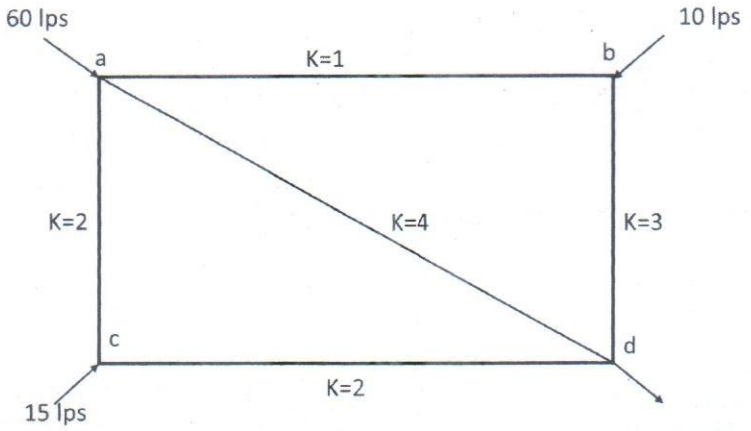


Fig. 3: Proposed pipe network.

4. (a) You are asked to determine various fluid properties for a simple hydro-structure. What parameters will you suggest? Name all available devices to determine those parameters. (06)

(b) Define jet. Water is flowing at a rate of 500 lps through a 120^0 V-notch. Find the position of the apex of the notch from the bed of the channel, if the depth of water from the bed of the channel is 2 m. Take C_d=0.65. (08)

(c) The velocity distribution in a rectangular channel of width B and depth of flow of y_o was approximated as $v = k_1\sqrt{y}$ in which k_1 is a constant. Calculate the average velocity for the cross section and correction factors α and β. (11)

5. (a) Refer to Fig. 4, if $\theta = 115^0$, and the water jet has a velocity of 25 m/s and a diameter of 40 mm, find (a) the component of the force acting on the blade in the direction of (11)

the jet; (b) the force component normal to the jet; and (c) the magnitude and direction of the resultant force exerted on the blade. Assume that friction is negligible.

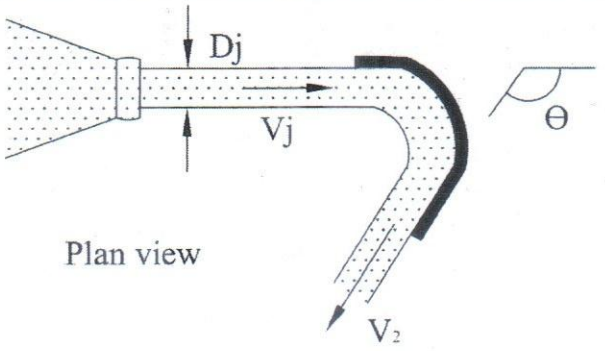


Fig.: 4

(b) A pump lifting water (Fig. 5) at 0.08 m^3/s adds 12 N.m/N to the flow. The suction line diameter is 200 mm, and at intake (elevation 50 m) the water pressure is 72 kPa. The discharge line diameter is 150 mm, and at outlet (elevation 56 m) the water pressure is 60 kPa. Sunshine striking the pipe adds 5 J/N of heat to the water. Find the change in water temperature between inlet and outlet. Assume specific weight of the water remains constant at 9.81 kN/m^3. (11)

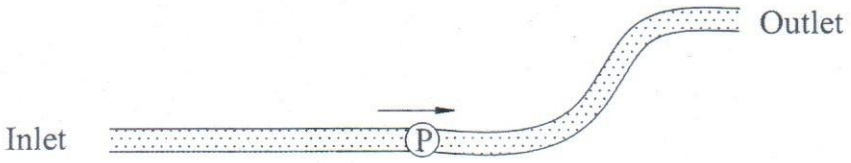


Fig.: 5

(c) Show the relationship between absolute and gage pressure with a diagram. (03)

6. (a) Refer to Fig. 6. Find the maximum value for b if a = 3.5 ft. Assume friction is negligible and the minimum pressure allowable in the siphon is a vacuum of -32.8 ft of water. (10)

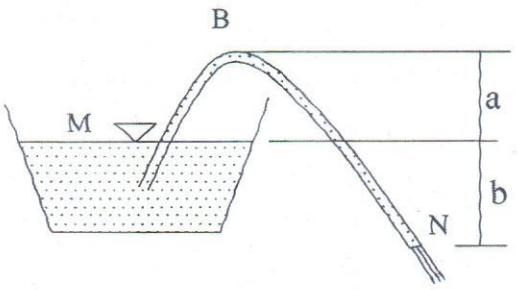


Fig.: 6

(b) In the constricted pipe of Fig. 7 friction loss between A and B is negligible while between B and C it is 0.15 ($V_B^2/2g$). Given h = 750 mm, $d_A = d_C$ = 250 mm, d_B= 100 mm. Find the pressure heads at A and C if the liquid is flowing through the circular pipe from A to C at the rate of 280 L/s. (12)

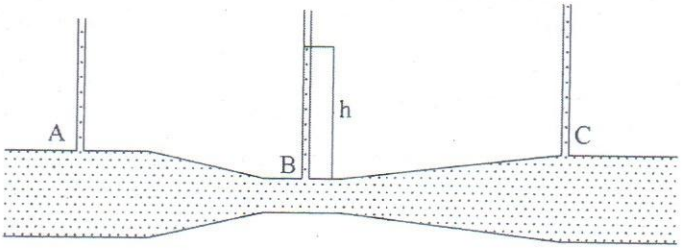


Fig.: 7

(c) What is cavitation? Write its causes and disadvantages. (03)

7. (a) The system in Fig. 8 is at 20^0 C. If atmospheric pressure is 101.03 kPa and the absolute pressure at the bottom of the tank is 231.3 kPa, what is the specific gravity of olive oil? Consider, specific gravity of SAE 30 oil is 0.89. (09)

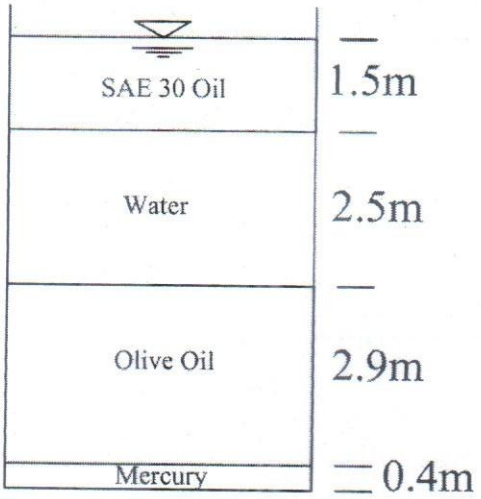


Fig.: 8

(b) An ideal liquid ($\gamma = 9810$ N/m^3) flows from a 400 mm diameter tank as shown in Fig. 9. The jet diameter is 80 mm and a = 250 mm. If the static coefficient of friction between the tank and floor is 0.6, determine the minimum value of h at which the tank will start to move to the left. The tank itself weighs 500 N. (10)

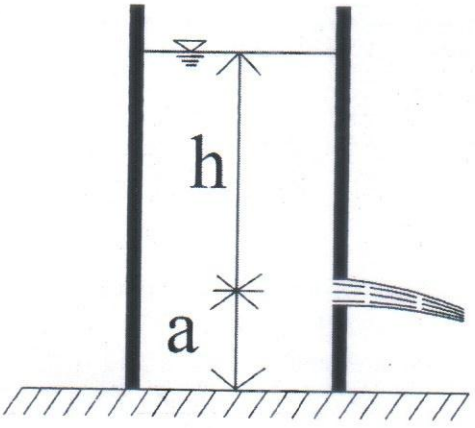


Fig.: 9

(c) Show the relationship between absolute and relative velocities with a diagram. (06)

8. (a) Derive Newton's equation of viscosity. Explain, why the viscosity of all liquids decrease and that of all gases increase with temperature. (05)

(b) An inverted differential manometer is connected to two pipes in which water is flowing as shown in Fig. 10. If the pressure in the pipe A is 2.2 m of water, find the pressure in the pipe B. (08)

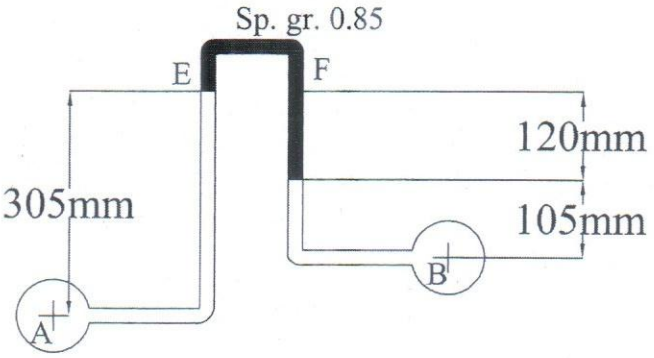


Fig.: 10

(c) Derive the equations of steady motion along a streamline for ideal and real fluids. (08)

(d) Define and proof Pascal's Law. (04)

B. Sc. Engg. (CEE)/ 5th Sem. 24 May, 2019 (Group B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination — **Winter Semester : 2018 - 2019**
Course No. CEE 4511 — **Full Marks: 150**
Course Title: Design of Concrete Structures I — **Time : 3 Hours**

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The symbols have their usual meaning. Use reasonable values for any missing data.

1(a) Explain the reasons of using steel bars as reinforcement in RC members. **(3)**

(b) Compare one-way slab and two-way slab. **(3)**

(c) Compare WSD and USD. **(3)**

(d) "Design codes provide the provision for using a lower value of capacity reduction factor for shear design ($\phi = 0.85$) compared to the same for flexural design ($\phi = 0.9$)" – Why? **(3)**

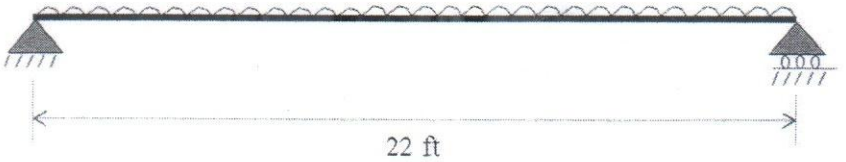
(e) Draw a simply supported beam and show the flexural and shear cracks on the beam that will be formed if the beam is subjected to a concentrated gravity load at the mid-span. **(3)**

(f) "In designing RC beams, tension yielding of steel is desirable before compression failure of concrete" – Explain the reasons. **(3)**

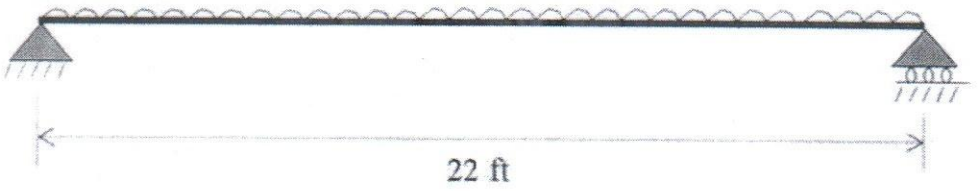
(g) Compare doubly reinforced and singly reinforced RC beams. **(2)**

(h) Draw the stress blocks (general stress block and rectangular stress block) of a RC beam section under ultimate loading condition with stress block related factors, such as α, β, γ, and β_1. **(5)**

2 Design the following simply-supported RC beam of span 22 *ft* for moment by **WSD** and **USD** and make **a brief discussion** on the results. Given: LL = 1 *k/ft*, DL = 1 *k/ft* (**excluding self-weight**), width of the beam = 12 *in.*, f_y = 60,000 *psi*, f_s=20,000 *psi*, and f_c' = 4,000 *psi*. **(25)**

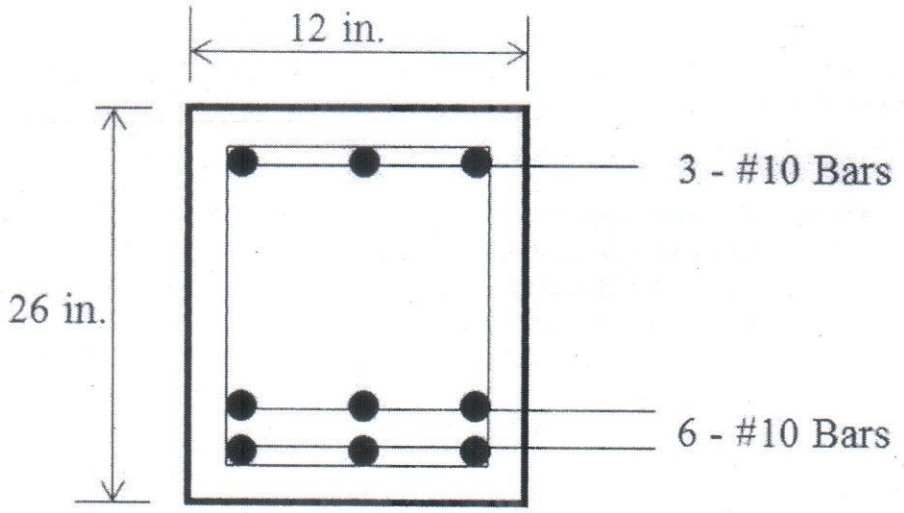


3(a) Design the shear reinforcement for the simply supported beam shown below by **USD**. Given: LL = 1.5 *k/ft*, DL = 1.5 *k/ft* (**excluding self-weight**), f_y = 60,000 *psi*, and f_c' = 4,000 *psi*. Draw the layout of the stirrups in a neat sketch. Given: width =12 *inch*, depth = 25 *inch*. Consider two layers of tension reinforcements. Assume reasonable data, if necessary. **(19)**

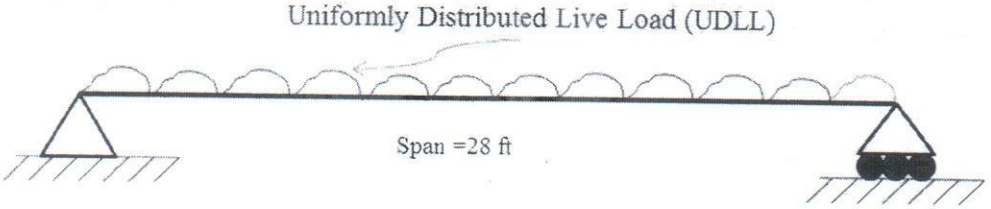


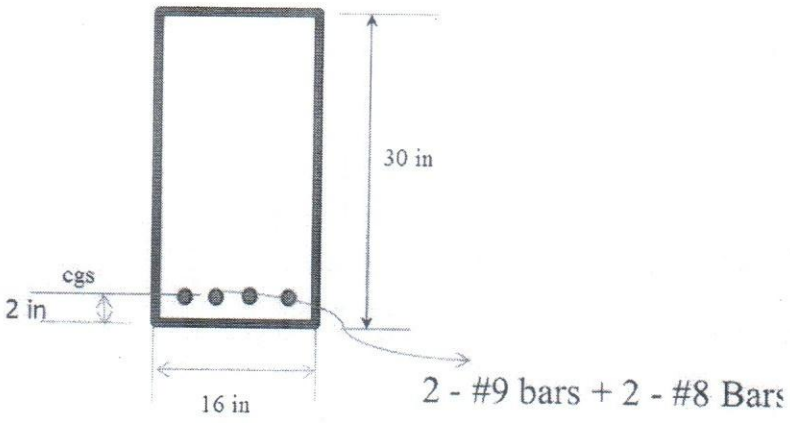
(b) Calculate the development lengths for 12 mm bar and 25 mm bar for stress in steel = 230 N/mm^2 and allowable bond stress = 1.44 N/mm^2. **Compare the results.** **(6)**

4 Calculate the design positive moment capacity of the following beam section by **WSD** and **USD** and **make a comparison of the results**. Given: f_y = 60,000 *psi*, f_c' = 4000 *psi*. f_s = 20,000 *psi*. The distance of cgs of tension steel from the bottom face is 3.5 *inch* and the same for compression steel is 2.5 *inch*. **(25)**



5 The layout of a simply supported RC beam and beam section is given below. **(25)**





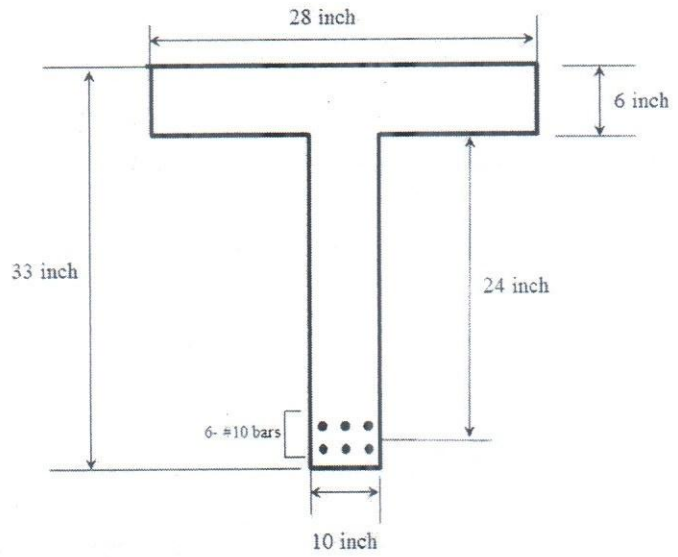
Beam Section

Use $f'_c = 4000\ psi$, $f_t = 410\ psi$, $f_y = 60{,}000\ psi$, $\Upsilon_{con}=150\ lb/ft^3$

Determine the following:

(i) Area of the uncraked transformed section,
(ii) Distance of the neutral axis from the outermost bottom fiber of the uncracked transformed section,
(iii) Moment of inertia of the uncracked transformed section about the neutral axis
(iv) Cracking moment of the section,
(v) Minimum amount of UDLL to produce crack,
(vi) Draw the stress distribution of the section,
(vii) Draw the strain distribution of the section, and
(viii) If load is increased beyond cracking load, draw the cracked transformed section of the beam,
(ix) Discuss the position of neutral axis and moment of inertia of the cracked transformed section.
(x) Compare deflection of a beam with un-cracked section and cracked section.

6(a) Refer to the following isolated T-Beam. Calculate the moment capacity of the section by **USD**. Given: $f_y = 60{,}000$ *psi*, $f_c' = 4{,}000$ *psi*. **(15)**



(b) Refer to the Question **6(a)**. If flange width is increased to 40 *inch* from 28 *inch*, calculate the moment capacity of the section. Use **USD**. **(10)**

7(a) **Define** balanced steel ratio. **Derive** the following equation for balanced steel ratio: **(10)**

$$\rho_b = \alpha \frac{87000}{87000 + f_y} \frac{f_c'}{f_y}$$

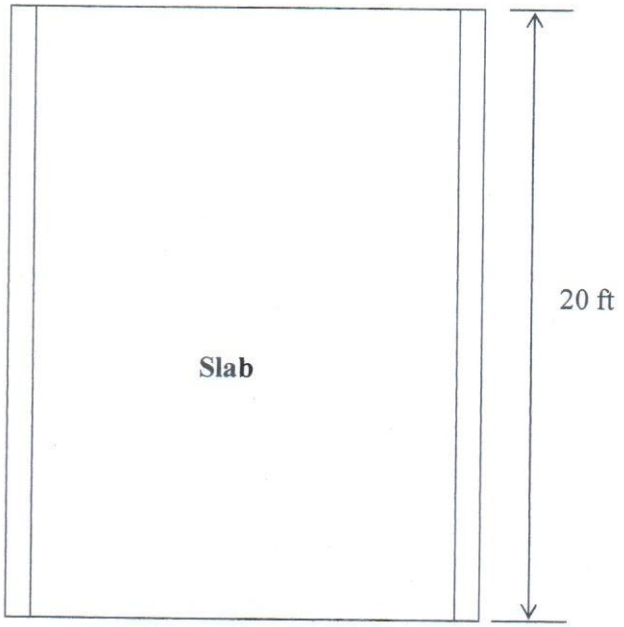
The symbols carry their usual meaning.

(b) Due to the architectural requirement, the section of a beam is limited to 12 *inch* by 25 *inch*. For the design working moment of 3100 *kip-inch*, determine the required steel area. Use **WSD**. Given: $f_s = 20{,}000$ *psi*, $f_c' = 4000$ *psi*. **(15)**

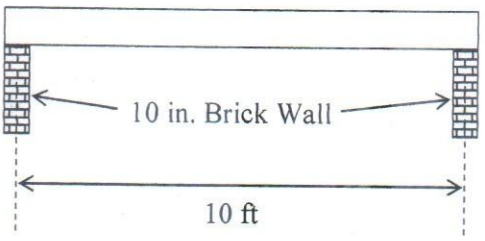
8(a) What are the critical sections to be checked for bond stress of a RC beam? **(6)** The design shear under factored load at the face of a support is 70 *K*. The beam has 4 - #10 bars at the face of the support (steel for negative moment). Effective depth of the beam is 23.5 *inch*. Check the bond stress at the face of the support. f'c = 3,500 *psi*. Use **USD**.

Use, ultimate bond stress = $\frac{6.7\sqrt{f_c'}}{D} \leq 560\ psi.$

(b) Design the following simply supported slab by **USD**. Given: f_y = 60,000 *psi*, f_c' = 3500 *psi*, LL = 60 *psf*, Floor Finish = 30 *psf*, Random partition Wall = 40 *psf*. **(19)**

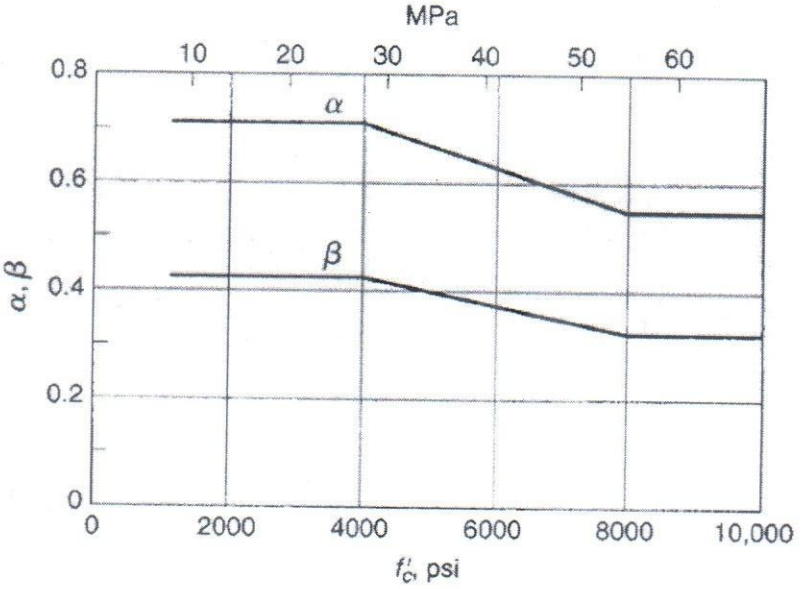


Plan



Section

Draw the layout of the reinforcements in neat sketches (plan and two sections).


MPa
10
20
30
40
50
60
0.8
0.6
0.4
0.2
0
α
β
α, β
0
2000
4000
6000
8000
10,000
f'_c, psi

425

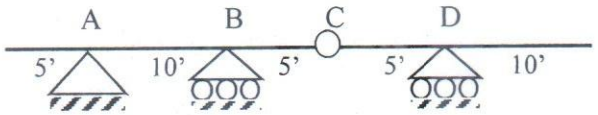
B.Sc. Engg. (CEE)/ 5th Sem. 27th May, 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester: Semester Final Examination **Winter Semester: 2018-2019**
Course No.: CEE 4513 **Full Marks: 200**
Course Title: Structural Analysis and Design I **Time: 3 hours**

There are **8 (Eight)** Questions. Answer any **6 (Six)** questions. All questions carry equal marks. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning and assume reasonable values for any missing information.

1(a) Draw influence lines for the following beam at locations: A (moment), B (shear just to left and right), C (shear just to left and right) and D (moment, reaction). (7x3)



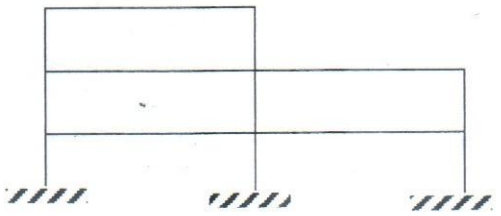
(b) Write the equations of suspended chord with uniformly distributed load. Clearly identify the factors, coefficients and conditions. (6)

(c) Write the formula for calculating earthquake load for each floor when floor weight and height are given. Clearly identify the factors, coefficients and conditions. (6.33)

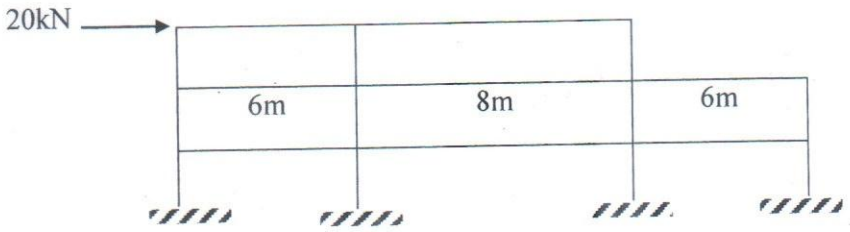
2(a) A 3-storied residential building will be made at zone 2. Structural system is RCC OMRF (R=5) and the soil is dense. Find Lateral forces due to earthquake at each floor. Total load (kPa) and height of each floor is provided in the following table. Use charts provided. (15.33)

	1st floor	2nd floor	3rd floor
Load (kPa)	5	5	5
Area (sq. m)	1000	1000	500
Height (m)	4	4	4

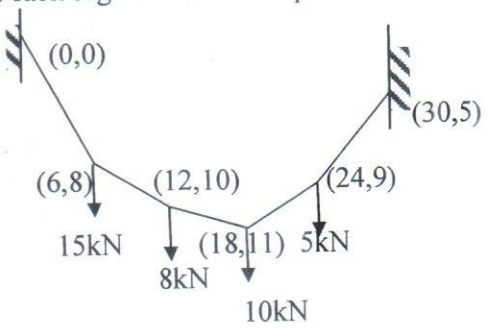
(b) For the structure shown below, use the loads calculated in 2(a) to find approximate shear and bending moment diagrams for the columns and beams using portal method for top two floors (assuming, only lateral load is present and forces are acting left to right). Floor height is 4m and spans are 8m. (18)



3. Draw moment diagrams for all beams using cantilever method for the given load. Floor height is 4m and left-side external columns have half cross-sectional area than that of other columns. (33.33)



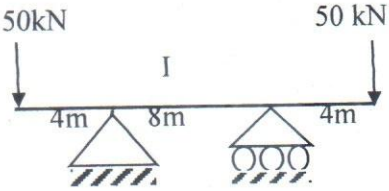
4(a) Find the forces in each segment of the suspension cable. (20)



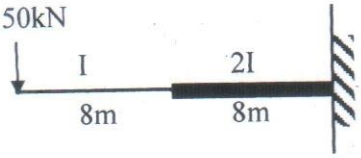
(b) Write down the assumptions and limitations of approximate analysis method using portal method, cantilever method, and vertical load analysis. (13.33)

5. Find vertical deflection of the mid-point for the following beams. Modulus of elasticity is E. (33.33)

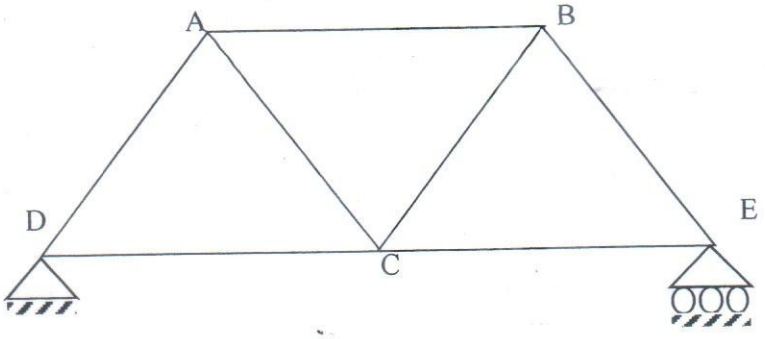
a)



b)

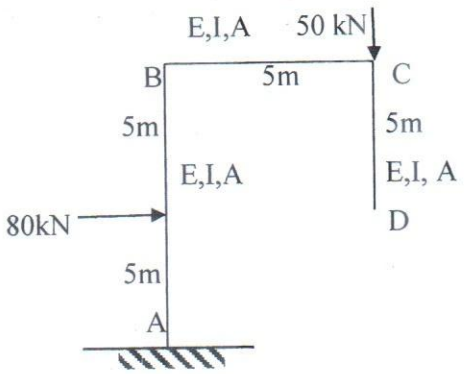


6(a) If the AB member is 0.5" short, what is the resultant vertical deflection of point C. Assuming EA=500 kip and each member is 5-ft long. (18)

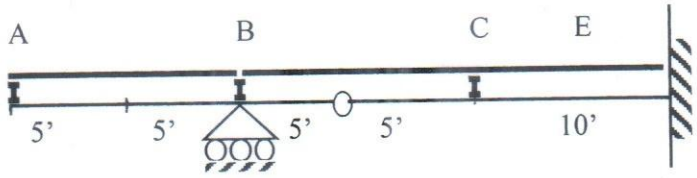


(b) Find the maximum shear at the mid-span of a 20-ft simply supported beam if there are unlimited rolling wheels of 18k each spaced at 18" c/c. (15.33)

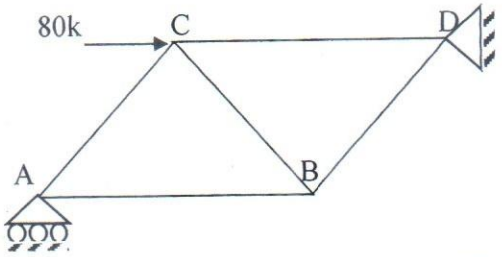
7. Find the horizontal and vertical deflection of point D for the given loading. (33.33)



8(a) Draw influence lines for floor beam reaction at A, B and C along with influence line for moment and shear on the main beam at location C (just to right and left) and reaction at B. (18)



(b) For the given load, find horizontal deflection of Point C. All members are 4-ft long and EA= 1500 kip. (15.33)



Integration of Product of Functions ($I = \int f_1 f_2 \, dS$)

f_2 \ f_1	A L	B L	A L	A B L	A C B L
a L				(A+B)aL/2	[A+4C+B]aL/6
b L				[A+2B]bL/6	[2C+B]bL/6
a L				[2A+B]aL/6	[A+2C]aL/6
a b L	A(a+b)L/2	B(a+2b)L/6	A(2a+b)L/6	[A(2a+b)+B(a+2b)]L/6	[Aa+Bb+ 2C(a+b)]L/6

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B. Sc. Engg. (CEE)/ 5th Sem. 18 May, 2019 (Group-B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination — **Winter Semester: 2018-2019**
Course No.: CEE 4543 — **Full Marks: 150**
Course Title: Foundation Engineering — **Time: 3 Hours**

There are 8 (Eight) questions. Answer any 6 (Six) questions. All questions carry equal marks. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1 (a) Briefly describe the general and punching shear failures in footing. What type of shear failure is seen in case of loose sand? (4)

(b) Considering local sear failure calculate ultimate and net allowable bearing capacities for a square footing (2.0 m X 2.0 m) placed at a depth of 1.20 m for homogeneous soil with cohesion, c =10.0 kN/m^2 and angle of internal friction, ϕ =20°, unit weight of soil, γ_t = 16.0 kN/m^3, and the position of water table is far below the ground surface. Use, factor of safety, FS=3.0, Use, Meyerhof equations for bearing capacity factors, shape factors and depth factors. (10)

(c) Compute the foundation depth (D_f) for a partially compensated mat foundation (50 m X 60 m) in fully saturated clay ground (ϕ =0, c =60.0 kN/m^2, γ_{sat} =19.8 kN/m^3). Consider factor of safety, FS=3.0; dead load, DL=400,000 kN; live load, LL=200,000 kN. Use, γ_w =9.8 kN/m^3. Use, Meyerhof equations for bearing capacity factors, shape factors and depth factors (11)

2 The plan for a mat foundation with column loads is shown in Fig.1, the drawing is not in scale. Calculate the soil pressures at points A, B, C, D, E, F, G, and H. All columns are 60 cm X 60 cm in section. Net allowable bearing capacity is 80.0 kPa. Compare the soil pressures obtained at points A to H with the net allowable bearing capacity. Divide the mat into four strips in the long direction and determine the average soil reactions at the ends of each strip. Also determine the thickness of the mat. (25)

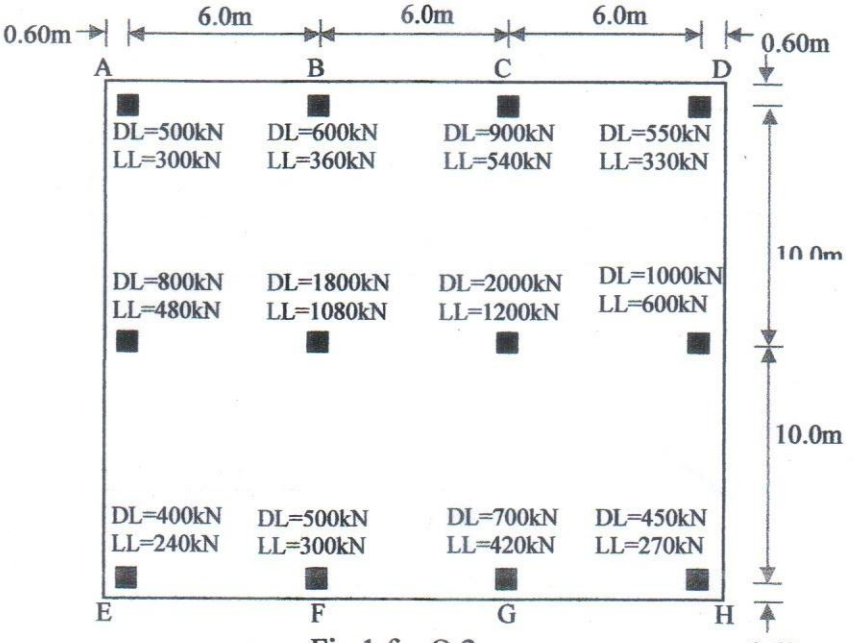

Fig.1 for Q.2

3(a) Briefly describe various rotational slope failures with net sketch. (4)

(b) Find the allowable bearing capacity of a reinforced concrete pile (diameter = 0.9 m) with a total length of 23.0 m driven in loose dense sand. The K and δ values are found to be 1.10 and 0.80ϕ, respectively. The soil profile is shown in Fig. 2. The angle of internal friction of soil, $\phi = 20°$. Use a factor of safety, FS=2.5. (11)

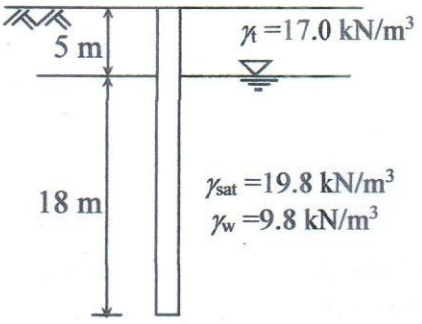

Fig.2 for Q.3(b)

(c) Find the allowable bearing capacity of a reinforced concrete pile (diameter = 0.60 m) with a total length of 16.50 m driven in clay soils (N_c=6.0) as shown in Fig. 3. Use a factor of safety of 2.5. (10)

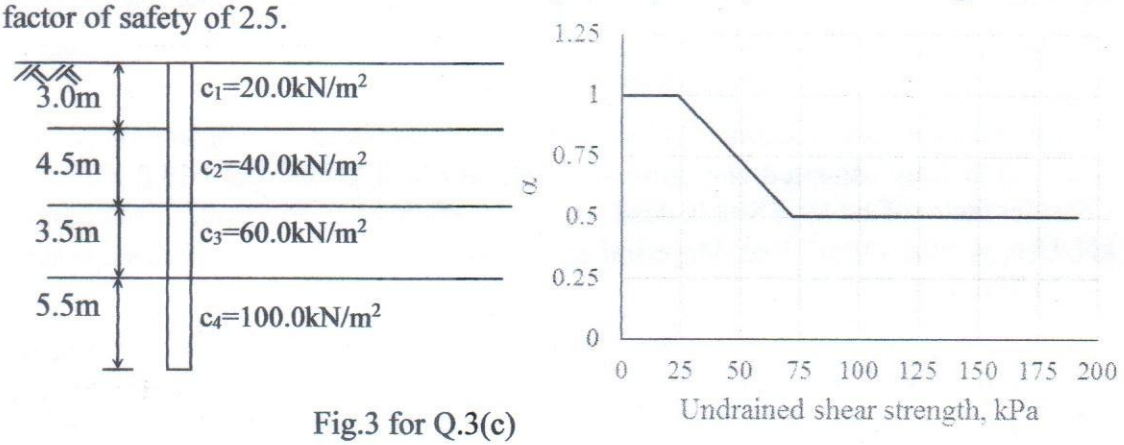

Fig.3 for Q.3(c)

4 (a) Briefly explain common types of mat foundation with sketches. (5)

(b) A group pile in clay is shown in Fig.4. Determine the consolidation settlement of the pile group, where, the pile length is 21 m, the working load is 2000 kN, each pile diameter is 400 mm, and spacing of the piles is 3 times the diameter of the pile. All clays are normally consolidated. (20)

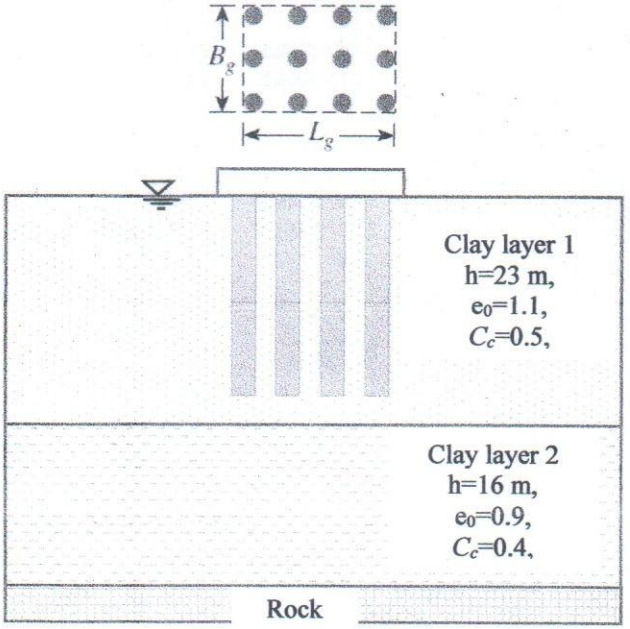

Fig.4 for Q.4(b)

4 30

5 (a) What are the parameters in selecting borehole depth? (5)

(b) Using Elastic solution and Broom's method calculate the lateral load capacity of a pile of 15.0 m length which is fully embedment in granular soil. The diameter of the circular pile is 0.5 m. The yield stress of the pile material F_y= 30 MPa, n_h = 10,000 kN/m^3, the unit weigh of soil γ= 17 kN/m^3, and the soil friction angle is 30^0. Lateral displacement at the pile head is 12.0 mm. Use, E_p= 30 GPa. Consider free head-pile (M_g =0 at the pile head). (20)

$$T=\sqrt[5]{\frac{E_pI_p}{n_h}},\ x_z(z)=A_x\frac{Q_gT^3}{E_pI_p}+B_x\frac{M_gT^2}{E_pI_p},\ M_z(z)=A_mQ_gT+B_mM_g,\ Z=z/T,\ n=\sqrt[5]{\frac{n_h}{E_pI_p}}$$

6(a) The plan of a proposed mat foundation is shown in Fig. 5 which will sit on a thick soft alluvial deposit (cohesive soil), where, E = 15 MPa, and Poisson's ratio is 0.50. It is estimated that the uniform applied pressure on the soil at the bottom face of the mat will be about 300 kPa. Estimate the immediate settlement under the point A considering flexible foundation. (12)

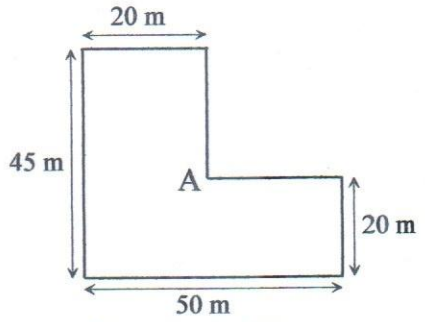

Fig.5 for Q.6(a)

Table for Q6(a)	
L/B	N_p
1.0	0.56
2.0	0.76
3.0	0.88
4.0	0.96
5.0	1.00

(b) The allowable working load on a prestressed concrete pile 20-m long that has been driven into sand is 500 kN. The pile is circular in shape with a diameter of 0.40 m. Skin resistance carries 300 kN of the allowable load, and point bearing carries the rest. Use, E_p= 30 GPa, E_s= 20 MPa, Poisson's ratio of soil 0.35, ξ = 0.60, I_{wp}=0.85, $I_{ws}=2+0.35\sqrt{\frac{L}{D}}$. Determine the settlement of the pile. (13)

7(a) Briefly describe some features of *Cone Penetration Test*. (4)

(b) Briefly describe the correction factors in Standard Penetration Test (SPT). (5)

(c) In an infinite slope is shown in Fig.6, where water table exists at the top of the surface. The height of the slope, H=10.0 m, saturated unit weight of soil γ_{sat} =19.8kN/m^3, angle of internal friction ϕ=20°, cohesion c=80 kN/m^2, β=30°, unit weight of water γ_w =9.8 kN/m^3. Determine the followings- (16)

(i) Shear stress τ, pore water pressure u, and normal effective stress σ' at the arbitrary slip surface.
(ii) Factor of safety.

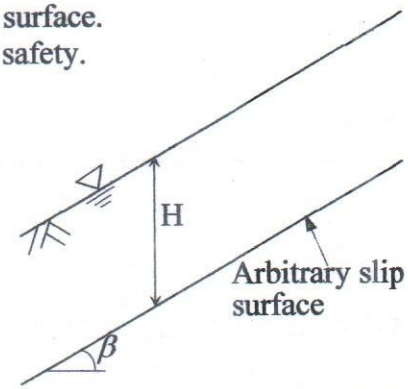

Fig.6 for Q.7(c)

8. Fig. 7 shows an arbitrary failure surface of an embankment. The cohesion of soil and the angle of shearing resistance to be 25 kPa and 20°, respectively. Unit weight of the ground is 18.0 kN/m^3. For the slice shown in the figure, determine the factor of safety for the pore pressure ratio, r_u= 0.5 and 0.8 using Bishop Method. (25)

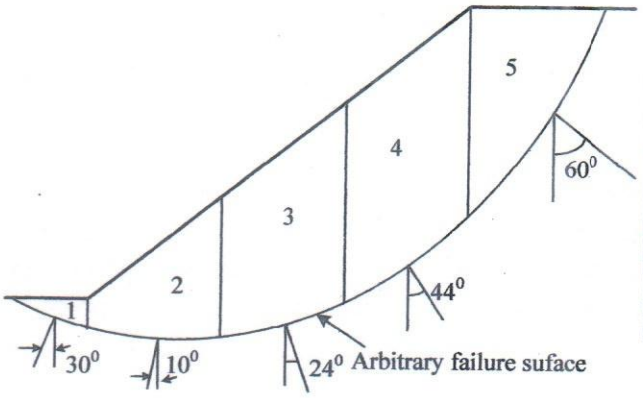

Table for Q8

Slice no	Breadth b (m)	α (degree)	Weight W (kN)
1	2.0	-30	10
2	4.0	-10	120
3	4.0	24	200
4	4.0	44	220
5	4.1	60	110

Fig.7 for Q.8

Use the following equations, graphs and table where necessary.

Meyerhof equations for bearing capacity factors, shape factors and depth factors are as follows

$$s_c = 1 + 0.2K_p\frac{B}{L},\quad s_q = s_\gamma = 1 + 0.1K_p\frac{B}{L},\quad d_c = 1 + 0.2\sqrt{Kp}\frac{D_f}{B},\quad d_q = d_\gamma = 1 + 0.1\sqrt{Kp}\frac{D_f}{B}$$

Settlement of single pile,

$$s_{e(1)} = \frac{(Q_{wp} + \xi Q_{ws})L}{A_p E_p},\quad s_{e(2)} = \frac{Q_{wp}D}{A_p E_s}(1-\nu^2)I_{wp},\quad s_{e(3)} = \frac{Q_{ws}D}{pLE_s}(1-\nu^2)I_{ws}$$

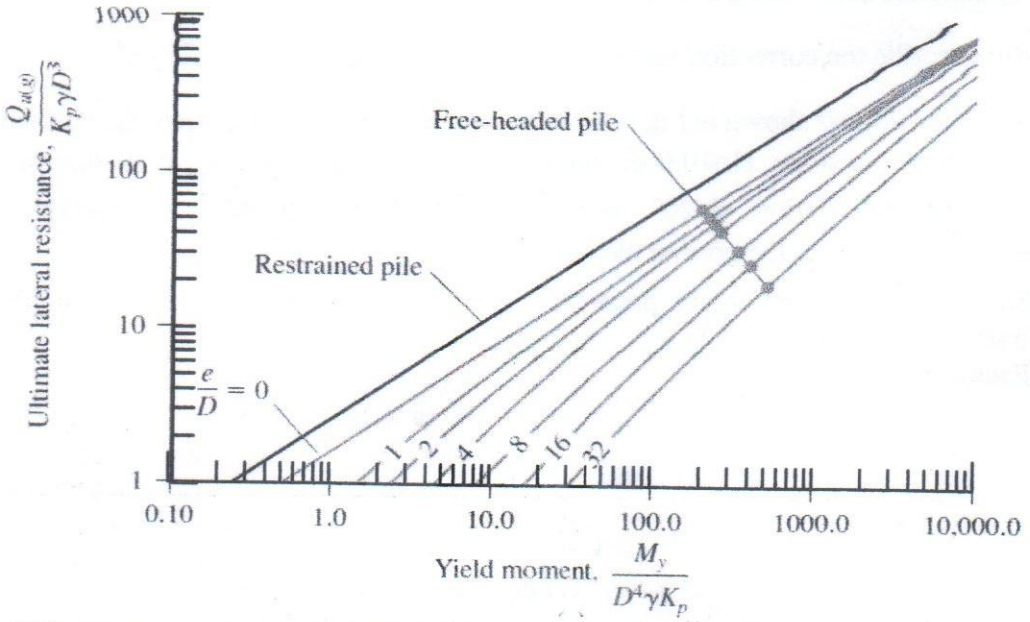

Fig.8 for Q.5(b): Broms's solution for ultimate lateral resistance of long piles in sand

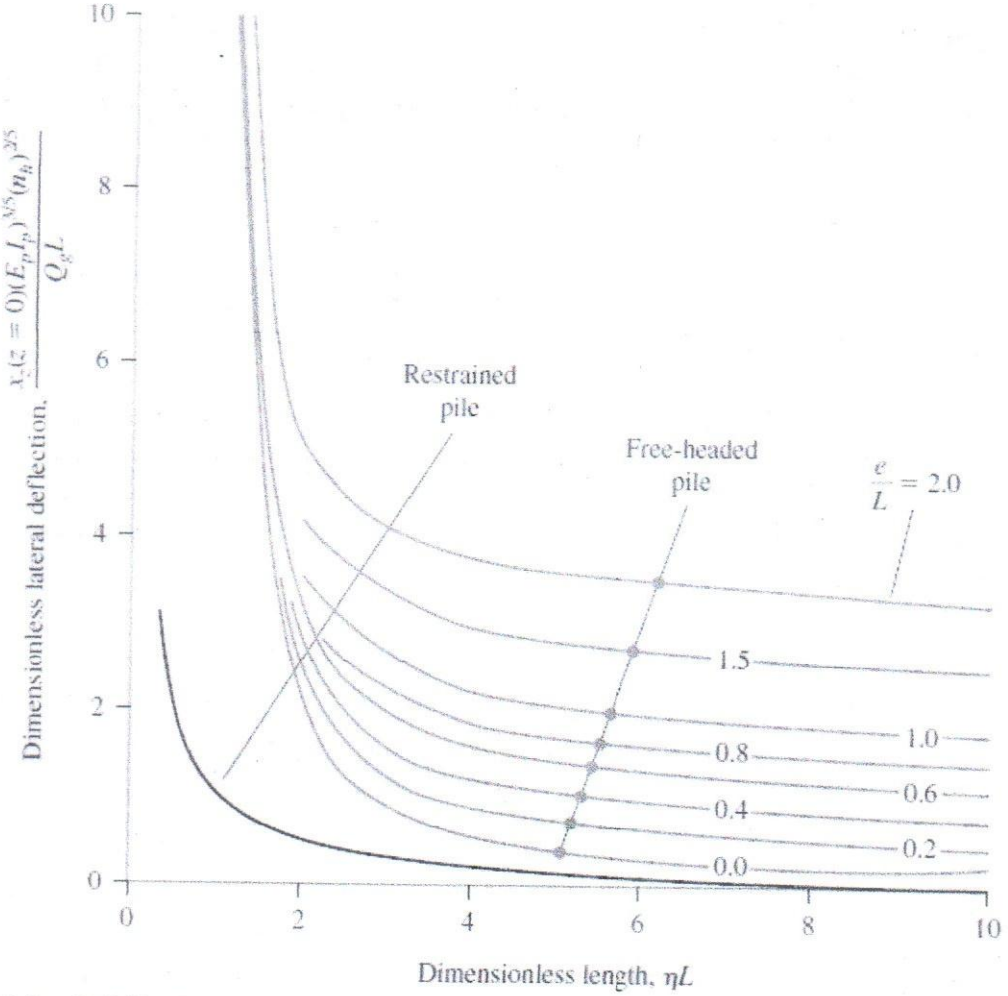

Fig.9 for Q.5(b): Broms's solution for estimating deflection of pile head in sand

Table for Q.5(b): Coefficients for long piles

Z	A_x	A_θ	A_m	A_v	A'_p	B_x	B_θ	B_m	B_v	B'_p
0.0	2.435	−1.623	0.000	1.000	0.000	1.623	−1.750	1.000	0.000	0.000
0.1	2.273	−1.618	0.100	0.989	−0.227	1.453	−1.650	1.000	−0.007	−0.145
0.2	2.112	−1.603	0.198	0.956	−0.422	1.293	−1.550	0.999	−0.028	−0.259
0.3	1.952	−1.578	0.291	0.906	−0.586	1.143	−1.450	0.994	−0.058	−0.343
0.4	1.796	−1.545	0.379	0.840	−0.718	1.003	−1.351	0.987	−0.095	−0.401
0.5	1.644	−1.503	0.459	0.764	−0.822	0.873	−1.253	0.976	−0.137	−0.436
0.6	1.496	−1.454	0.532	0.677	−0.897	0.752	−1.156	0.960	−0.181	−0.451
0.7	1.353	−1.397	0.595	0.585	−0.947	0.642	−1.061	0.939	−0.226	−0.449
0.8	1.216	−1.335	0.649	0.489	−0.973	0.540	−0.968	0.914	−0.270	−0.432
0.9	1.086	−1.268	0.693	0.392	−0.977	0.448	−0.878	0.885	−0.312	−0.403
1.0	0.962	−1.197	0.727	0.295	−0.962	0.364	−0.792	0.852	−0.350	−0.364
1.2	0.738	−1.047	0.767	0.109	−0.885	0.223	−0.629	0.775	−0.414	−0.268
1.4	0.544	−0.893	0.772	−0.056	−0.761	0.112	−0.482	0.688	−0.456	−0.157
1.6	0.381	−0.741	0.746	−0.193	−0.609	0.029	−0.354	0.594	−0.477	−0.047
1.8	0.247	−0.596	0.696	−0.298	−0.445	−0.030	−0.245	0.498	−0.476	0.054
2.0	0.142	−0.464	0.628	−0.371	−0.283	−0.070	−0.155	0.404	−0.456	0.140
3.0	−0.075	−0.040	0.225	−0.349	0.226	−0.089	0.057	0.059	−0.213	0.268
4.0	−0.050	0.052	0.000	−0.106	0.201	−0.028	0.049	−0.042	0.017	0.112
5.0	−0.009	0.025	−0.033	0.015	0.046	0.000	−0.011	−0.026	0.029	−0.002

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B.Sc. Engg. (CEE)/5th Sem. 16 May, 2019 (Gr-B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination **Winter Semester: 2018-2019**
Course No.: CEE 4563 **Full Marks: 150**
Course Title: Hydrology **Time: 3 Hours**

There are 8 (Eight) questions. Answer any 6 (Six) questions. .Programmable calculators are not allowed. Do not write on this question paper.The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1. (a) Define a 'catchment'. Is IUT campus a catchment? Why or why not? (4)

   (b) Classify runoff according to source and also name the sources. (3)

   (c) How do altitude and relative humidity affect the rate of evaporation? (4)

   (d) The initial and the constant infiltration rates for a 25 km^2 catchment are 16 and 6 mm/hr and the Horton's constant is 2 hr^{-1}. If a storm with an intensity of 22 mm/hr occurs in the catchment for 45 minutes, then what is the volume of infiltration? (8)

   (e) A 6 hour storm in a 35 km^2 watershed had hourly intensities of 20, 16, 0, 14, 12 and 5 mm/hr. If the Φ index for the catchment is 5 mm/hr, then what is the volume of direct runoff? (6)

2. (a) What is return period? If the rank of a flood is 5 in a set of 40 years of data, then what is the probability of exceedence of that flood in a year? (5)

   (b) If a flood of 5 m or greater occurs on average once every 10 years, what is the probability that it will not occur for the next 5 years? What is the probability that it will occur at least once in 10 years? (5)

   (c) Explain the terms: perennial stream, tributary and distributary. (3)

   (d) The discharge for various stages of Rupsha river are shown in the following table. If the stage for zero discharge is 1.6 m, then determine the stage-discharge relationship and the discharge for a stage of 12 m. (12)

Stage (m)	4.4	5.3	6.1	6.59	7.2	7.5	7.7	8.1	8.5
Discharge (m^3/sec)	320	456	583	651	821	906	985	1098	1296

3. (a) What is the difference between infiltration rate and infiltration capacity? Explain with figure how the infiltration capacity curve would change if the rainfall intensity is less than the infiltration capacity at the beginning of the rainfall. (5)

   (b) What is drainage density? How does drainage density affect the runoff from a watershed? (4)

   (c) The outflows from a 104 km^2 catchment for a 4-hr storm are shown in the following table. Assuming a constant base flow of 15 m^3/sec, derive the 4-hr unit hydrograph. What is the peak flow of a 12-hr unit hydrograph in that catchment? (16)

Time (hr)	0	2	4	6	8	10	12	14	16	18	20	22
Flow (m^3/sec)	15	173	274	298	235	198	170	143	124	104	86	15

4. (a) What are the intensity, duration and amount of effective rainfall for a 4 hour unit hydrograph? (3)

(b) If the flow at the start of a recession curve is 245 m^3/sec and the recession constant is 0.78, then what is the flow 4 hours after the start of the recession? (4)

(c) Explain with figures the difference between 'rating curve' and 'loop rating curve'. (4)

(d) Between a 3-hour and a 5-hour unit hydrographs for a given catchment, which hydrograph would have a higher peak discharge and why? (3)

(e) The direct runoff data from three successive 1-hr storms of 1.06 cm, 1.93 cm and 1.81 cm in a basin are shown in the following table. Derive a 1-hr unit hydrograph. (11)

Time (hr)	1	2	3	4	5	6	7	8	9	10	11
Flow (m^3/sec)	43	192	530	913	1063	783	392	185	140	83	31

5. (a) Draw the velocity profile in a river and show the locations of maximum, minimum and average velocities. (3)

(b) How does vegetation affect the infiltration rate? (2)

(c) What is flood routing? Explain with a figure the effect of routing on flood hydrograph. (5)

(d) The outflow versus storage (O and $2S/\Delta t + O$) data of a reservoir are shown in the following table. (15)

Outflow (m^3/sec)	0	18	37	50	70
($2S/\Delta t + O$) m^3/sec	0	69	200	245	300

Calculate the peak outflow from the reservoir for the following inflows:

Time (hrs)	0	1	2	3	4	5	6
Inflow (m^3/sec)	0	20	40	60	50	30	0

6. (a) What is ADCP and how does it operate? (4)

(b) What are the four assumptions in the derivation of unit hydrograph? What are the major limitations? (4)

(c) What is an aquifer? What is the difference between aquitard and aquiclude? (4)

(d) The maximum 24-hour rainfall at Rupnagar is shown in the following table. Develop a 24-hour IDF curve. (13)

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Rainfall (mm)	71.1	61.9	57.5	135.6	89.1	68.5	77.2	75.2	122.4	104.2	182.0

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Rainfall (mm)	67.7	448.7	78.1	81.6	147	83.1	70.5	50.8	72.4	90.4	182.0

7. (a) Define specific yield and specific retention. How are they related with porosity? (4)

(b) Whys is actual velocity always greater than Darcy's velocity? How are they related? (4)

(c) Explain with figures the difference between prism storage and channel storage. (4)

(d) The ordinates of a 4-hr unit hydrograph for catchment are shown in the following table. Derive a 6-hour unit hydrograph. What is the area of the catchment? (13)

Time (hr)	0	2	4	6	8	10	12	14	16	18	20	22
Flow (m^3/sec)	0	25	100	160	190	170	110	70	30	10	5	0

8. (a) What is a hygrometer? Why is 'double ring' preferred over 'single ring' infiltrometers in the measurement of infiltration? (4)

(b) What is cone of depression? How does hydraulic conductivity affect its shape? (4)

(c) Explain how uniformity coefficient and soil texture affect the infiltration rate. (4)

(d) Explain why there is regional variability in rainfall but not in evaporation in Bangladesh. (3)

(e) In a 3000 km^2 catchment the total length of the main stream is 120 km and the distance from the centroid of the catchment to the outlet is 63 km. If the peak flow factor and the lag factor are 0.64 and 1.60, respectively, then derive a 3-hour unit hydrograph and determine the peak discharge. Show the calculated hydrograph parameter in a figure. (10)

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B.Sc. Engg. (CEE)/5th Semester — 21 May, 2019 (Gr. B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

THE ORGANISATION OF ISLAMIC CONFERENCE (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

EXAM	:	**FINAL EXAMINATION**	WINTER SEMESTER	:	2018-2019
COURSE NO.	:	**CEE 4565**	TIME	:	3.0 Hrs.
COURSE TITLE	:	**Open Channel Flow**	FULL MARKS	:	150

There are **8 (Eight) questions**. Answer any **6 (Six) questions**.
Programmable calculators are not allowed. The figures in the right margin indicate full marks.
Do not write on the question paper.

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1. a) Water in a rectangular channel has a velocity head equal to its depth. Explain, whether the flow is sub-critical, critical, or super-critical? [03]

b) For the purpose of discharge measurement, the width of a rectangular channel is reduced from 3m to 2m and the floor is raised by 0.3m at a given section. When the approaching depth of flow is 2m, what rate of flow will be indicated by a drop of 0.15m in the water surface elevation at the contracted section? [08]

c) Show the following relationship in GVF in frictionless rectangular channel: [08]

$$x = \left(\frac{y}{s_b}\right)\left[1 + \frac{1}{2}\left(\frac{y_c}{y}\right)^3\right] + Constant$$

d) A rectangular channel which is laid on a bottom slope of 0.0064 is to be carry 20 m^3/sec of water. Determine the channel width, when the flow is at critical condition. Assume n = 0.015. [06]

2. a) A rectangular channel 5.4m wide and 1.2m deep has a slope of 1 in 1000 and is lined with good masonry for which Manning's n = 0.017. It is desired to increase the discharge to a maximum by changing the section of the channel, but the new channel section must contain the same amount of lining. Compute the new dimensions of the channel section and also the probable increase in discharge. [06]

b) Show that equation of gradually varied flow in wide rectangular channel with Chezy's equation is: [09]

$$\frac{dy}{dx} = s_b \frac{1 - \left(\frac{y_n}{y}\right)^3}{1 - \left(\frac{y_c}{y}\right)^3}$$

c) A trapezoidal channel with side slope 2H:1V has to carry a discharge of 20 m^3/sec. If the bottom width is 4m, calculate the longitudinal slope of the channel to maintain a uniform flow at a depth of 1.5m. Take Manning's n = 0.015. [05]

d) State the necessary conditions for the formation of hydraulic jump. Classify the hydraulic jump based on incoming water Froude's number. What are the practical uses of hydraulic jump in Civil Engineering applications? [05]

3. a) Define best hydraulic section. Derive the expressions for the most economical depth of flow of water in terms of diameter of the channel of circular cross-section for maximum discharge using Chezy's formula. [07]

b) A spillway discharges a flood flow at a rate of 7.75 m^3/s per meter width. At the downstream horizontal apron the depth of flow was found to be 0.5 m. What tail water depth is needed to form a hydraulic jump? If a jump is formed, find its type, length of jump, loss of energy and efficiency of the jump. [07]

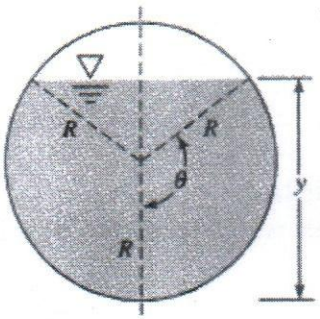
c) What are the functions of chute blocks, sills and baffle piers in the designing of stilling basin? [03]

d) Prove that the relative height of hydraulic jump in a rectangular horizontal floor can be expressed as: [08]

$$\frac{h_j}{E_1} = \frac{\sqrt{1 + 8F_1^{\,2}} - 3}{F_1^{\,2} + 2}$$

Where, h_j is the height of jump, E_1 is the specific energy and F_1 is the Froude number of the approaching flow.

4 a) A circular, unfinished concrete drainpipe as shown below is laid on a slope of 0.0025 and is planned to carry from 60 to 300 ft^3/s of run-off water. Design constraints are that (i) the water depth should be no more than 3/4 of the diameter; and (ii) the flow should always be subcritical. What is the appropriate pipe diameter to satisfy these requirements? [08]



b) A trapezoidal channel with b = 5.5 m, z = 1.5, n = 0.015, α = 1.1 and S_0 =0.0020 carries a discharge of 25.0 m^3/s. The critical and normal depth in this channel are 1.25 m and 1.65 m, respectively. The depths of flow at two sections A and B are 2.50 m and 2.20 m respectively. Determine the distance AB by the direct step method in one step. [09]

c) A rectangular channel 10 m wide and having α = 1.10 and n = 0.025 has three reaches arranged serially. The bottom slopes of the three reaches are 0.0040, 0.0065 and 0.0090, respectively. For a discharge of 35 m^3/sec in this channel, sketch the resulting flow profiles. [08]

5. a) Derive the general expression of hydraulic exponent (M) for critical flow computation. Compute the value of M for a trapezoidal section with b = 6.5m, z = 1.5 and depth of flow y = 2.0 m. [08]

b) What are the best dimensions y and b for a rectangular brick channel designed to carry 5.0 m^3/sec of water in uniform flow with S_0 = 0.001, and n = 0.015? [06]
What percentage of flow increased or decreased if a half-hexagon and semicircle of same area is used to carry the discharge?

c) Show that the head loss in a hydraulic jump formed in a rectangular channel can be expressed by [07]

$$\Delta E = \frac{(V_1 - V_2)^3}{2g(V_1 + V_2)}$$

where, V_1 and V_2 are the velocity before and after the hydraulic jump.

d) What are the conditions for uniform flow in a channel? Write down the three basic equations of fluid mechanics to describe the water motion for steady one-dimensional open channel flow of an ideal fluid. [04]

6. a) Compute the wetted perimeter of the best hydraulic section for a lined channel to carry a discharge of 15.0 m^3/sec with n = 0.013 and S_O = 0.001, if the section is triangular, trapezoidal and circular. Which section has the minimum wetted perimeter? [08]

b) What are the limitations of Kennedy's theory? What modification was proposed by Lindley? [04]

c) Design a lined channel to carry a discharge of 120 m^3/sec on a slope of 1/2500. The maximum permissible velocity is limited to 2.2 m/sec, z = 1.2 and n = 0.014. [06]

d) When the Manning formula is used, show that the critical slope at a given normal depth y_n can be expressed by [07]

$$S_c = \frac{gn^2 D_n}{R_n^{4/3}}$$

and that this slope for a wide channel is $S_c = \frac{n^2 g^{10/9}}{q^{2/9}}$

Where, q is the discharge per unit width and other symbols has their usual meanings.

7. a) A rectangular channel with b = 6.5 m, n = 0.025 and S_0 = 0.0025 carries a discharge of 40 m^3/sec. At a section A of the channel, the depth of flow is 2.0 m. What will be the depth at a distance 50 m upstream of section A, using (i) Euler method and (ii) Modified Euler method? [06]

b) Design a canal in alluvial soil for Q = 30 cumecs using Kennedy's theory. Assume CVR = 0.95, bed slope is 1/5000 and n = 0.0225. The velocity in the canal is given by: [08]

$$V = \left[\frac{\left(23 + \frac{0.00155}{s_b} + \frac{1}{n}\right)}{1 + \left(23 + \frac{0.00155}{s_b}\right)\frac{n}{\sqrt{R}}}\right]\sqrt{Rs_b}$$

c) In a concave channel, the pressure is higher than the pressure obtained by the hydrostatic pressure- prove this statement. [05]

d) The specific energy in a 2.0m wide rectangular channel is not to exceed 1.2m. What maximum discharge can be carried in such a channel? What longitudinal slope is required to sustain such a flow in the channel? Assume Manning's n = 0.015. [06]

8 a) Design a regime channel by Lacey's theory for a discharge of 40 cumecs, the average size of the bed materials is 0.85 mm and assume a side slope z = 1. [06]

b) The velocity distribution in a rectangular channel is given by [07]

$$v = V_{max}\left(\frac{y}{y_0}\right)^{1/7}$$

If v is the velocity at y, V_{max} = 2 m/sec, y_o= 2.0 m, calculate α and β.

c) What is tractive force? Show that the shear stress ratio is given by: [06]

$$K = \sqrt{\frac{1 - sin^2\theta}{1 - sin^2\varphi}}$$

where, the symbols have their usual meanings.

d) Design the chute blocks and dentated sills of a USBR stilling basin II for an overflow spillway with the following data: [06]
Design discharge = 15,870 m^3/sec, TW level = 17.26 m, basin width = 227.1m, elevation of the ground = 0.00 and velocity at the foot of the spillway = 27.70 m/sec.

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B.Sc. Engg. (CEE)/ 7th Sem. May 25, 2019 (Group A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : Semester Final Examination
COURSE NO. : CEE 4703
COURSE TITLE : GIS Application in Civil Engineering

WINTER SEMESTER: 2018-2019
TIME : 3.0 Hours
FULL MARKS: 150

There are 8 (Eight) questions. Answer any 6 (Six) questions. This is an open book exam. Students are allowed to bring lecture notes in the exam hall. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. (a) Suppose, you have been working as a GIS analyst in a renowned company. Your team have prepared a classified land cover image that was created from a Landsat data set. This generated a map with three thematic land cover classes: Water, Forest and Urban. For the accuracy assessment you have sampled a total of 95 reference sites in the field to verify the land cover types. Out of these reference sites, 33 were Water, 39 were Forest and 23 were Urban. These reference sites were then compared to your classified map generated from the Landsat data. Below is the error matrix generated from the data. Calculate the followings to check the accuracy of the classified land cover map: overall accuracy of the map, user accuracy, producer accuracy, mean accuracy, areal difference and Kappa value. [15]

		Reference Data			
		Water	Forest	Urban	Total
Classified Data	Water	21	6	0	27
	Forest	5	31	1	37
	Urban	7	2	22	31
	Total	33	39	23	95

(b) Explain the Nearest Neighbour analysis with a suitable example. [10]

2. (a) Suppose, you are a cartographer and leading a team from Bangladesh government dealing with border conflicts with India. To be most accurate, what method will you select to project earth surface on to a flat surface? Also, what basic shape of projection will you select? Now, what will be your choices if you are to maximize the land area for Bangladesh? Explain your logics. [15]

(b) You have a database over Dhaka. The neighbourhoods (wards) are represented as a polygon theme (layer) and in the attribute table you have the number of schools for each ward. You also have all the schools as a point theme with data for the total number of students for each school. Someone asks you: [10]
- Which word has the most students?
- How many students go to school at least 7 km from the Zero Point (a location near Gulistan in Dhaka), but not further than 14 km (so between 7 and 14 km from Zero Point)?

What steps (operations) would you do to answer these two questions?

3. (a) The raster below presents a cost surface. Calculate the cheapest path from the centre of cell (2, 1) to the centre of cell (4, 4) [values having asterisk as superscript represent these cells respectively]. [15]

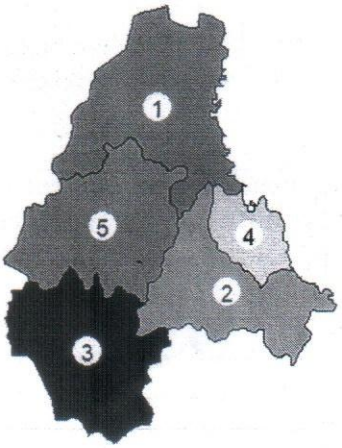
3	8	6	2
51*	42	48	27
97	17	47	27
78	14	17	33*

(b) Bangladesh Fire Service & Civil Defence department has been dealing with a lot of fire events recently. There were several challenging problems facing the fire teams using GIS, and precious time was lost when they arose. With just a little pre-planning, many of these issues could be eliminated. The administration of the department identified several issues which are given below: [10]

- Lost opportunity for tracking fire history because hand drawn maps by fire fighters were lost early on.
- Lack of understanding of GIS and GPS capabilities by fire staff resulted in redundant work effort.
- A computer virus brought in on a laptop computer plagued the systems for a couple of days before being identified and removed.

They hire you, as a GIS expert to solve these issues. What are the measures will you take as solutions to those problems?

4. (a) The relation between differences in values and distances is known as spatial auto-correlation. Moran's I is a correlation coefficient that measures the overall spatial autocorrelation. Calculate the Moran's I value using the following map and the attribute data of the map. Comment on the results. [15]



Polygon	Value
1	10
2	6
3	4
4	11
5	6

(b) What are the differences between interpolation and extrapolation? Give examples of point-based interpolation and line-based interpolation in GIS. [10]

5. (a) Suppose you are a Russian commander in 1980s and the US has launched an attack on one of your missile sites in Europe where most of your resources (major cities, military facilities, and natural resources) are located. You are aware of the GPS technology that the US has recently adopted and to win the war you need to reduce its capability as much as possible. You have 7 missiles of which 2 can hit any ground target and 5 can hit any satellite. How will you use those to protect Russia? Explain. [15]

Just in case the war has spread to Africa as well. In that case, will your decisions on how to use those 7 missiles change? Explain.

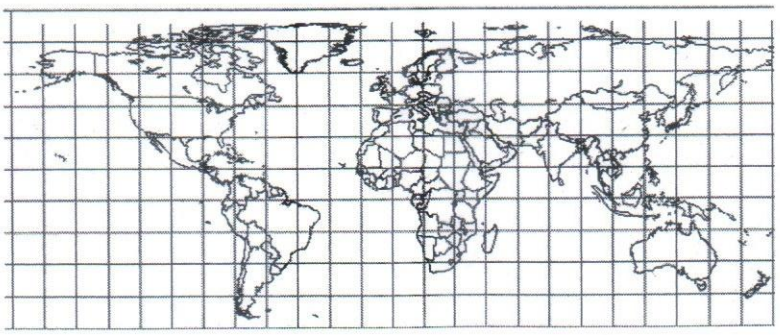
(b) Calculate the aspect value of the center cell of the moving window given below. [10]

101	92	85
101	92	85
101	91	84

6. (a) In a network analysis involving roads, how could you estimate the quickest way between two points if you were only given the speed limit of each road segment? Formulate an example network and demonstrate your answer. Your network should have at least 5 nodes, of which, at least 2 should be connected with more than 2 links. Assume the travel times for each link and show the calculation step by step in matrix. [20]

(b) What are the significances of topographical data in urban planning, social science, agricultural practices? [5]

7. (a) Redraw the world map below in raster format where each continent (North America, South America, Europe, Africa, Asia and Australia) can be identified separately. Also, mention how you have dealt with cells that contain multiple features. Which continent occupies highest land area following your strategy? How is the size (memory) of this raster database influenced when the cell size is reduced by half? [20]



(b) If data is saved with 1 BYTE per pixel, what is the range (minimum and maximum) of numbers that can be stored? How is the number "151" stored in binary form using 1 byte (8 bit)? [5]

8. (a) From the raster map below, calculate slope, aspect, and flow direction for the shaded area. If each cell has a dimension = 100 m and rainfall intensity is 35 cm/sq. m/day then how much water will be accumulated in the three cells in the middle of the last row (1,1,1) if it rains for two hours? If you are given an assignment to prevent water from entering last row (1,1,1) then how will you change the values of the raster? Solve by altering minimum number of raster cells. Also, assume that the rainwater falls only in the shaded area. Assume missing values as necessary. [25]

4	2	9	5	1
9	9	7	3	3
4	7	8	6	9
8	7	9	5	6
4	1	1	1	5

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B.Sc. Egg. (CEE)/7th Sem. 15 May, 2019 (Gr. A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2018-2019

COURSE NO. : CEE 4711 TIME : 3.0 Hours

COURSE TITLE: STRUCTURAL ANALYSIS AND DESIGN II FULL MARKS: 150

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The symbols have their usual meanings.

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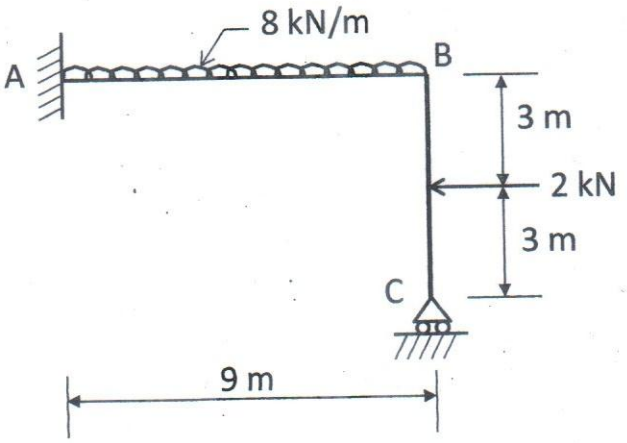
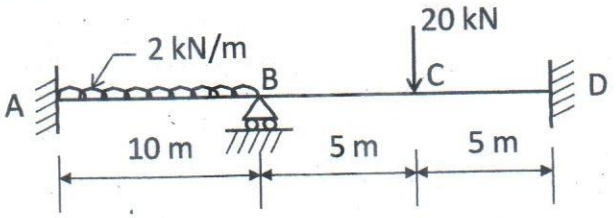
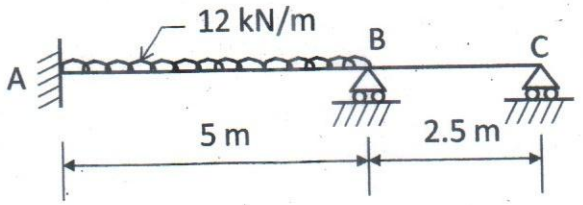
1. Determine the reactions at A and C of the following frame using flexibility method. Neglect the effect of axial load. Given: $E = 200$ GPa, $I_{AB} = 1250\times10^6$ mm^4 and $I_{BC} = 625\times10^6$ mm^4. (25)



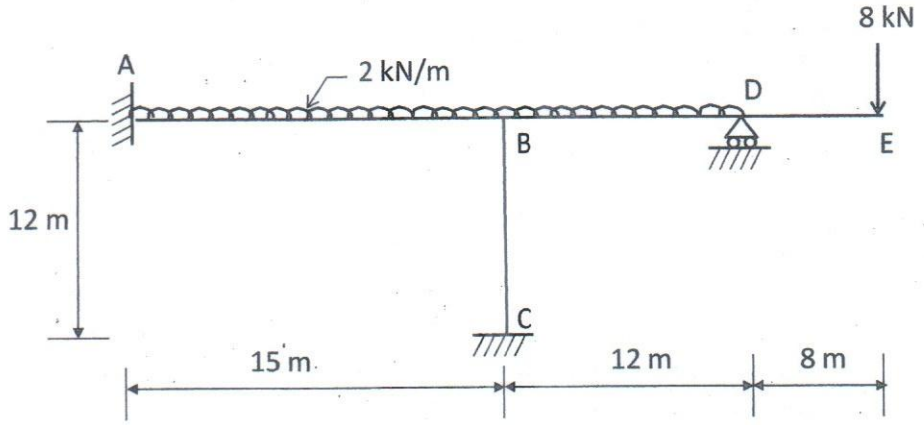
2. (a) Analyze the following beam using moment distribution method. Draw bending moment diagram. EI is constant. (13)



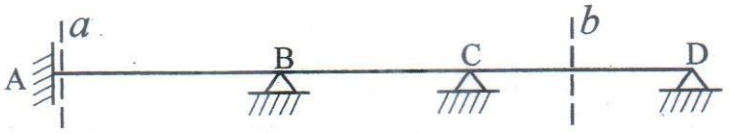
(b) Analyze the following beam using moment distribution method. Draw bending moment diagram. EI is constant. (12)



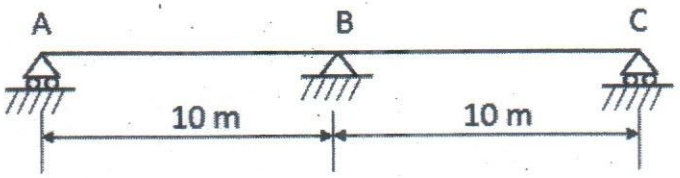
3. Analyze the following frame using moment distribution method. Draw bending moment diagram. *EI* is constant. (25)



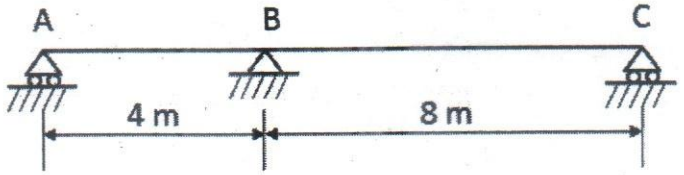
4. (a) Draw qualitative influence lines of the following beam for (12)
   (i) reactions at supports ***A*** and ***B***,
   (ii) shear and moment at '***a***',
   (iii) shear and moment at '***b***'.



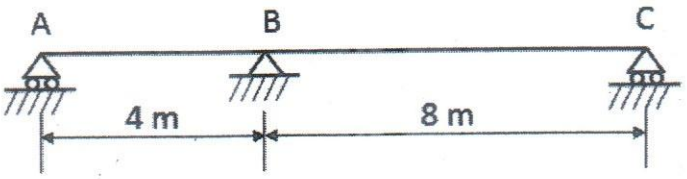
(b) Compute the ordinates, at intervals of 2.5 m, of the influence line for moment at the midpoint of span ***BC*** of the following beam. *EI* is constant. (13)



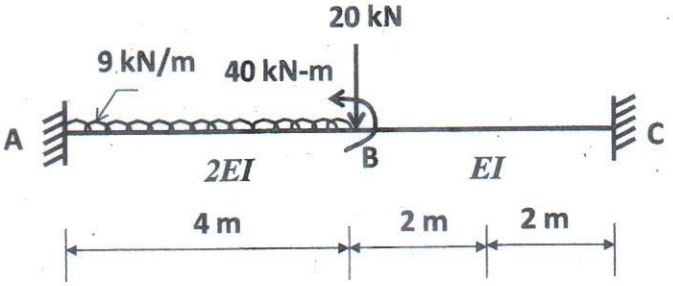
5. (a) Compute the ordinates, at intervals of 2 m, of the influence line for reaction at ***A*** of the following beam. *EI* is constant. (12)



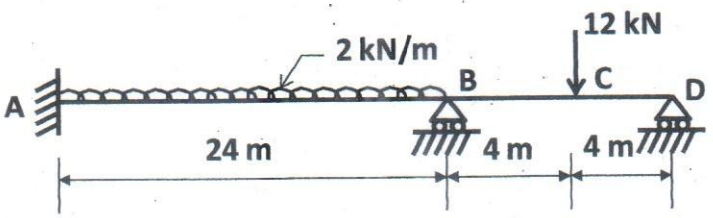
(b) Compute the ordinates, at intervals of 2 m, of the influence line for shear at the midpoint of span ***BC*** for the beam shown in the following figure. *EI* is constant. (13)



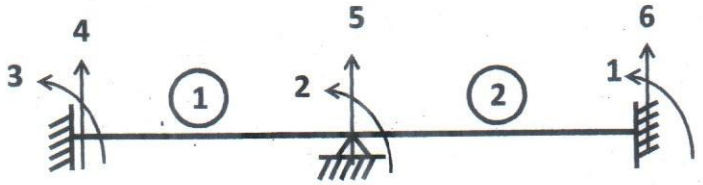
6. Determine all the reactions at supports of the following beam using the stiffness method. Also, draw the shear force and bending moment diagrams. Flexural stiffness of member ***AB*** is *2EI* and of member ***BC*** is *EI*. (25)



7. (a) Determine all the reactions at support *A* of the following beam using the stiffness method. *EI* is constant. (15)



(b) Write down algorithms of stiffness matrix and load vector for the following beam according to the degree of freedom indicated in the figure. Neglect the effect of axial load. (10)



8. Determine the structure stiffness matrix and support reactions at pin support *A* for the frame shown in the following figure according to the degree of freedom indicated. Take E = 200 GPa, $I = 350\times10^6$ mm^4, $A = 15\times10^3$ mm^2 for both members. (25)

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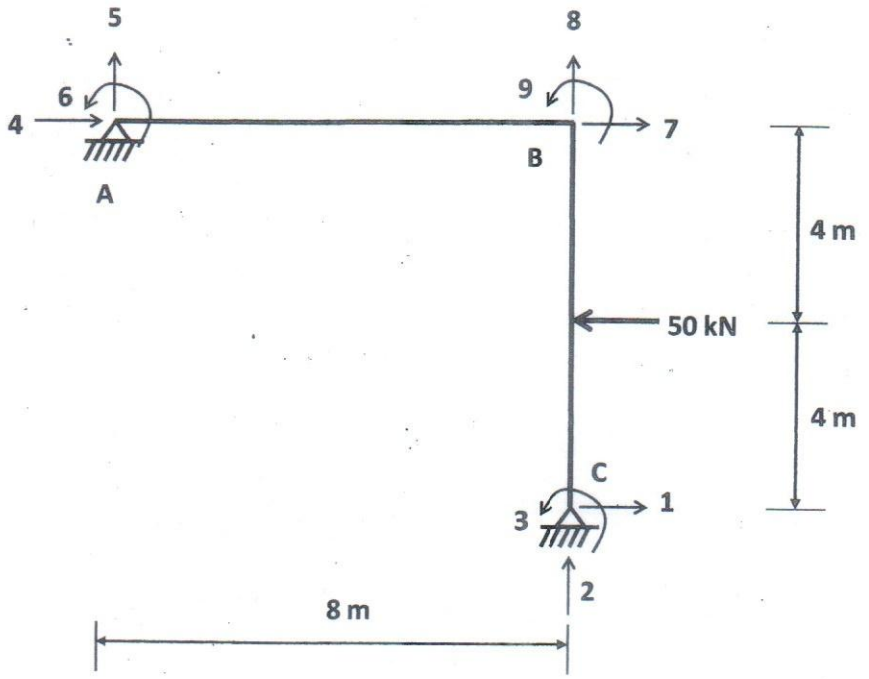
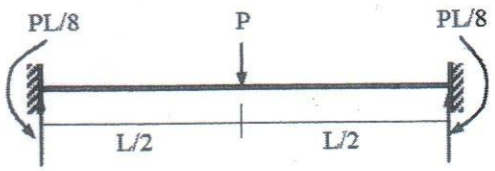
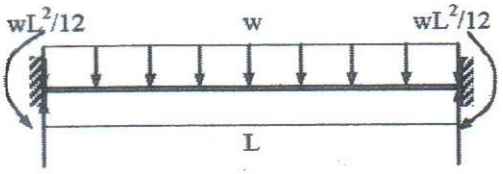


Fixed-End Moments





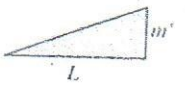
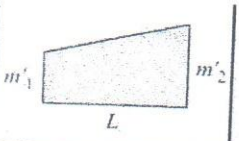
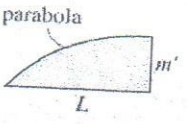
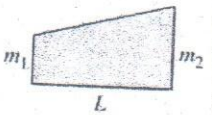
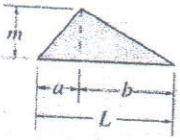
Necessary equations

For frame:

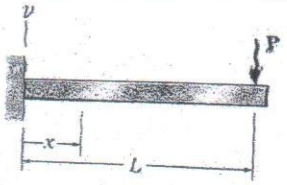
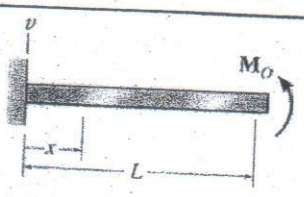
$$[k]=\begin{bmatrix}
\left(\frac{EA}{l}\lambda_x^2+12\frac{EI}{l^3}\lambda_y^2\right) & \left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & -6\frac{EI}{l^2}\lambda_y & -\left(\frac{EA}{l}\lambda_x^2+12\frac{EI}{l^3}\lambda_y^2\right) & -\left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & -6\frac{EI}{l^2}\lambda_y \\
\left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & \left(\frac{EA}{l}\lambda_y^2+12\frac{EI}{l^3}\lambda_x^2\right) & 6\frac{EI}{l^2}\lambda_x & -\left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & -\left(\frac{EA}{l}\lambda_y^2+12\frac{EI}{l^3}\lambda_x^2\right) & 6\frac{EI}{l^2}\lambda_x \\
-6\frac{EI}{l^2}\lambda_y & 6\frac{EI}{l^2}\lambda_x & 4\frac{EI}{l} & 6\frac{EI}{l^2}\lambda_y & -6\frac{EI}{l^2}\lambda_x & 2\frac{EI}{l} \\
-\left(\frac{EA}{l}\lambda_x^2+12\frac{EI}{l^3}\lambda_y^2\right) & -\left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & 6\frac{EI}{l^2}\lambda_y & \left(\frac{EA}{l}\lambda_x^2+12\frac{EI}{l^3}\lambda_y^2\right) & \left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & 6\frac{EI}{l^2}\lambda_y \\
-\left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & -\left(\frac{EA}{l}\lambda_y^2+12\frac{EI}{l^3}\lambda_x^2\right) & -6\frac{EI}{l^2}\lambda_x & \left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & \left(\frac{EA}{l}\lambda_y^2+12\frac{EI}{l^3}\lambda_x^2\right) & -6\frac{EI}{l^2}\lambda_x \\
-6\frac{EI}{l^2}\lambda_y & 6\frac{EI}{l^2}\lambda_x & 2\frac{EI}{l} & 6\frac{EI}{l^2}\lambda_y & -6\frac{EI}{l^2}\lambda_x & 4\frac{EI}{l}
\end{bmatrix}$$

and $[T]=\begin{bmatrix} \lambda_x & \lambda_y & 0 & 0 & 0 & 0 \\ -\lambda_y & \lambda_x & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_x & \lambda_y & 0 \\ 0 & 0 & 0 & -\lambda_y & \lambda_x & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$; $[k]=\begin{bmatrix} \frac{EA}{l} & 0 & 0 & -\frac{EA}{l} & 0 & 0 \\ 0 & 12\frac{EI}{l^3} & 6\frac{EI}{l^2} & 0 & -12\frac{EI}{l^3} & 6\frac{EI}{l^2} \\ 0 & 6\frac{EI}{l^2} & 4\frac{EI}{l} & 0 & -6\frac{EI}{l^2} & 2\frac{EI}{l} \\ -\frac{EA}{l} & 0 & 0 & \frac{EA}{l} & 0 & 0 \\ 0 & -12\frac{EI}{l^3} & -6\frac{EI}{l^2} & 0 & 12\frac{EI}{l^3} & -6\frac{EI}{l^2} \\ 0 & 6\frac{EI}{l^2} & 2\frac{EI}{l} & 0 & -6\frac{EI}{l^2} & 4\frac{EI}{l} \end{bmatrix}$ for beam

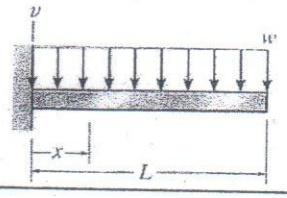
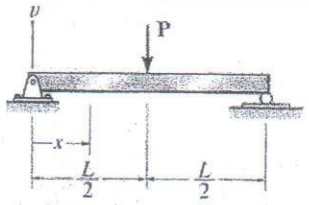
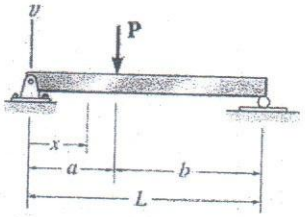
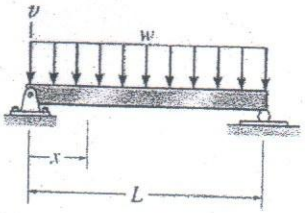
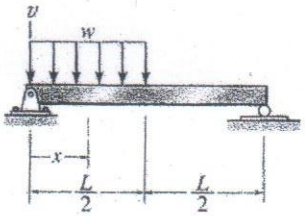
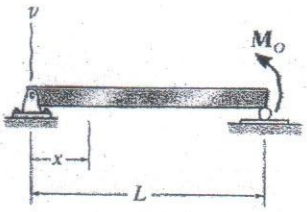
Table for Evaluating $\int_0^L m\,m'\,dx$

$\int_0^L m\,m'\,dx$				
	$mm'L$	$\frac{1}{2}mm'L$	$\frac{1}{2}m(m'_1 + m'_2)L$	$\frac{2}{3}mm'L$
	$\frac{1}{2}mm'L$	$\frac{1}{3}mm'L$	$\frac{1}{6}m(m'_1 + 2m'_2)L$	$\frac{5}{12}mm'L$
	$\frac{1}{2}m'(m_1 + m_2)L$	$\frac{1}{6}m'(m_1 + 2m_2)L$	$\frac{1}{6}[m'_1(2m_1 + m_2) + m'_2(m_1 + 2m_2)]L$	$\frac{1}{12}[m'(3m_1 + 5m_2)]L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'(L + a)$	$\frac{1}{6}m[m'_1(L + b) + m_2(L + a)]$	$\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'L$	$\frac{1}{6}m(2m'_1 + m'_2)L$	$\frac{1}{4}mm'L$

Beam Deflections and Slopes

Loading	$v +\uparrow$	$\theta +\circlearrowleft$	Equation $+\uparrow +\circlearrowleft$
	$v_{max} = -\frac{PL^3}{3EI}$ at $x = L$	$\theta_{max} = -\frac{PL^2}{2EI}$ at $x = L$	$v = \frac{P}{6EI}(x^3 - 3Lx^2)$
	$v_{max} = \frac{M_O L^2}{2EI}$ at $x = L$	$\theta_{max} = \frac{M_O L}{EI}$ at $x = L$	$v = \frac{M_O}{2EI}x^2$

Beam Deflections and Slopes (continued)

	$v_{max} = -\frac{wL^4}{8EI}$ at $x = L$	$\theta_{max} = -\frac{wL^3}{6EI}$ at $x = L$	$v = -\frac{w}{24EI}(x^4 - 4Lx^3 + 6L^2x^2)$
	$v_{max} = -\frac{PL^3}{48EI}$ at $x = L/2$	$\theta_{max} = \pm\frac{PL^2}{16EI}$ at $x = 0$ or $x = L$	$v = \frac{P}{48EI}(4x^3 - 3L^2x)$, $0 \le x \le L/2$
		$\theta_L = -\frac{Pab(L + b)}{6LEI}$ $\theta = \frac{Pab(L + a)}{6LEI}$	$v = -\frac{Pbx}{6LEI}(L^2 - b^2 - x^2)$ $0 \le x \le a$
	$v_{max} = -\frac{5wL^4}{384EI}$ at $x = \frac{L}{2}$	$\theta_{max} = \pm\frac{wL^3}{24EI}$	$v = -\frac{wx}{24EI}(x^3 - 2Lx^2 + L^3)$
		$\theta_L = -\frac{3wL^3}{128EI}$ $\theta_R = \frac{7wL^3}{384EI}$	$v = -\frac{wx}{384EI}(16x^3 - 24Lx^2 + 9L^3)$ $0 \le x \le L/2$ $v = -\frac{wL}{384EI}(8x^3 - 24Lx^2 + 17L^2x - L^3)$ $L/2 \le x \le L$
	$v_{max} = -\frac{M_O L^2}{9\sqrt{3}EI}$	$\theta_L = -\frac{M_O L}{6EI}$ $\theta_R = \frac{M_O L}{3EI}$	$v = -\frac{M_O x}{6EIL}(L^2 - x^2)$

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B.Sc. Engg. (CEE)/ 7th Sem. May 20 , 2019 (Group-A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester: Final Semester Examination **Winter Semester: 2018-2019**
Course No.: CEE 4733 **Full Marks: 150**
Course Title: Industrial Wastewater Engineering **Time: 3 hours**

There are **8 (eight)** Questions. Answer any **6 (six)** questions. All questions carry equal marks. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume reasonable data if needed.

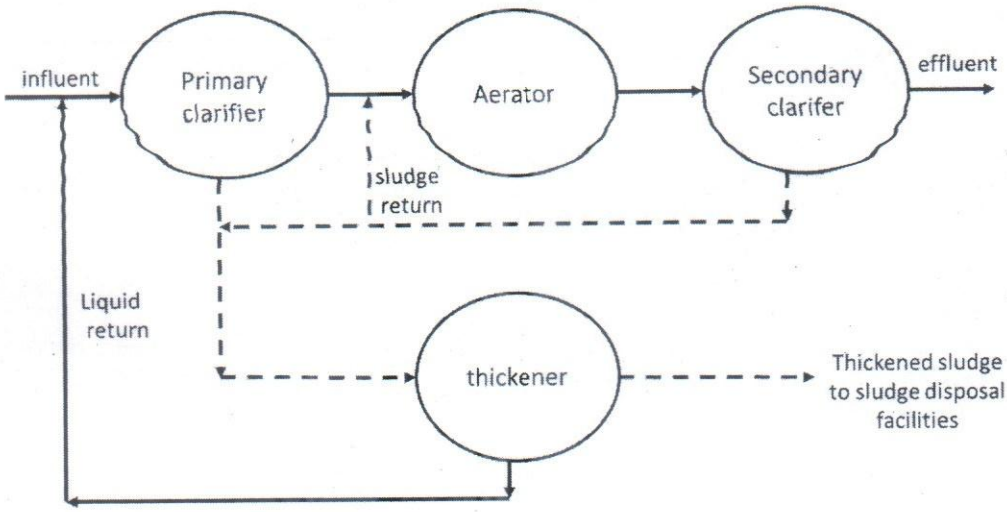
1(a) Draw a schematic diagram showing interparticle bridging using polymer of different concentrations. (05)

(b) A tannery industry wants to establish an ETP. For the secondary treatment, they asked the consultant to design a facility that will treat wastewater biologically in an attached system. Suggest the appropriate treatment facility including its working principle and sketch. Briefly justify your choice. (10)

(c) The completely mix aerobic biological reactor without recycle receives wastewater with a biodegradable soluble COD (bsCOD) concentration of 600 g/m^3. The flow rate is 1000 m^3/d and the reactor effluent (bsCOD) and VSS concentration are 30 g/m^3 and 250 g/m^3 respectively. Determine observed yield. Also, calculate theoretical yield for biomass. (10)

2(a) Describe a system available for sludge dewatering using plants. Do think this system is suitable for urbanized area? Justify your opinion. (07)

(b) A wastewater treatment plant flowing at a rate of 20,000 m^3/d consists of primary treatment units followed by an activated sludge secondary system. The primary and secondary sludges are mixed, thickened and sent to further treatment. A schematic diagram is given below- (18)



Wastewater, treatment plant and sludge characteristics are as follows-

Wastewater		Treatment plant		Sludge	
Influent SS	250 mg/L	Primary clarifier diameter	20 m	Primary	5% solids
Influent BOD	225 mg/L	Aeration volume	3000 m^3	Secondary	0.5% solids
Effluent BOD	20 mg/L	MLSS in aerator	3000 mg/L	Thickened	3% solids

Now determine: i) total solids loading in Kg/d to the sludge disposal facilities, ii) Total volume of sludge to the thickener, and iii)% volume reduction achieved by thickener?

Assume reasonable data if needed. Use graphs provided at the end of the questions.

3(a) Name three different types of adsorbents. (03)

(b) Why sludge production per inhabitant for facultative aerated lagoon is lower than other WWTP systems? How dry substances increase (show only in sketch) in different stages of sludge treatment process. (06)

(c) A settling analysis is run om sludge from an extended aeration activated sludge reactor with the following results: (16)

Concentration, mg/L	1000	2000	3000	4000	5000	6000
Settling velocity, m/h	2.8	1.4	0.4	0.2	0.1	0.06

Under equilibrium conditions, flow to the secondary clarifier is 4200 m^3/d and influent concentration of MLSS is 2000mg/L. For a preselected G value of 2.25 kg/m^2h, determine the solid loadings to the clarifier, underflow rate and the required diameter of the basin.

4(a) Colloidal particles doesn't settle- give your opinion about the statement. (04)

(b) Colloidal particles should be destabilized to increase the attachment between colloids. Explain the principle mechanism involved in double layer compression. (06)

(c) A water treatment plant is being designed to process 40,000 m^3/d of water. Jar testing and pilot plant analysis indicate that an alum dosage of 50 mg/L with flocculation at a Gt_0 value of $9X10^4$ produces optimal results. Use G value is 60 s^{-1} for the first trail. Determine: (15)

i) The monthly alum requirement.
ii) Volume of the tank if four paddles are to be used. The flocculator should be a maximum of 10m wide and 4m deep in order to connect to the basin properly. Does the G value satisfy the given criteria? What will be the new G value? No need to draw any sketch.

5(a) The effluent from a pharmaceutical wastewater needs advanced treatment. You are considering reverse osmosis process. What is fouling? What types of fouling may develop from RO system? (05)

(b) Write short notes on- (10)

I. Reverse Osmosis

II. Electrodialysis

(c) How do you determine sludge characteristics in activated sludge process? Determine sludge volume (ml/L) and sludge volume index and sludge quality index on (ml/g) using following values- (10)

Time (min)	0	5	10	20	40	60	90
Sludge volume (ml/l)	1250	1100	925	820	620	500	400

Given, total solid= 5000 mg/l, Total dissolved solid= 1000 mg/l.

6(a) A paper and pulp industry need a filtration system in their facility. However, they gave some restrictions before aiming for a suitable filtration system. Criteria are: (06)

- Filter operation duration: 1-3 days
- Need higher filtration rate of 8 m/h
- High turbidity removal in comparison to color.

Which one do you suggest based on the criteria mentioned above? Write down the characteristics with appropriate sketch.

(b) List different problems associated with filtration process. (04)

(c) Determine the clean water headloss, drag coefficient and Reynolds number in a filter bed composed of 0.75m of uniform sand with size distribution given below for a filtration rate of 200 $L/m^2.min$. Use Rose equation for your calculation. Given, $\upsilon=1X10^{-6}$ m^2/s (15)

Sieve size or number	6-8	8-10	10-12	12-18	18-20	20-30	30-40	40-50
Percent of sand retained	0	2	6	18	18	22	25	9
Geometric mean, mm	2.82	2.18	1.83	1.30	0.92	0.71	0.50	0.35

Assume the porosity of sand layers is 0.40 and 0.85 for the shape factor of sand.

7(a) You want to design a sludge handling facility. Draw typical flow diagram showing different processes for sludge handling. (05)

(b) Describe with sketch four-step model for methane production from sludge. (08)

(c) Define composting. Explain different types of composting. Which system is suitable for a small tannery industry? (12)

8(a) Draw different types of adsorption isotherm. (04)

(b) Write down the design steps for designing GAC contractor. (06)

(c) An engineer performed the following adsorption experiment of benzidine on granular carbon. The liquid volume is 2L and equilibrium obtained after 5 days. (15)

Activated carbon dosage, M (mg)	3.71	8.42	24.5	39.8	1.08	2.12	4.05	10.85	13
Initial Concentration. C_o (mg/l)	9.81	9.81	9.81	9.81	1.17	1.17	1.17	1.17	1.17
Final concentration, C_e (mg/L)	8.63	7.52	3.55	1.41	0.98	0.84	0.66	0.17	0.11

Plot the Freundlich adsorption isotherm and estimate different parameters for this experiment if applicable.

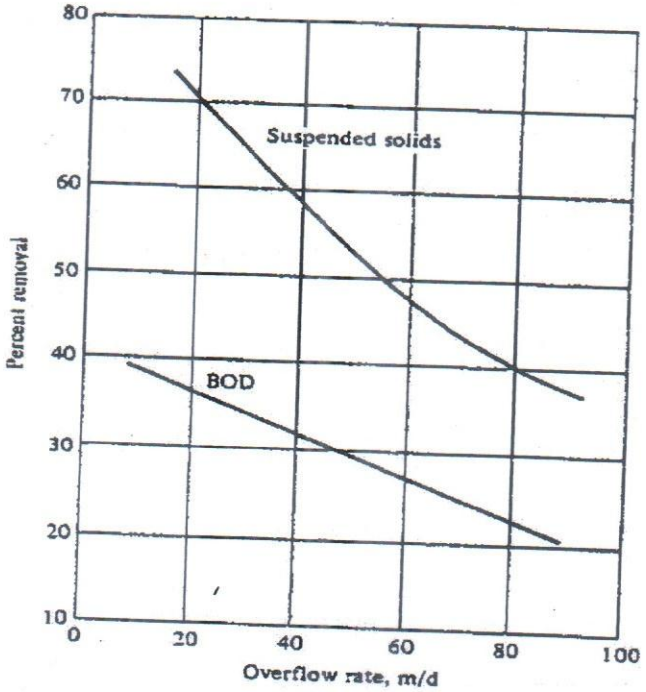


Fig. 1: Suspended solids and BOD removal as a function of overflow rate (question 2).

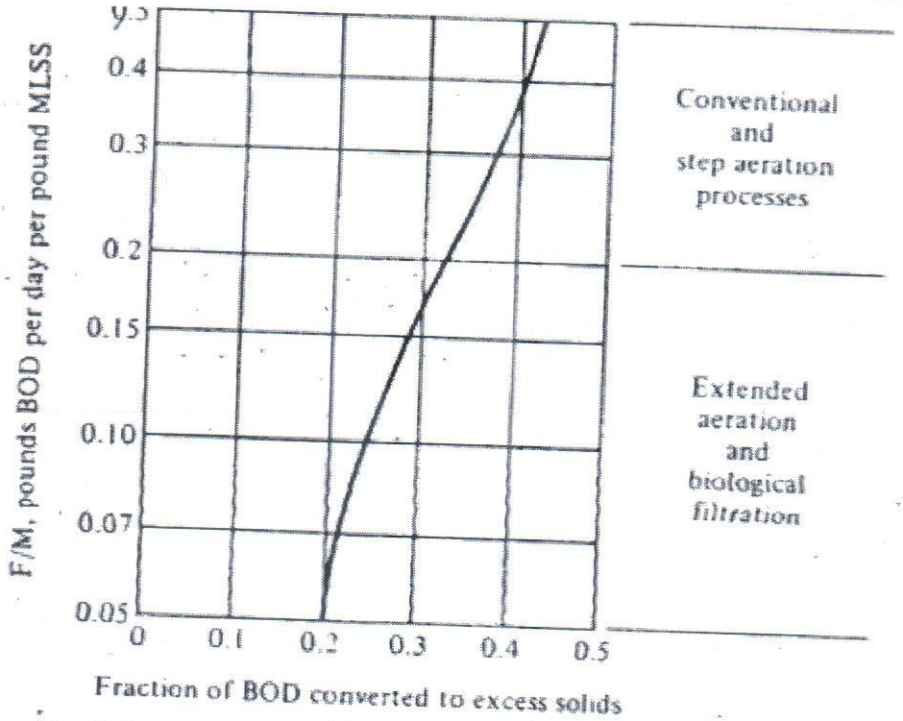


Fig. 2: Generalized diagram of excess sludge production as a function of food to biomass ratio. Actual quantities would vary from plant to plant (question 2).

N.B.: Attach both of the figure with answer script showing your selected values if you answer question 2(b).

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B.Sc. Engg. (CEE)/7th Sem. 23 May, 2019 (Group A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

EXAM : SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO.: CEE 4735 TIME: 3 Hours
COURSE TITLE: Environmental Pollution & its Control FULL MARKS: 150

There are 8 (Eight) questions. Answer any6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. Page 5 of this question paper contains necessary formulas and figures. Use where necessary. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1. (a) A river stream receives waste water from different discharge points (A, B and C) as shown in **Figure 1**. Draw qualitative diagrams of concentration of persistent pollutants, biodegradable organic pollutants and microbial pollutants at different waste discharge points in the downstream. **(6)**

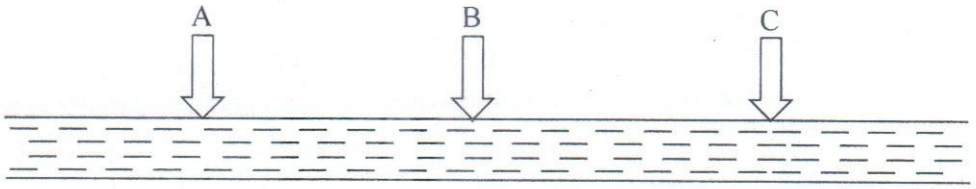


Figure 1

(b) Derive Streeter-Phelps model. Sketch DO sag curve and explain its different phases. Discuss limitations of DO sag model. **(9)**

(c) The wastewater is being discharged into a river that has a temperature of 15^0C. The BOD rate constant determined in the laboratory for this mixed water is 0.12 per day. What fraction of maximum oxygen consumption will occur in first four days? **(5)**

(d) Explain the concept of natural succession in lakes. **(5)**

2. A stream containing BOD of 1 mg/L has a DO of 7.0 mg/L and a flow rate of 0.97 m^3/s. The temperature of the stream is 20°C at which DO saturation value is 9.0 mg/L. The average velocity in the stream is 0.40 m/s and the average depth of the stream is 6.0 m. **(25)**

i. Determine the reaeration rate constant, k_r.
ii. If the stream receives a treated waste discharge of 0.11 m^3/s having DO of 2 mg/L and BOD_5 of 14 mg/L, with a BOD rate constant, K= 0.12 day^{-1}, at 20°C, what would be the rate of reaeration and deoxygenation in the stream right after mixing? Assume that deoxygenation rate constant is the same as the BOD reaction rate constant.
iii. When and where the dissolved oxygen level is critical in the downstream?
iv. Estimate DO_{min}.
v. Draw DO profile for a 120 km reach.

3. (a) Discuss temperature and DO relationships in stratified lake with sketch. Also explain the overturn phenomenon in lakes. **(8)**

(b) A lake having a surface area of 100*106 m2 is fed by a stream having an avg. flow of 20m3/s, and avg. phosphorus concentration of 0.01 g/m3. A wastewater treatment plant adds 10 mg/L of phosphorus with a flow 0.5 m3/s. The settling rate of phosphorus is estimated to be 10m/yr. Estimate phosphorus removal rate at treatment plant to keep phosphorus concentration below 0.01 mg/L. **(6)**

(c) What is centrifugal collector and mention its standard dimensions? The operating efficiency of a centrifugal collector depends on which parameters? Why collection efficiency of centrifugal collector varies from gravitational settling chambers? **(4)**

(d) Prepare a comparison chart by listing the minimum collectable particles size, efficiency, advantages and disadvantages of different control devices for particulate matter. **(7)**

4. (a) A flue gas with a particulate matter concentration of 6500 $mg.m^{-3}$ needs to be treated before emission to the atmosphere to meet the emission standard of 100 $mg.m^{-3}$. The facility managers consider building a settling chamber to treat the flue gas. The area restrictions within the facility limit the height of the settling chamber to 2 m. Assuming an average particle size of 35 microns with a density of 1800 $kg.m^{-3}$, estimate the required length of the settling chamber to meet the emission standard. Assume a dynamic viscosity of $1.8x10^{-5}$ $kg.m^{-1}.s^{-1}$ for the flue gas. **(15)**

(b) Consider two identical settling chambers are operating parallel at a total flow rate of 50400 $m^3.h^{-1}$. If the flow of flue gas is distributed evenly between the chambers, the overall particulate collection efficiency of the system is 85.4%. Calculate the overall particulate collection efficiency if the flue gas is unintentionally distributed unevenly such that one chamber gets 75% of the gas flow and the other receives the rest. **(10)**

5. (a) How sound propagates through geometric spreading? Explain based on point source and line source with figure. **(8)**

(b) What is background noise level? What are the non-acoustical design consideration of a noise barrier? A statistical distribution of noise level of a class room is shown in **Figure 2**. Find out the equivalent noise level and noise climate of the room. **(8)**

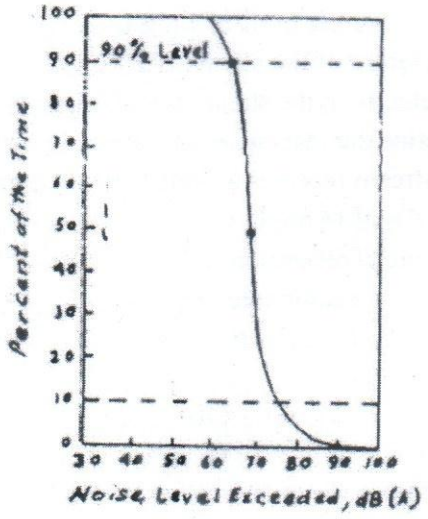
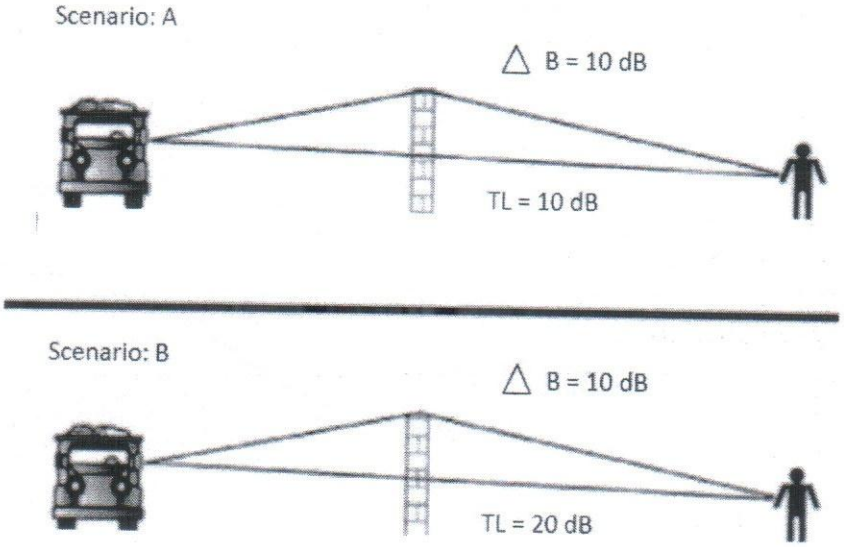


Figure 2

(c) What are the common techniques to control sound pollution at source? **(5)**

(d) Define soil pollution? Make a checklist of information that are required to clean up a contaminant soil. **(4)**

6. (a) Two scenarios are given in **Figure 3**. The source produces a sound of 70 dB and in both cases the diffracted noise is same. Only in the second case the transmission loss made by the barrier is higher than the first case. Which case is acceptable according to Federal Highway Administration (FHWA) and why? **(6)**



(b) The air pollution control equipment on a municipal waste incinerator includes a fabric filter particle collector (known as a baghouse). The baghouse contains 424 cloth bags arranged in parallel, that is 1/424 of the flow goes through each bag. The gas flow rate into and out of the baghouse is 47 m^3/s, and the concentration of particles entering the baghouse is 15 g/m^3. In normal operation the baghouse particulate discharge meets the regulatory limit of 24 mg/m^3. During preventive maintenance replacement of the bags, one bag is inadvertently not replaced, so only 423 bags are in place. **(5)**

Calculate the fraction of particulate matter removed and the efficiency of particulate removal when all 424 bags are in place and the emissions comply with the regulatory requirements. Estimate the mass emission rate when one of the bags is missing and recalculate the efficiency of the baghouse. Assume the efficiency for each individual bag is the same as the overall efficiency for the baghouse.

(c) What are the possible control measures for thermal pollution? Discuss briefly. **(7)**

(d) Why plastic pollution is a threat to earth's ocean? How it can be controlled or reduced? **(7)**

7. Define REMEL. A roadway segment (two lanes, 14 ft each) from has a traffic composition as follows: **(25)**

Heavy truck: 52 vph each lane, speed=65 mph

Medium truck= 245 vph each lane, speed=55 mph

Auto= 504 vph each lane, speed=60 mph

The surrounding ground can be considered exerting moderate reflection ($\alpha = 0.25$). The roadway has 8 ft high side railing made of 4 inch thick concrete wall (TL 36 dBA).

Assume same amount of traffic flow (vph) in both lane.
Find out the equivalent noise level in dBA at 1 ft above the ground level of a residential house 65 ft distance from the centerline of the roadway. Use **Table 1** for modeled height for different vehicle types and **Figure 4** for barrier attenuation.

Table 1: Modeled height for different kinds of vehicles suggested by FHWA Highway Traffic Noise Model

Vehicle Type	Modeled Height (m)
Autos	0
Medium Trucks	0.7
Heavy Trucks	2

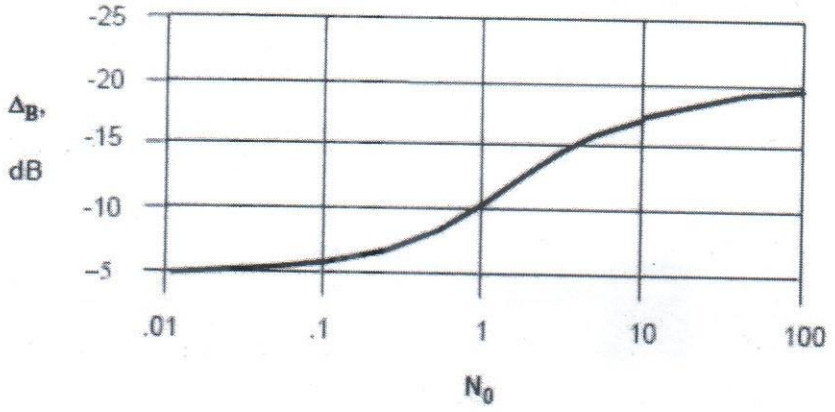


Figure 4

8. (a) Define lapse rate and adiabatic lapse rate. Explain different plume patterns with sketch showing velocity and adiabatic lapse rate profile for each pattern. **(13)**

   (b) What are the design considerations for stack design? Determine the effective height of stack, given the following data: **(6)**

Physical stack is 180 m tall with a 0.95 m inside diameter	Barometric pressure is 1000 millibars
Wind velocity is 2.75 m/s	Stack gas velocity is 11.12 m/s
Air temperature is 20^0 C	Stack gas temperature is 160^0 C

   (c) The dilution factor for an unseeded mixture of waste and water is 0.030. The DO of the mixture is initially 9.0 mg/L and after 5 days it has dropped to 3.0 mg/L. The reaction rate constant has been found to be 0.2/day. What would be the ultimate Carbonaceous BOD? **(6)**

Necessary Formulas and Figures (use where applicable):

$$DO_{sat} = 14.62 - 0.394T + 0.007714T^2 - 0.0000646T^3$$

$$t_c = \frac{1}{k_r - k_d} \ln\left[\frac{k_r}{k_d}\left\{1 - \frac{D_0 (k_r - k_d)}{k_d L_0}\right\}\right]$$

REMEL Calculation
Heavy Trucks:
25-31 mph (40-50 km/h):
REMEL=51.9+19.2Log10(Speed, mph) or 47.9+19.2Log10(Speed, km/h)

35-65 mph: (56-105 km/h):
REMEL=50.4+19.2Log10(Speed, mph) or 46.4+19.2Log10(Speed, km/h)

31-35 mph: (50-56 km/h):
REMELS=Approximately 80 dBA

Medium Trucks:
REMEL=35.3+25.6Log10(Speed, mph) or 30.0+25.6Log10(Speed, km/h)

Autos:
REMEL=5.2+38.8Log10(Speed, mph) or -2.8+38.8Log10(Speed, km/h)

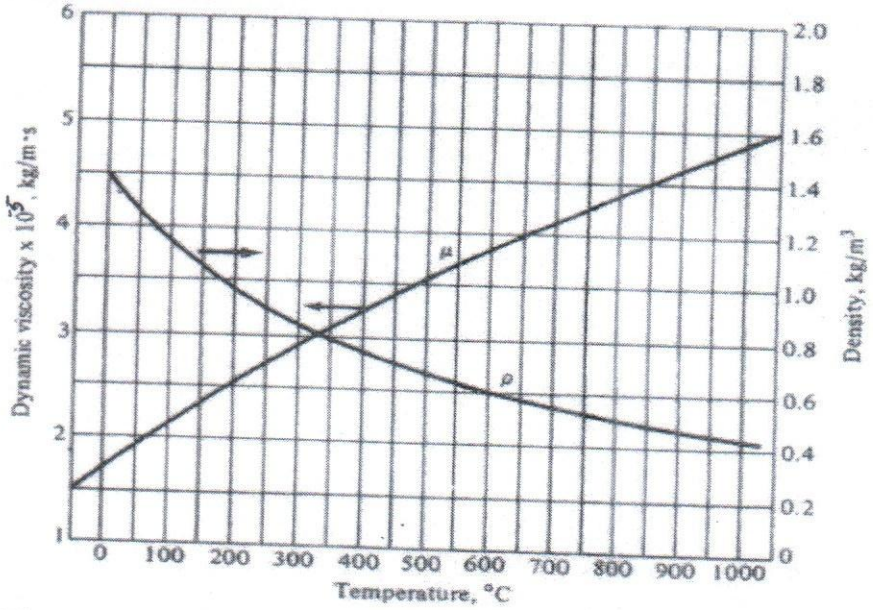


Figure: Density and dynamic viscosity of pure air at 1.0 atm pressure as a function of temperature

B.Sc. Engg. (CEE), 7th Sem. May 17, 2019 (Group A)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

SEMESTER FINAL EXAMINATION — Winter Semester : 2018-2019
Course No. : HUM 4753 — Time : 3 hours
Course Title : Engineering Economics and Accounting — Full Marks : 150

There are **8 (eight)** questions. Answer **any 6 (six)** of them. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

1. a) Compare the alternatives shown below on the basis of a future worth analysis, using an interest rate of 8% per year. 10

	P	Q
First cost	-23,000	-30,000
Annual operating cost, per year	-4,000	-2,500
Salvage value	3000	1000
Life, years	3	6

b) You work for Midstates Solar Power. A manager asked you to determine which of the following two machines will have the lower (i) capital recovery and (ii) equivalent annual total cost. Machine Semi2 has a first cost of $80,000 and an operating cost of $21,000 in year 1, increasing by $500 per year through year 5, after which time it will have a salvage value of $13,000. Machine Auto1 has a first cost of $62,000 and an operating cost of $21,000 in year 1, increasing by 8% per year through year 5, after which time it will have a scavenge value of $2000. Utilize an interest rate of 10% per year to determine both estimates. 15

2. a) With a proper flow chart describe the steps in an engineering economy study. 6

b) The cost associated with manufacturing high performance lubricants closely follows the cost of crude oil. For the last 10 years, a small independent refiner had a cost of $3.4 million in years 1 through 3, after which the cost increased by 3% per year through this year. Determine the current equivalent worth (i.e., now) of the manufacturing cost, using an interest rate of 10% per year. 7

c) Water damage from a major flood in a Midwestern city resulted in damages estimated at $108 million. As a result of the claimant payouts, insurance companies raised homeowners' insurance rates by an average of $59 per year for each of the 160,000 households in the affected city. If a 20-year study period is considered, what was the rate of return on the $108 million paid by the insurance companies? 6

d) Chem-Tex Chemical is considering two additives for improving the dry-weather stability of its low-cost acrylic paint. Additive A has a first cost of $110,000 and an annual operating cost of $60,000. Additive B has a first cost of $175,000 and an annual operating cost of $35,000. If the company uses a 3-year recovery period for paint products and a MARR of 20% per year, which process is economically favored? Use an incremental ROR analysis. 6

3. a) The board of directors of Halliburton International has just approved an $18 million worldwide engineering construction design contract. The services are expected to generate new annual net cash flows of $3 million. The contract has a potentially lucrative repayment clause to Halliburton of $3 million at any time that the contract is canceled by either party during the 10 years of the contract period. If i =15%, compute the payback period. 6

b) A small aerospace company is evaluating two alternatives: the purchase of an automatic feed machine and a manual feed machine for a finishing process. The auto feed machine has an initial cost of $23,000, an estimated salvage value of $4000, and a predicted life of 10 years. One person will operate the machine at a rate of $12 per hour. The expected output is 8 tons per hour. Annual maintenance and operating cost is expected to be $3500.
The alternative manual feed machine has a first cost of $8000, no expected salvage value, a 5-year life, and an output of 6 tons per hour. However, three workers will be required at $8 per hour each. The machine will have an annual maintenance and operation cost of $1500. All projects are expected to generate a return of 10% per year. How many tons per year must be finished to justify the higher purchase cost of the auto feed machine? 8

c) The U.S. government recently released an RFP to construct a second-story floor on an existing building at the Pentagon Complex. Separate contractors proposed two methods. Method 1 will use lightweight expanded shale on a metal deck with open web joists and steel beams. For this method, the costs will be $14,100 for concrete, $6000 for metal decking, $4300 for joists, and $2600 for beams.
Method 2 will construct a reinforced concrete slab costing $5200 for concrete, $1400 for rebar, $2600 for equipment rental, and $1200 for expendable supplies. Special additives will be included in the lightweight concrete that will improve the heat-transfer properties of the floor. If the energy costs for method 1 will be $600 per year lower than for method 2, which one is more attractive? Use an interest rate of 7% per year, a 20 -year study period, and the B/C method. 11

4. a) The inflation rate in a Central American country is 6% per year. What real rate of return will an investor make on a $100,000 investment in a copper mine stock that yields an overall internal rate of return of 28% per year? 7

b) An engineer must recommend one of two rapid prototyping machines for integration into an upgraded manufacturing line. She obtained estimates from salespeople from two companies. Salesman A gave her the estimates in constant-value (today's) dollars, while saleswoman B provided the estimates in future (then-current) dollars. The company's MARR is equal to the real rate of return of 20% per year, and inflation is estimated at 4% per year. Use PW analysis to determine which machine the engineer should recommend? 10

	A (in CV dollars)	**B** (in future dollars)
First Cost	-140,000	-155,000
AOC, per year	-25,000	-40,000
Life, years	10	10

c) A Toyota Tundra can be purchased today for $32,350. A civil engineering firm is going to need three more trucks in 2 years because of a land development contract it just won. If the price of the truck increases exactly in accordance with an estimated inflation rate of 3.5% per year, determine how much the three trucks will cost in 2 years. 8

5. a) Describe the NSPE code of ethics for engineers. 9

b) An asset that is book-depreciated over a 5-year period by the straight line method has BV_3= $62,000 with a depreciation charge of $26,000 per year. Determine (i) the first cost of the asset and (ii) the assumed salvage value. 6

c) Freeport-McMoRan Copper and Gold has purchased a new ore grading unit for $80,000. The unit has an anticipated life of 10 years and a salvage value of $10,000. Use the DB and DDB methods to compare the schedule of depreciation and book values for each year. 10

6 a) Jack Quaney started his own consulting firm, Quaney Company, on June 1, 2018. The trial balance at June 30 is shown below. 15

QUANEY COMPANY

Trial Balance

June 30, 2018

Accounts Title	Debit	Credit
Cash	$ 7,150	
Accounts Receivable	6,000	
Supplies	2,000	
Prepaid Insurance	3,000	
Office Equipment	15,000	
Accounts Payable		$ 4,500
Unearned Service Revenue		4,000
J.Quaney, Capital		21,750
Service Revenue		7,900
Salaries Expense	4,000	
Rent Expense	1,000	
	$38,150	**$38,150**

In addition to those accounts listed on the trial balance, the chart of accounts for Quaney Company also contains the following accounts and account numbers: No. 158 Accumulated Depreciation—Office Equipment, No. 212 Salaries Payable, No. 244 Utilities Payable, No. 631 Supplies Expense, No. 711 Depreciation Expense, No. 722 Insurance Expense, and No. 732 Utilities Expense.

Other data:

i) Supplies on hand at June 30 are $600.

ii) A utility bill for $150 has not been recorded and will not be paid until next month.

iii) The insurance policy is for a year.

iv) $2,500 of unearned service revenue has been earned at the end of the month.

v) Salaries of $2,000 are accrued at June 30.

vi) The office equipment has a 5-year life with no salvage value. It is being depreciated at $250 per month for 60 months.

vii) Invoices representing $1,000 of services performed during the month have not been recorded as of June 30.

Required:

Required 1: Prepare the adjusting entries for the month of June.

Required 2: Prepare an adjusted trial balance at June 30, 2018.

b) "Cash-basis accounting often produces misleading financial statements." Do you agree with the statement? Explain the reason. 4

c) "Efforts should be matched with accomplishments"-this statement indicates a principle of accounting. Explain the statement. 4

d) Which items are included in Deferrals and Accruals? 2

7 a) Your friend Jawad is confused about the accounts that are closed and the accounts that are not closed. Which chart will you show him? 4

b) Draw the Accounting Cycle. 3

c) The trial balance columns of the worksheet for Goode Company at March 31,2018, are as follows. 18

GOODE COMPANY

Worksheet

For the Month Ended March 31, 2018

Account Titles	Trial Balance	
	Dr.	Cr.
Cash	$ 4,500	
Accounts Receivable	3,200	
Roofing Supplies	2,000	
Equipment	11,000	
Accumulated Depreciation-Equipment		$ 1,250
Accounts Payable		2,500
Unearned Revenue		550
T.Goode, Capital		12,900
T.Goode, Drawing	1,100	
Service Revenue		6,300
Salaries Expense	1,300	
Miscellaneous Expense	400	
	$ 23,500	**$ 23,500**

Other data:

i) A physical count reveals only $650 of roofing supplies on hand.

ii) Depreciation for March is $250.

iii) Unearned revenue amounted to $170 at March 31.

iv) Accrued salaries are $600.

Required:

Required 1: Enter the trial balance on a worksheet and complete the worksheet.

Required 2: Journalize the closing entries from the financial statement columns of the worksheet.

8 a) What is Free Cash Flow? Explain with example. 5

b) Which method is favored by the companies in preparing Statement of Cash Flows? Why? 5

c) The following tables present information related to 2018 for Sparkle Company: 15

SPARKLE COMPANY **Comparative Balance Sheets** December 31			
Assets	**2018**	**2017**	**Change Increase/Decrease**
Cash	$191,000	$159,000	$ 32,000 Increase
Accounts receivable	12,000	15,000	3,000 Decrease
Inventory	170,000	160,000	10,000 Increase
Prepaid expenses	6,000	8,000	2,000 Decrease
Land	140,000	80,000	60,000 Increase
Equipment	160,000	0	160,000 Increase
Accumulated depreciation—equipment	(16,000)	0	16,000 Increase
Total	**$663,000**	**$422,000**	
Liabilities and Stockholders' Equity			
Accounts payable	$ 52,000	$ 60,000	$ 8,000 Decrease
Accrued expenses payable	15,000	20,000	5,000 Decrease
Income taxes payable	12,000	0	12,000 Increase
Bonds payable	130,000	0	130,000 Increase
Common stock	360,000	300,000	60,000 Increase
Retained earnings	94,000	42,000	52,000 Increase
Total	**$663,000**	**$422,000**	

SPARKLE COMPANY **Income Statement** For the Year Ended December 31, 2018		
Revenues		$975,000
Cost of goods sold	$6,60,000	
Operating expenses (excluding depreciation)	176,000	
Depreciation expense	18,000	
Loss on sale of store equipment	1,000	
		855,000
Income before income taxes		**120,000**
Income tax expense		36,000
Net income		**$ 84,000**

Additional information:

i) In 2018, the company declared and paid a $32,000 cash dividend.

ii) Bonds were issued at face value for $130,000 in cash.

iii) Equipment costing $180,000 was purchased for cash.

iv) Equipment costing $20,000 was sold for $17,000 cash when the book value of the

equipment was $18,000.

v) Common stock of $60,000 was issued to acquire land.

Required:

Prepare a **Statement of Cash Flows** under the **Indirect Approach** for the Year Ended December 31, 2018.

Compound Interest Factor Tables

Interest rate 6%

	Single Payments		Uniform Series Payments				Arithmetic Gradients	
n	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.0600	0.9434	1.00000	1.0000	1.06000	0.9434		
2	1.1236	0.8900	0.48544	2.0600	0.54544	1.8334	0.8900	0.4854
3	1.1910	0.8396	0.31411	3.1836	0.37411	2.6730	2.5692	0.9612
4	1.2625	0.7921	0.22859	4.3746	0.28859	3.4651	4.9455	1.4272
5	1.3382	0.7473	0.17740	5.6371	0.23740	4.2124	7.9345	1.8836
6	1.4185	0.7050	0.14336	6.9753	0.20336	4.9173	11.4594	2.3304
7	1.5036	0.6651	0.11914	8.3938	0.17914	5.5824	15.4497	2.7676
8	1.5938	0.6274	0.10104	9.8975	0.16104	6.2098	19.8416	3.1952
9	1.6895	0.5919	0.08702	11.4913	0.14702	6.8017	24.5768	3.6133
10	1.7908	0.5584	0.07587	13.1808	0.13587	7.3601	29.6023	4.0220
11	1.8983	0.5268	0.06679	14.9716	0.12679	7.8869	34.8702	4.4213
12	2.0122	0.4970	0.05928	16.8699	0.11928	8.3838	40.3369	4.8113
13	2.1329	0.4688	0.05296	18.8821	0.11296	8.8527	45.9629	5.1920
14	2.2609	0.4423	0.04758	21.0151	0.10758	9.2950	51.7128	5.5635
15	2.3966	0.4173	0.04296	23.2760	0.10296	9.7122	57.5546	5.9260
16	2.5404	0.3936	0.03895	25.6725	0.09895	10.1059	63.4592	6.2794
17	2.6928	0.3714	0.03544	28.2129	0.09544	10.4773	69.4011	6.6240
18	2.8543	0.3503	0.03236	30.9057	0.09236	10.8276	75.3569	6.9597
19	3.0256	0.3305	0.02962	33.7600	0.08962	11.1581	81.3062	7.2867
20	3.2071	0.3118	0.02718	36.7856	0.08718	11.4699	87.2304	7.6051

Interest rate 7%

	Single Payments		Uniform Series Payments				Arithmetic Gradients	
n	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.0700	0.9346	1.00000	1.0000	1.07000	0.9346		
2	1.1449	0.8734	0.48309	2.0700	0.55309	1.8080	0.8734	0.4831
3	1.2250	0.8163	0.31105	3.2149	0.38105	2.6243	2.5060	0.9549
4	1.3108	0.7629	0.22523	4.4399	0.29523	3.3872	4.7947	1.4155
5	1.4026	0.7130	0.17389	5.7507	0.24389	4.1002	7.6467	1.8650
6	1.5007	0.6663	0.13980	7.1533	0.20980	4.7665	10.9784	2.3032
7	1.6058	0.6227	0.11555	8.6540	0.18555	5.3893	14.7149	2.7304
8	1.7182	0.5820	0.09747	10.2598	0.16747	5.9713	18.7889	3.1465
9	1.8385	0.5439	0.08349	11.9780	0.15349	6.5152	23.1404	3.5517
10	1.9672	0.5083	0.07238	13.8164	0.14238	7.0236	27.7156	3.9461
11	2.1049	0.4751	0.06336	15.7836	0.13336	7.4987	32.4665	4.3296
12	2.2522	0.4440	0.05590	17.8885	0.12590	7.9427	37.3506	4.7025
13	2.4098	0.4150	0.04965	20.1406	0.11965	8.3577	42.3302	5.0648
14	2.5785	0.3878	0.04434	22.5505	0.11434	8.7455	47.3718	5.4167
15	2.7590	0.3624	0.03979	25.1290	0.10979	9.1079	52.4461	5.7583
16	2.9522	0.3387	0.03586	27.8881	0.10586	9.4466	57.5271	6.0897
17	3.1588	0.3166	0.03243	30.8402	0.10243	9.7632	62.5923	6.4110
18	3.3799	0.2959	0.02941	33.9990	0.09941	10.0591	67.6219	6.7225
19	3.6165	0.2765	0.02675	37.3790	0.09675	10.3356	72.5991	7.0242
20	3.8697	0.2584	0.02439	40.9955	0.09439	10.5940	77.5091	7.3163

Interest rate 8%

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.0800	0.9259	1.00000	1.0000	1.08000	0.9259		
2	1.1664	0.8573	0.48077	2.0800	0.56077	1.7833	0.8573	0.4808
3	1.2597	0.7938	0.30803	3.2464	0.38803	2.5771	2.4450	0.9487
4	1.3605	0.7350	0.22192	4.5061	0.30192	3.3121	4.6501	1.4040
5	1.4693	0.6806	0.17046	5.8666	0.25046	3.9927	7.3724	1.8465
6	1.5869	0.6302	0.13632	7.3359	0.21632	4.6229	10.5233	2.2763
7	1.7138	0.5835	0.11207	8.9228	0.19207	5.2064	14.0242	2.6937
8	1.8509	0.5403	0.09401	10.6366	0.17401	5.7466	17.8061	3.0985
9	1.9990	0.5002	0.08008	12.4876	0.16008	6.2469	21.8081	3.4910
10	2.1589	0.4632	0.06903	14.4866	0.14903	6.7101	25.9768	3.8713
11	2.3316	0.4289	0.06008	16.6455	0.14008	7.1390	30.2657	4.2395
12	2.5182	0.3971	0.05270	18.9771	0.13270	7.5361	34.6339	4.5957
13	2.7196	0.3677	0.04652	21.4953	0.12652	7.9038	39.0463	4.9402
14	2.9372	0.3405	0.04130	24.2149	0.12130	8.2442	43.4723	5.2731
15	3.1722	0.3152	0.03683	27.1521	0.11683	8.5595	47.8857	5.5945
16	3.4259	0.2919	0.03298	30.3243	0.11298	8.8514	52.2640	5.9046
17	3.7000	0.2703	0.02963	33.7502	0.10963	9.1216	56.5883	6.2037
18	3.9960	0.2502	0.02670	37.4502	0.10670	9.3719	60.8426	6.4920
19	4.3157	0.2317	0.02413	41.4463	0.10413	9.6036	65.0134	6.7697
20	4.6610	0.2145	0.02185	45.7620	0.10185	9.8181	69.0898	7.0369

Interest rate 10%

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.1000	0.9091	1.00000	1.0000	1.10000	0.9091		
2	1.2100	0.8264	0.47619	2.1000	0.57619	1.7355	0.8264	0.4762
3	1.3310	0.7513	0.30211	3.3100	0.40211	2.4869	2.3291	0.9366
4	1.4641	0.6830	0.21547	4.6410	0.31547	3.1699	4.3781	1.3812
5	1.6105	0.6209	0.16380	6.1051	0.26380	3.7908	6.8618	1.8101
6	1.7716	0.5645	0.12961	7.7156	0.22961	4.3553	9.6842	2.2236
7	1.9487	0.5132	0.10541	9.4872	0.20541	4.8684	12.7631	2.6216
8	2.1436	0.4665	0.08744	11.4359	0.18744	5.3349	16.0287	3.0045
9	2.3579	0.4241	0.07364	13.5795	0.17364	5.7590	19.4215	3.3724
10	2.5937	0.3855	0.06275	15.9374	0.16275	6.1446	22.8913	3.7255
11	2.8531	0.3505	0.05396	18.5312	0.15396	6.4951	26.3963	4.0641
12	3.1384	0.3186	0.04676	21.3843	0.14676	6.8137	29.9012	4.3884
13	3.4523	0.2897	0.04078	24.5227	0.14078	7.1034	33.3772	4.6988
14	3.7975	0.2633	0.03575	27.9750	0.13575	7.3667	36.8005	4.9955
15	4.1772	0.2394	0.03147	31.7725	0.13147	7.6061	40.1520	5.2789
16	4.5950	0.2176	0.02782	35.9497	0.12782	7.8237	43.4164	5.5493
17	5.0545	0.1978	0.02466	40.5447	0.12466	8.0216	46.5819	5.8071
18	5.5599	0.1799	0.02193	45.5992	0.12193	8.2014	49.6395	6.0526
19	6.1159	0.1635	0.01955	51.1591	0.11955	8.3649	52.5827	6.2861
20	6.7275	0.1486	0.01746	57.2750	0.11746	8.5136	55.4069	6.5081

Interest rate 15%

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.1500	0.8696	1.00000	1.0000	1.15000	0.8696		
2	1.3225	0.7561	0.46512	2.1500	0.61512	1.6257	0.7561	0.4651
3	1.5209	0.6575	0.28798	3.4725	0.43798	2.2832	2.0712	0.9071
4	1.7490	0.5718	0.20027	4.9934	0.35027	2.8550	3.7864	1.3263
5	2.0114	0.4972	0.14832	6.7424	0.29832	3.3522	5.7751	1.7228
6	2.3131	0.4323	0.11424	8.7537	0.26424	3.7845	7.9368	2.0972
7	2.6600	0.3759	0.09036	11.0668	0.24036	4.1604	10.1924	2.4498
8	3.0590	0.3269	0.07285	13.7268	0.22285	4.4873	12.4807	2.7813
9	3.5179	0.2843	0.05957	16.7858	0.20957	4.7716	14.7548	3.0922
10	4.0456	0.2472	0.04925	20.3037	0.19925	5.0188	16.9795	3.3832
11	4.6524	0.2149	0.04107	24.3493	0.19107	5.2337	19.1289	3.6549
12	5.3503	0.1869	0.03448	29.0017	0.18448	5.4206	21.1849	3.9082
13	6.1528	0.1625	0.02911	34.3519	0.17911	5.5831	23.1352	4.1438
14	7.0757	0.1413	0.02469	40.5047	0.17469	5.7245	24.9725	4.3624
15	8.1371	0.1229	0.02102	47.5804	0.17102	5.8474	26.6930	4.5650
16	9.3576	0.1069	0.01795	55.7175	0.16795	5.9542	28.2960	4.7522
17	10.7613	0.0929	0.01537	65.0751	0.16537	6.0472	29.7828	4.9251
18	12.3755	0.0808	0.01319	75.8364	0.16319	6.1280	31.1565	5.0843
19	14.2318	0.0703	0.01134	88.2118	0.16134	6.1982	32.4213	5.2307
20	16.3665	0.0611	0.00976	102.4436	0.15976	6.2593	33.5822	5.3651

Interest rate 20%

n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	Compound Amount F/P	Present Worth P/F	Sinking Fund A/F	Compound Amount F/A	Capital Recovery A/P	Present Worth P/A	Gradient Present Worth P/G	Gradient Uniform Series A/G
1	1.2000	0.8333	1.00000	1.0000	1.20000	0.8333		
2	1.4400	0.6944	0.45455	2.2000	0.65455	1.5278	0.6944	0.4545
3	1.7280	0.5787	0.27473	3.6400	0.47473	2.1065	1.8519	0.8791
4	2.0736	0.4823	0.18629	5.3680	0.38629	2.5887	3.2986	1.2742
5	2.4883	0.4019	0.13438	7.4416	0.33438	2.9906	4.9061	1.6405
6	2.9860	0.3349	0.10071	9.9299	0.30071	3.3255	6.5806	1.9788
7	3.5832	0.2791	0.07742	12.9159	0.27742	3.6046	8.2551	2.2902
8	4.2998	0.2326	0.06061	16.4991	0.26061	3.8372	9.8831	2.5756
9	5.1598	0.1938	0.04808	20.7989	0.24808	4.0310	11.4335	2.8364
10	6.1917	0.1615	0.03852	25.9587	0.23852	4.1925	12.8871	3.0739
11	7.4301	0.1346	0.03110	32.1504	0.23110	4.3271	14.2330	3.2893
12	8.9161	0.1122	0.02526	39.5805	0.22526	4.4392	15.4667	3.4841
13	10.6993	0.0935	0.02062	48.4966	0.22062	4.5327	16.5883	3.6597
14	12.8392	0.0779	0.01689	59.1959	0.21689	4.6106	17.6008	3.8175
15	15.4070	0.0649	0.01388	72.0351	0.21388	4.6755	18.5095	3.9588
16	18.4884	0.0541	0.01144	87.4421	0.21144	4.7296	19.3208	4.0851
17	22.1861	0.0451	0.00944	105.9306	0.20944	4.7746	20.0419	4.1976
18	26.6233	0.0376	0.00781	128.1167	0.20781	4.8122	20.6805	4.2975
19	31.9480	0.0313	0.00646	154.7400	0.20646	4.8435	21.2439	4.3861
20	38.3376	0.0261	0.00536	186.6880	0.20536	4.8696	21.7395	4.4643

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M. Sc. Engg. (CEE)

May 29, 2019 (Group B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : FINAL EXAMINATION
COURSE NO. : CEE 6109
COURSE TITLE: Advance Concrete Technology

WINTER SEMESTER: 2018-2019
TIME : 3 Hours
FULL MARKS: 150

There are 6 (SIX) questions. Answer ALL questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1 Concrete mix design is required for a commercial building project based on the following data: (40)

Volume ratio of sand to total aggregate = 0.36
Air Content = 1 % (air-entraining admixture is not used)
Specific gravity of cement = 2.9 (Fly Ash Cement)
Specific gravity of sand (SSD) = 2.60
Specific gravity of coarse aggregate (SSD) = 2.70
Design compressive strength (28 days) = 4500 psi
Minimum required slump = 175 mm
Maximum aggregate size = ¾ inch, Aggregate type = Stone chips
Dosage of superplasticizer = 10 ml/kg of cement if W/C is less than 0.45.

The following graphs are provided :

- Variation of compressive strength (28 days) with W/C,
- Variation of cement content with compressive strength (28 days) for different aggregate size and slump value.

(i) Calculate the unit contents.
(ii) Prepare a mixture proportion table. Typical form of mixture proportion table is attached.
(iii) Calculate the volume ratio of the mix. Aassume unit weights of cement, sand (SSD), and coarse aggregate (SSD) with void are 1300 kg/m^3, 1350 kg/m^3 and 1450 kg/m^3, respectively.
(iv) Calculate the cost of concrete for one cubic meter. Assume the cost of 1 bag cement is Tk. 400, cost of 1 cft sand is Tk. 30, and cost of 1 cft stone chips is Tk. 130.
(v) Estimate the materials in weight and volume (cement, water, sand, and coarse aggregate) required to make 10 beams of 12 inch width 18 inch depth and 18 feet span.
(vi) Assume 3% surplus water in sand over SSD condition and the amount of bulking of sand is 10%. What adjustments are necessary in the mix design?
(vii) Calculate the compaction factor of the mix.
(viii) Explain advantages and disadvantages of volumetric and weight based mix design.

2 The following data (carbonation depth with time) were recorded for a structure in Dhaka City: (25)

Time (Year)	Carbonation Depth (mm)
0	0
5	13
10	18
15	21
20	25
30	30
40	35
50	40

(i) Draw the depth of carbonation versus square root of time curve in a plain graph paper,
(ii) Determine the carbonation coefficient of concrete,
(iii) If cover concrete depth = 25 mm, make a brief discussion on the status of corrosion of steel bars inside concrete,
(iv) Determine the time necessary to break down the passivation film over the steel bars inside concrete.
(v) "The exposure condition of Bangladesh is favorable for carbonation of concrete" – Discuss briefly.
(vi) How will you reduce the carbonation coefficient of concrete during planning and construction of a structure in Dhaka City?

3 Concrete samples were collected to determine chloride profile in concrete. Mixture proportion of concrete and data associated with the chloride profile are given in Appendix A. (25)

i) Show all calculation steps to determine chloride concentration with respect to % of cement and kg/m^3 of concrete,
ii) Draw chloride profile,
iii) If the cover concrete depth is 50 mm, briefly explain the status of chloride induced corrosion of steel bars inside concrete.

4(a) You are in charge of a project located near a renowned cement factory. After receiving cement from this factory, you found that cement is warm. Explain the consequences from the use of this cement. (10)

(b) April 24 is the Corrosion Awareness Day. Explain the significance of this day for Civil Engineers. (10)

5 Refer to the following photographs. Discuss the reasons for deterioration of these structures. (20)

(a) Concrete Slab – Mirpur, Dhaka

(b) RC Beam, Cox's Bazar

6 Discuss the variation of microstructure of concrete with the change of W/C. (20)

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Mixture Proportion Table

W/C	s/a	Maximum Aggregate Size	Slump	Air Content	Unit Contents (kg/m3)				Super plasticize
%	%	mm	cm	%	C	W	FA	CA	ml/kg of cement

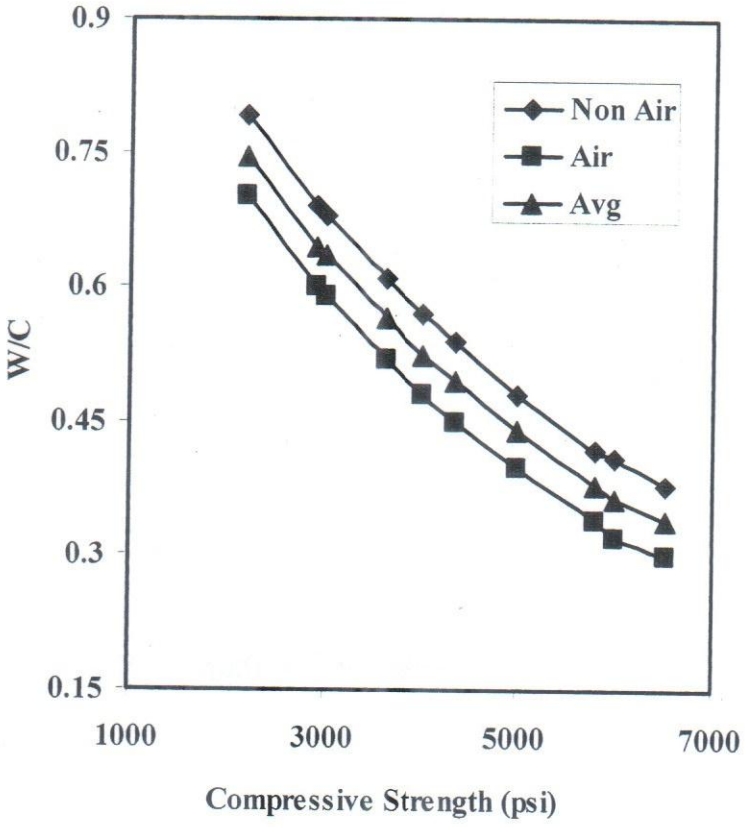

Fig. W/C versus Compressive Strength (aggregate type = stone chips)

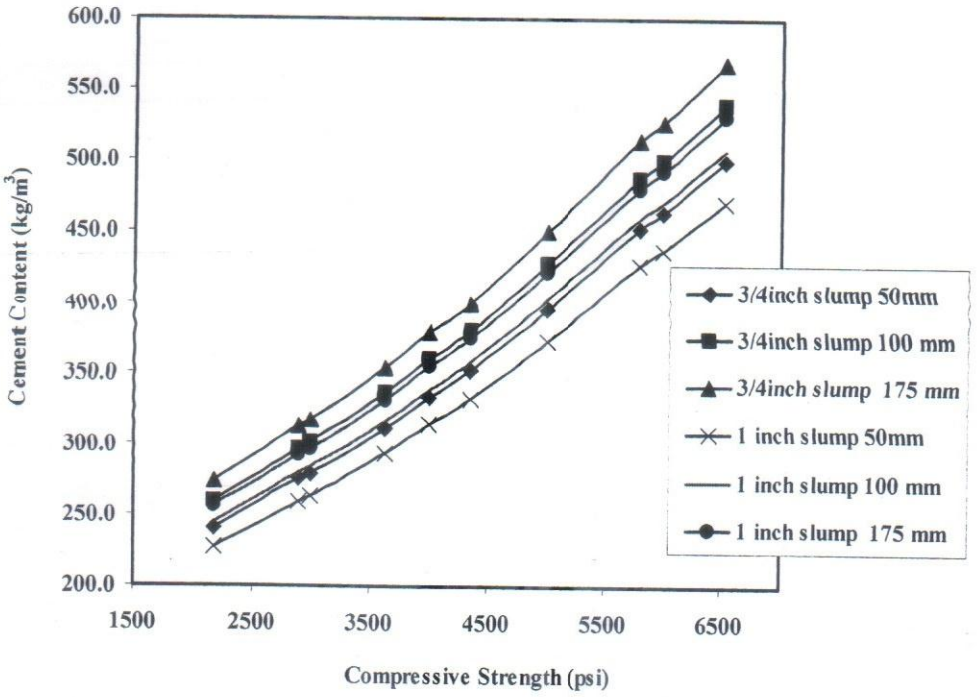

Fig. Cement Content versus Compressive Strength (aggregate type = stone chips)

Appendix A

Mixture Proportion of Concrete

Max. Aggregate Size (mm)	s/a (%)	W/C (%)	Air (%)	Slump (cm)	Unit Contents (kg/m^3)			
					Cement	Water	Sand	Coarse Aggregate
20	40	50	1~2	6~10	400	200	700	1100

For a structure with the similar mixture proportion, the following data were recorded for evaluation of the chloride profile after 20 years of marine exposure condition:

Chloride Analysis Data

Average Sample Depth (mm)	Amount of Concrete Powdered Sample (g)	Amount of Water Used to Dissolve Chloride into Water (ml)	Volume of Filtered Water Used for Titration (g)	Volume of $AgNO_3$ Solution Used for Titration (ml)
2	10	100	3	4
10	15	100	5	5
20	15	100	7	3
30	15	100	12	2
40	15	100	30	2

Concentration of $AgNO_3$ solution is N/200.

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M.Sc. Egg. (CEE)/1st Sem. 16 May, 2019 (Gr. B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2018-2019

COURSE NO. : **CEE 6303** TIME: 3.0 Hours

COURSE TITLE: **Municipal Wastewater Treatment and Process Design** FULL MARKS: 150

There are 8 (Eight) questions. Answer any 6 (Six) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

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1. (a) What is Domestic Wastewater and why we treat it? Draw a complete flow diagram of a wastewater treatment plant and explain the function of each phase. (11)

   (b) Explain briefly the role of micro-organisms in waste stabilization. (05)

   (c) What is oxygen demand? Explain the ways of expressing oxygen demand. Why COD is always greater than BOD? (09)

2. (a) For the refinement of wastewater why one need to put primary treatment in the first phase? What does unit operation and unit process mean in wastewater treatment? (08)

   (b) What are the benefits of primary treatment? Write the working principle of primary sedimentation tank. (08)

   (c) A radial flow circular primary sedimentation tank is of 24m diameter and 2.4m deep. Calculate the surface loading, retention time and weir load for a flow of 11000 m^3/day. Comment on this value. (09)

3. (a) What can you achieve through secondary treatment of municipal wastewater? Classify secondary treatment with two examples each. (10)

   (b) Describe the most important micro-organisms responsible for waste stabilization. Explain briefly the role of micro-organisms in waste stabilization. (08)

   (c) "Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and feces". Explain the statement. (07)

4. (a) Differentiate between BOD loading and hydraulic loading. Also describe aerobic, anaerobic and anoxic biological treatment process for secondary treatment. (10)

   (b) Which difficulties we do come across during the operation of a tricking filter? How they can be controlled? (09)

   (c) Two lagoons 700 ft by 500 ft, operated in parallel, are receiving an organic load of 203.8 mg/L of BOD_5 from a community of 1700 people. What is the organic loading, in lbs of BOD_5 per acre per day and hydraulic loading in GPD/ft^2? Use per capita wastewater production as 100 gallons/day. (06)

5. (a) What is activated sludge process? State the mechanisms involved in BOD removal process using activated sludge process. (09)

   (b) Show that in a complete mix recycle activated sludge system, mean cell residence time (θ_c) in the reactor is equal to the hydraulic retention time (θ). (07)

   (c) What is SVI? Calculate the daily food to microorganism ratio, SVI and the amount of return sludge from the given following data. (09)

   Aeration tank 28' x 120' x 15'
   Raw sewage flow = 7.5MGD
   Primary influent BOD = 115 mg/L
   Mixed liquor volatile suspended solids (MLVSS) = 4,700 mg/L
   Settled volume in the SVI test = 230mL

6. (a) What are the modifications of conventional activated sludge process? Why these modifications have been developed? (08)

   (b) 'Recirculation in trickling filter differs greatly from that in activated sludge process' –Explain. (07)

   (c) Why sludge treatment is required? Write the name of sludge treatment processes. Describe the basic process of aerobic composting with a suitable flow diagram. (10)

7. (a) What do you mean by tertiary treatment? Why it is required? How different types of solids are removed from effluent coming from secondary treatment plant? (09)

   (b) What is the basic improvement made in the pour flush sanitation technology compared to simple pit and VIP technologies? What are the major components of a pour flush sanitation system? (10)

   (c) Design a single pit VIP latrine for a family of eight. The family uses water for anal cleansing. The groundwater table is only 2.0m below the ground surface. (06)

8. (a) VIP latrines are an improvement to overcome the disadvantages of simple pit latrines – Explain the statement. (06)

   (b) Draw a schematic diagram showing various components of a septic tank. Position the inlet and outlet devices carefully and explain how these can influence the septic tank operation. (09)

   (c) Design a septic tank to serve a household of 10 persons who produce 90 lpcd (litres per capita per day) of wastewater. The tank is to be desludged every three years. (10)

M. Sc. Engg. (CEE) 24 May, 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination **Winter Semester: 2018-2019**
Course No.: CEE 6701 **Full Marks: 150**
Course Title: Advanced Soil Mechanics I **Time: 3.0 Hours**

There are 7 (Seven) questions. Answer any 6 (Six) questions. Do not write on this question paper. The figures in the right margin indicate full marks. The symbols have their usual meaning.

1(a) Derive the equation of principle of virtual work. Formulate the work done for discontinuous surface (cracks) using the derived equation of principle of virtual work and Mohr-Coulomb failure criteria. (20)

(b) Briefly describe the limitations of upper bound and lower bound theories in solving geotechnical problems. (5)

2(a) Define liquidity index. What type of soil should be used as a subgrade material? (4)

(b) Calculate ultimate bearing capacity of a strip foundation for the ground, where undrained shear strength is 100 kPa and angle of internal friction is zero, after deriving the respective equation by upper and lower bound theories. Neglect the unit weight of the ground. (10)

(c) The thickness of a NC clay layer is 4.0 m, void ratio is 0.95, primary compression index is 0.30, and secondary compression index is 0.025. An effective pressure of 200 kPa is applied at the center of the clay layer where the initial stress was 100 kPa. Calculate the total consolidation settlement of the clay layer 15 years after the completion of the primary consolidation where the primary consolidation finishes by 3 years. (11)

3(a) Answer the following questions for points ① to ④ shown in Fig.1 (18)

(i) Draw the graphs showing the relations of deviatoric stress (q) ~ deviatoric strain (ε_d), volumetric strain (ε_v) ~ deviatoric strain (ε_d), and stress ratio (q/p') ~ deviatoric strain (ε_d) in Triaxial Drain test under constant mean principal stress of clay.

(ii) Draw the graphs showing the relation of deviatoric stress (q) ~ effective mean principal stress (p') in Triaxial Undrain test of clay.

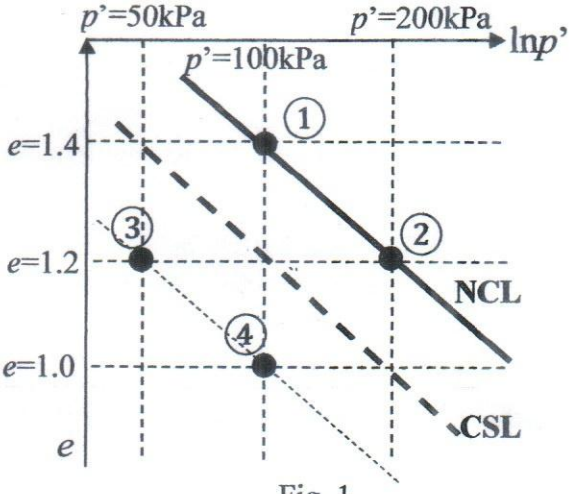

Fig. 1

3(b) Explain long term stability and short term stability in geotechnical problems showing the figures of deviatoric stress and mean principal stress for drain and undrain conditions. (7)

4(a) Write the stress tensors for various modes of deformation. (4)

(b) Draw various stress paths in principal stress space, triaxial plane and octahedral plane. (4)

(c) Briefly illustrates the factors that should be considered in the bearing capacity of shallow foundation. (5)

(d) Calculate the ultimate bearing capacity of a strip footing for the following two conditions. Where the width of the footing is 3.0 m which is placed 1.50 m from the ground surface, and the water table is located at the ground surface. Neglect the depth factors in the calculation. For both conditions, saturated unit weight of soil, $\gamma_{sat} = 19.8$ kN/m^3, and unit weight of water, $\gamma_w = 9.8$ kN/m^3. (12)

Use, $N_q = \frac{1+\sin\phi}{1-\sin\phi}\exp(\pi\tan\phi)$, and $N_c = (N_q - 1)\cot\phi$, $N_\gamma = (N_q - 1)\tan(1.4\phi)$ where required.

(i) Homogeneous soil with cohesion $c = 30.0$ kN/m^2, and angle of internal friction, $\phi = 32°$.

(ii) Homogeneous soil with cohesion $c = 100.0$kN/m^2, and angle of internal friction, $\phi = 0°$.

5(a) Derive the expression of active earth pressure for c -ϕ soil by lower bound theory using Mohr-Coulomb failure criteria. (12)

(b) Answer the following questions corresponding to the retaining structure shown in Fig.2. Consider no friction between the wall and the ground. (13)

(i) For active earth pressure condition, draw the distributions of the active earth pressure coefficient (K_a).

(ii) For passive earth pressure condition, draw the distributions of the passive earth pressure coefficient (K_p).

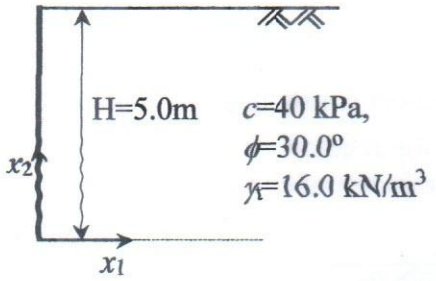

Fig.2

6(a) What is the critical depth in active earth pressure condition? Derive the expression of the critical depth (H_c) for both c -ϕ and c soils. (5)

(b) Answer the following questions related to Fig. 3. Use, $\gamma_t = 18.0$ kN/m^3 for all layers. (20)

(i) Draw Mohr circles for points A and B for illustrating the active stress conditions with the numerical value at each pole.

(ii) Draw lateral stress distributions for active and passive conditions.

(iii) Compute the active and passive earth pressures on the retaining wall from the lateral stress distributions.

(iv) Comments on the results regarding the stability of the retaining wall.

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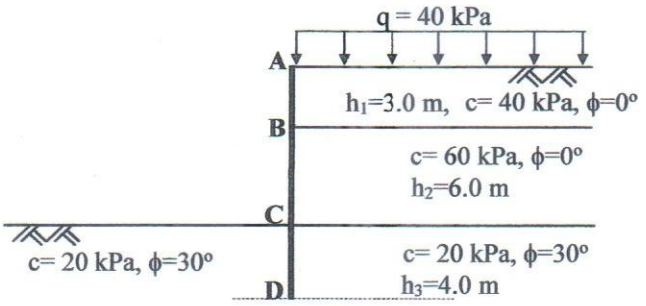

Fig.3

7(a) Why total-stress calculation is required for designing retaining wall? Explain why weep holes are kept in a retaining wall? (3)

(b) Briefly explain the procedures of determining soil parameters (cohesion and angle of internal friction) from the Direct shear test and Triaxial Consolidated Drain test. (5)

(c) What are the assumptions in the mathematical derivations of the Degree of Consolidation proposed by Terzaghi? Explain the drawbacks of the assumptions where applicable. (5)

(d) Derive the equation of factor of safety for a slope by Bishop Method. (12)