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7th June, 2018 (Morning)

B.Sc. Engg. (CEE)/ 1st Sem.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : Semester Final Examination — SUMMER SEMESTER: 2017-2018
COURSE NO. : CEE 4101 — TIME : 3.0 Hours
COURSE TITLE: Introduction to Civil Engineering — FULL MARKS: 100

There are 8 (Eight) questions. Answer any 6 (Six) questions including Question No. 1. Question No. 1 is compulsory to answer. 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) Mr. Loki is a very skilled person who has the capability of critical thinking. He also has excellent communications skill. From his childhood he was raised in a way to be a leader. He has finished his engineering education with good academics. Do you think these attributes are all he needs to be a successful engineer? Logically explain your answer. (8)

(b) Shallow foundations are constructed where soil layer at shallow depth (1.5 m) is able to support the structural loads. Discuss about different types of shallow foundations. (8)

(c) Write the name of the different sections in which construction equipment are categorized. Provide two examples for each. (4)

2 (a) Differentiate between the following terminologies: (10)

- Natural Environment and Built Environment
- Tension and Compression
- Framed Structure and Truss
- Interrupted Traffic Flow Facilities and Uninterrupted Traffic Flow Facilities

(b) In your opinion what are the contributions Geotechnical Engineers can make to the society? (6)

3 From the given data which was collected while conducting spot speed studies at certain length of a road within the urban area determine the following: (16)

- Average speed of traffic stream
- Modal speed of traffic Stream
- Upper and lower values of speed limit regulation
- Design speed for checking the geometric design

Spot Speed Test

Car No.	Speed (mph)	Car No.	Speed (mph)	Car No.	Speed (mph)	Car No.	Speed (mph)
1	38	16	47	31	54	46	53
2	37	17	41	32	43	47	49
3	43	18	35	33	52	48	48
4	53	19	36	34	47	49	46
5	46	20	41	35	42	50	45
6	43	21	38	36	36	51	54
7	41	22	48	37	51	52	38
8	39	23	42	38	38	53	44
9	43	24	48	39	54	54	51
10	49	25	41	40	52	55	55
11	47	26	45	41	37	56	40
12	50	27	48	42	49	57	39
13	55	28	46	43	35	58	43
14	52	29	45	44	40	59	41
15	49	30	43	45	53	60	55

4 (a) Define Ecology and Environment. (2)

(b) What are the fundamentals of Environmental Engineering? (2)

(c) It took the world around 300 years to increase in population from 0.5 billion to 4.0 billion. Assuming exponential growth at a constant rate over the period of time, what would that growth rate be? Also estimate the time required for this population to be doubled. (6)

(c) In your opinion what are the biggest threat to environment in recent times? (6)

5 (a) Write down about the scopes of Highway Engineering. What are the characteristics of road transportation? (7)

(b) Discuss about the basic concepts in Transportation System Modelling. (9)

6 (a) Draw a schematic diagram of a Wastewater Management Trickling Filter System and discuss about it's different parts. (9)

(b) Write about aerated water treatment systems with figure. (7)

7 (a) Discuss about different ways of collecting transportation survey data. (6)

(b) Define the most commonly used daily volume parameters. (4)

(c) From the traffic volume data given below find out the different daily volume parameters. (6)

Month	Total Monthly Volume (Veh)	Total Weekday Volume (Veh)
January	379261	207195
February	416501	206682
March	379430	207040
April	408874	206875
May	414448	205825
June	414605	209740
July	394864	207909
August	432011	208955
September	446708	205925
October	414753	207328
November	441844	206886
December	416467	208957

8 (a) Discuss about the compositions and purposes of the following cements: (10)

- Rapid Hardening Cement
- Pozzolanic Cement
- Quick Setting Cement
- White Cement
- Low Heat Cement

(b) The no. of trips per household size by auto ownership obtained from a regional study is given below. (6)

		Auto Ownership					
		0		1		2^+	
		HH	Trips	HH	Trips	HH	Trips
House -hold Size	1	1221	2542	514	1524	55	135
	2	875	2098	3546	9756	6200	20165
	3^+	1138	2587	2589	8026	8642	33504

Forecasted no of households in another study zone is given below. Estimate the probable total no. of trips for this zone.

		Auto Ownership		
		0	1	2^+
House -hold Size	1	25	125	3
	2	32	178	254
	3^+	12	88	51

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B. Sc. Engg. (CEE)/ 1st Sem. 24 May, 2018 (Morning)

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

Semester Final Examination **Summer Semester: 2017-2018**
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 data are taken from an old level book where some readings are missing (indicated by "?"). Some calculations (Rise/Fall/ R. L.) are also missing in the level book. Calculate all missing data and fill up the table. Apply necessary checks and draw the elevation of the land profile in figure. (20)

Station	Staff reading (m)			Rise(m)	Fall(m)	R. L.(m)	Remarks
	Back	Inter	Fore				
A	1.1						
B		?					
C	2.1		1.8		0.5		Turning point
D	?		4.1				Turning point
E			3.0	1.5		20.2	Bench Mark

(b) What is "Orientation of a Plane Table?" Discuss the methods of orientation of a Plane Table. (13 $\frac{1}{3}$)

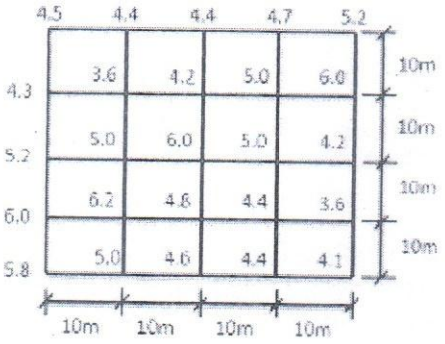
2(a) A closed traverse was conducted round an obstacle and the following observations were made. Work out the missing quantities. (20)

Side	Length(m)	Bearing
AB	500	$98^0 30'$
BC	620	$30^0 20'$
CD	468	$298^0 30'$
DE	?	230^0
EA	?	$150^0 10'$

(b) Define: (i) True Meridian and True Bearing (ii) Magnetic Meridian and Magnetic Bearing (iii) Arbitrary Meridian and Arbitrary Bearing (13 $\frac{1}{3}$)

3(a) Two broad guage lines meet at an angle 112^0 0'. It is the proposed to insert a circular curve of 8 chain radius with transition curve at each end. The speed of the train is 60 mph, super-elevation 6 inch and the gradient is 1/300. Calculate the necessary data to set out the combined curve (Chainage at the intersection point is 12.30 chain). (20)

(b) Using the following R. L. (m) data, draw the 4m, 5m, and 6m contour lines for the area shown in figure below. The R. L. (m) of the corner points of the 10 m X 10 m squares are indicated in the figure. (13 $\frac{1}{3}$)



4(a) Calculate the reduced levels of the various points on a vertical curve connecting gradients of -2% and +2%. The chainage and reduced level at the intersection point are 2000 m and 1000 m respectively. The allowable rate of change of grade is 0.1% per chain. (20)

(b) Define simple, complex and reverse curve. What is transition curve? What is its usage? (13 $\frac{1}{3}$)

5(a) The following observations were taken in a tacheometric surveying an anallactic tacheometer. The staff was held vertical at all times. (15 $\frac{1}{3}$)

Instrument Station	Staff Station	Whole Circle Bearing(WCB)	Vertical Angle	Stadia Reading(ft)
P	X	35^0	0	2.3, 2.55, 2.8
	Q	20^0	-2^0	2.6, 3.75, 4.9
	R	50^0	1^0	1.35, 3.8, 6.25

Given: PX= 50 ft, R. L. of X= 20 ft
Determine R. L. of Q
Determine the horizontal distance QR

(b) Find the elevation of the top of a chimney from the following data: (10)

Instrument Station	Reading on B. M.(m)	Angle of elevation	Remarks
A	0.862	$18^036'$	R. L. of B. M.= 421.380 m Distance AB= 50 m
B	1.222	$10^012'$	

Stations A and B and the top of the chimney are in the same vertical plane.

(c) Write down the advantages and disadvantages of plane table surveying. What are differences between chain surveying and traverse surveying? (08)

6(a) A straight embankment having level section has a formation level width of 20 m. Side slope is 2 horizontal to 1 vertical. Using the prismoidal rule, determine the volume of earthwork with the following data: (13)

Chainage(m)	0	50	100	150
Ground level(m)	12	8	6	4
Formation level(m)	8	8	8	8

(b) The scale of an aerial photograph is 1 cm= 20m. , photograph size is 24 cm X 24 cm. Determine the numbers of photographs required to cover an area of 30 km X 20 km, if the longitudinal overlap is 65% and the side lap is 25%. Also, calculate the distance between flight lines. (10)

(c) Describe the field works involved in a terrestrial photogrammetry. Discuss the different types of errors occurred in levelling. ($10\frac{1}{3}$)

7(a) A 30-m- long steel tape is supported at the ends. Find the normal tension for the tape with the following data: Cross section of the tape= $4mm^2$, weight of tape material= 0.0786 N/ mm^3, E= 2x 10^{11} N/m^2. The pull at which the tape is standardized is 100 N. (10)

(b) The following observations were recorded with a level: ($13\frac{1}{3}$)

Level Station Close to	Staff Reading(ft)	
	A	B
A	4.10	5.76
B	1.80	2.64

If the horizontal distance AB= 500 ft, determine the collimation error(angle between line of sight and horizontal), if any. Explain whether you need to consider effects of curvature and refraction here.

(c) Explain how the procedure of reciprocal levelling eliminates the effect of atmospheric refraction and earth's curvature as well as the effect of inadjustment of the line of collimation. (10)

8(a) What do you understand by remote sensing? Differentiate between active and passive remote sensing. (08)

(b) Write a note on the components of a GIS. (10)

(c) Define: (i) Ecliptic (ii) Hour Angle (iii) Solastices (iv) Equinoctial Points. Find the G. A. T. on April 22, 2018 when the G. M. T. is 6^h A. M. Given E. T. at G. M. N. on April 22, 2018= 10 min increasing at the rate of 1 sec per hour. ($15\frac{1}{3}$)

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. $C_p = \frac{(P-P_o)L}{AE}$	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. $H = \frac{1}{2}[(h_a - h_b) + (h_á - h_b)]$
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 = 2Rsin$\frac{\Delta}{2}$	51.tan $\theta = \frac{v^2}{gR}$
38. T = Rtan$\frac{\Delta}{2}$	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 = H$T_2(\frac{x}{L})^2$
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.Δ_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. May 30, 2018 (Group B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination — **Winter Semester: 2017-2018**
Course No.: Math 4153 — **Full Marks: 150**
Course Title: Differential and Integral Calculus, Matrix — **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 meanings.

1(a) Use numerical evidence to make a conjecture about the value of (10)

$$\lim_{x\to 0}\frac{1-\cos x}{x}$$

Hence verify your answer analytically.

(b) Find values of the constants k and m, if possible, that will make the function continuous everywhere. (10)

$$f(x)=\begin{cases} x^2, & x>2 \\ m(x+1)+k, & -1<x\le 2 \\ 2x^3+x+7, & x\le -1 \end{cases}$$

(c) Find all values in the interval $[-2\pi, 2\pi]$ at which the graph of (5)

$f(x)=x-\cos x$ has a horizontal tangent line.

2(a) Discuss the continuity and differentiability of the of the function (15)

$$f(x)=\begin{cases} x^2+2, & x\le 1 \\ x+2, & x>1 \end{cases}$$

at $x = 1$. Also sketch the graph of $f(x)$.

(b) Find an equation for the tangent line to the lemniscates (10)

$2(x^2+y^2)^2=25(x^2-y^2)$ at the point $(3,1)$

3(a) Find the radius and height of the right circular cylinder of largest volume that can be inscribed in a right circular cone with radius 6 inches and height 12 inches. (10)

(b) Find the radius of curvature of the parabola $y^2 = 4x$ at the vertex $(0,0)$. (5)

(c) Suppose that $w = x^2 + y^2 - z^2$ and $x = \rho \sin\varphi \cos\theta$, $y = \rho \sin\varphi \sin\theta$, $z = \rho \cos\varphi$. (10)

Find $\frac{\partial w}{\partial \rho}$ and $\frac{\partial w}{\partial \theta}$.

4(a) Evaluate (10)

$\int_0^{10} \left(x + \sqrt{10x - x^2}\right) dx$ by applying appropriate formulas from geometry.

(b) Evaluate (5)

$\int_{\pi^2}^{4\pi^2} \frac{\sin\sqrt{x}}{\sqrt{x}}\, dx$

(c) Prove that (10)

$$\int \sin^n x\, dx = -\tfrac{1}{n} \sin^{n-1} x \cos x + \tfrac{n-1}{n} \int \sin^{n-2} x\, dx$$

and hence evaluate $\int \sin^6 x\, dx$.

5(a) Evaluate (10)

$\int \frac{\sqrt{x^2-9}}{x}\, dx$, by assuming that $x \geq 3$.

(b) Evaluate (5)

$\int \sin^5 x \cos^4 x\, dx$

(c) Evaluate (10)

$\int_0^{+\infty} (1 - x)\, e^{-x} dx$

6(a) Find the volume of the tetrahedron bounded by the planes (10)

$$x + 2y + 3z = 6, \quad x = 0, \quad y = 0, \quad z = 0$$

by using triple integral.

(b) Find, for what values of a and b the system (15)

$$\begin{aligned} ax + \quad & bz = 2 \\ ax + ay + 4z &= 4 \\ ay + 2z &= b \end{aligned}$$

has

(i) a unique solution.
(ii) a one-parameter solution.
(iii) a two-parameter solution.
(iv) no solution.

Justify your answer.

7(a) State Cayley-Hamilton theorem. Verify the Cayley-Hamilton theorem for (10)

the matrix $A = \begin{bmatrix} 1 & -1 & 1 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$. Hence find A^{-1}.

(b) Find the eigenvalues and the corresponding eigenvectors and eigenspaces of the (15)

matrix

$$A. = \begin{bmatrix} 5 & 6 & 2 \\ 0 & -1 & -8 \\ 1 & 0 & -2 \end{bmatrix}.$$

Also determine whether the matrix is diagonalizable or not. Justify your answer.

8(a) Solve the following system of linear equations, if consistent (15)

$$\begin{aligned} 2x + y - 2z - 2w &= -2 \\ -x + 2y - 4z + w &= 1 \\ 3x \qquad\quad - 3w &= -3 \\ x - y + 2z - w &= -1 \end{aligned}$$

Also find the rank of the coefficient matrix.

(b) Find the inverse (10)

of $A = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \\ -1 & 1 & 1 \end{bmatrix}$ by using elementary row operations. Hence

express A as a product of elementary matrices.

B.Sc. Engg. (CEE)/ 1st Sem. 05 June, 2018 (Morning)

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

TERM : SEMESTER FINAL EXAMINATION — WINTER SEMESTER: 2017–2018
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 is interference of light? Distinguish between constructive and destructive interferences of light. **(08)**

   (b) Discuss Young's double-slit experiment and hence obtain expressions of the fringe distance and fringe separation. **(12)**

   (c) Green light of wavelength 5100 Å emitted from a narrow source is incident on a double-slit. If the overall separation of 10 fringes on a screen 200 cm away from the slit is 2 cm, find the slit separation. **(05)**

2. (a) Describe Lloyd's experiment and write down the conclusions of the results about the phase change of light obtained from this experiment. State and prove Stoke's theorem on phase change of light. **(12)**

   (b) For the case of a wedge-shaped film, show that $\beta = \frac{\lambda}{2\mu\theta}$. **(08)**

   (c) A parallel beam of light of wavelength 5890 Å is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction into the plate is 60°. Calculate the smallest thickness of the glass plate which will appear dark by reflection. **(05)**

3. (a) Discuss how Newton's rings are formed. **(05)**

   (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. **(15)**

   (c) In a Newton's rings experiment the diameter of the 15th ring was found to be 0.59 cm and that of the 5th ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, calculate the wavelength of light. **(05)**

4. (a) What do you mean by Fresnel and Fraunhofer diffractions of light? **(04)**

   (b) In a Fraunhofer type of diffraction through a double-slit, find the expression of intensity of the diffracted light on a screen and also find the condition of missing order. **(16)**

   (c) In a Fraunhofer diffraction due to a narrow slit, a screen is placed 2 m away from the lens to obtain the diffraction pattern. If the slit width is 0.2 mm and the wavelength of light used is 5000 Å, find the distance of first minima from the central maximum. **(05)**

5. (a) What do you understand by polarization of light? Write down the names of methods by which light can be polarized. **(05)**

   (b) Discuss and explain how white light can be plane polarized by reflection and refraction. **(15)**

   (c) How will you orient a polarizer and an analyzer so that a beam of natural light is reduced to half of its original intensity? **(05)**

6. (a) Write down the assumptions of the kinetic theory of gases? **(05)**

   (b) Derive an expression for the pressure exerted by gas on the basis of kinetic theory. **(15)**

   (c) At what temperature will oxygen molecules have the same root mean square velocity as that of hydrogen molecules at $-100^{\circ}C$? **(05)**

7. (a) Describe the terms isothermal, isobaric and adiabatic processes? **(06)**

   (b) Using the first law of thermodynamics, obtain the gas equations for an adiabatic process. **(14)**

   (c) A motor car tyre has a pressure of 2 atmospheres at the room temperature of $27^{\circ}C$. If the tyre bursts at 1 atmospheric pressure, find the resulting temperature. The ratio of specific heats, $\gamma=1.4$. **(05)**

8. (a) What is Carnot's heat engine? State the second law of thermodynamics. **(06)**

   (b) State and prove the Carnot theorem for all reversible engines. **(14)**

   (c) A Carnot engine operates between a hot reservoir at 200 °C and a cold reservoir at $100^{\circ}C$. If the engine absorbs 5000 cal heat at the hot reservoir, how much work in Joule does it deliver? **(05)**

B.Sc. Engg. (CEE)/ 3rd Sem. 29 May, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : FINAL SEMESTER EXAMINATION WINTER SEMESTER : 2017-2018
COURSE NO. : CEE 4311 TIME : 3.0 Hours
COURSE TITLE : **Mechanics of Solids I** FULL MARKS : 150

There are 8 (Four) questions. Answer any 6 (Three) 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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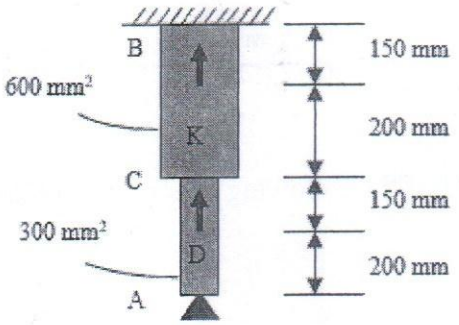
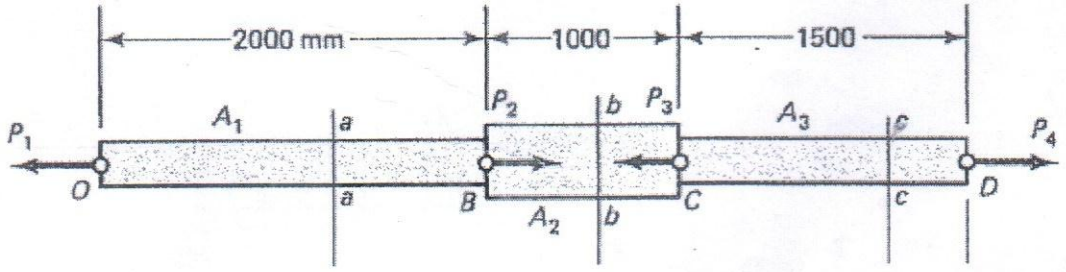
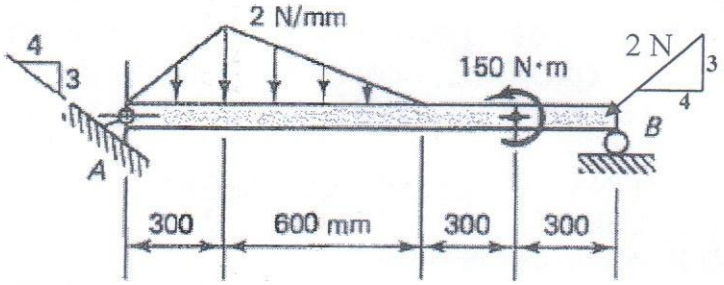
1. a) Determine the reactions at A and B for the steel bar and loading shown, assuming a close fit at both supports before the loads are applied. (10)



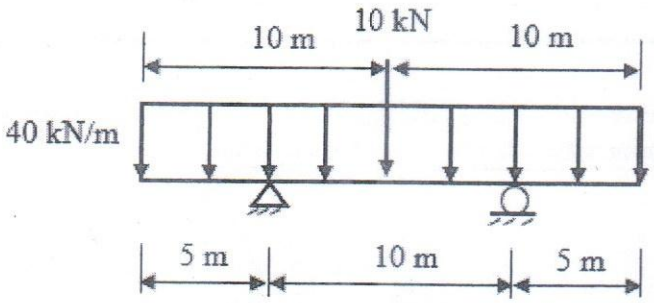
b) Determine the relative displacement of point D from point O for the elastic steel bar of various cross-sections shown below caused by the application of concentrated force P_1 = 100 kN and P_3 = 300 kN acting to the left, P_2 = 250 kN and P_4 = 50 kN acting to the right. The respective areas of the bar segments OB, BC, and CD are 1000, 2000, and 1000 mm^2. Let E = 200 GPa. (15)



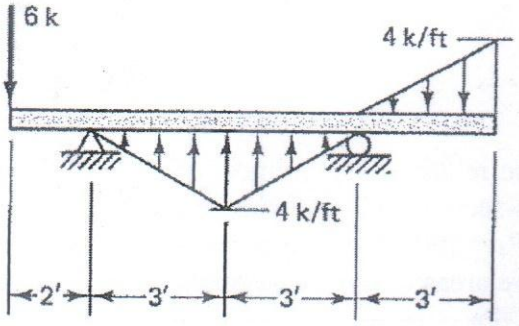
2. a) Draw AFD, SFD, and BMD for the following beam (***use section method***) (12)



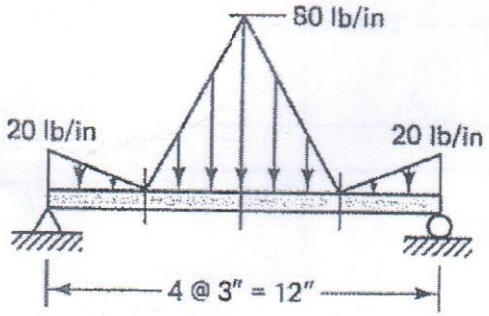
b) Draw SFD, BMD of the following beam. (***Use section method***) (13)



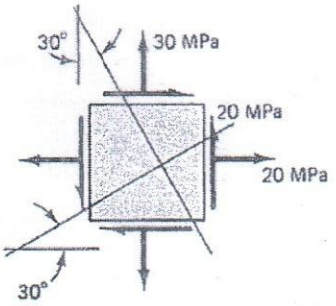
3. a) Draw SFD, BMD of the following beam. (***Use section method***) (10)



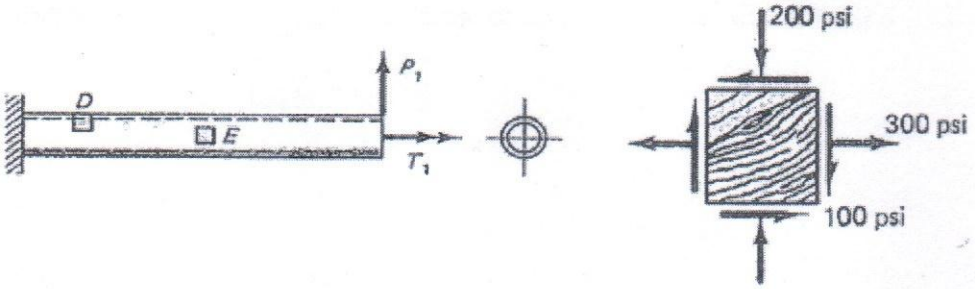
b) Draw SFD, BMD of the following beam. (***Use intigration method***) (15)



4. a) For the infinitesimal element shown in the figure, find the normal and shearing stresses acting on the indicated inclined plane. Use the "wedge" method of analysis. (15)



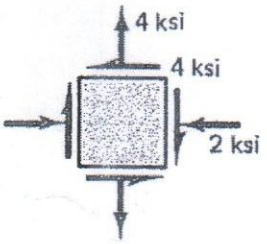
b) At a particular point, *E*, in a wooden member, the state of stress is shown below is as shown in the figure. The direction of grain in the wood makes angle of $+30^0$ with the horizontal. The allowable shear stress parallel to the grain is 150 psi for this wood. Is this state if stress permissible? Verify your answer by calculation. (10)



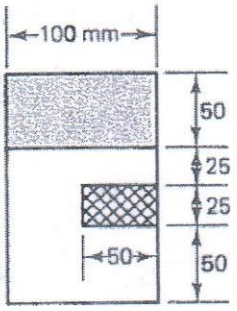
5. a) For the following data, using Mohr's circle of stress and trigonometry, (17)
   i. find the principal stresses,
   ii. find the maximum shear stresses and associated normal stresses.

   For each case show their sense on a properly oriented isolated elements, where $\sigma_x = +50$ MPa, $\sigma_y = +30$ MPa, and $\tau = +20$ MPa

   b) Using Mohr's circle of stress and trigonometry, find the stresses acting on $\theta = +30^0$ for the element shown below. (08)

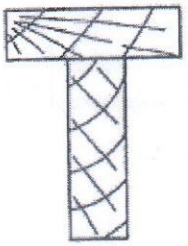


6. a) A beam of rectangular cross-section with the dimension shown in the figure is subjected to a positive bending moment of 16000 N-m acting around the horizontal axis. (i) Find compressive force acting on the shaded area of cross-section developed by the bending stress, (ii) Find the tensile force acting on the cross-hatched area of the cross-section. (17)

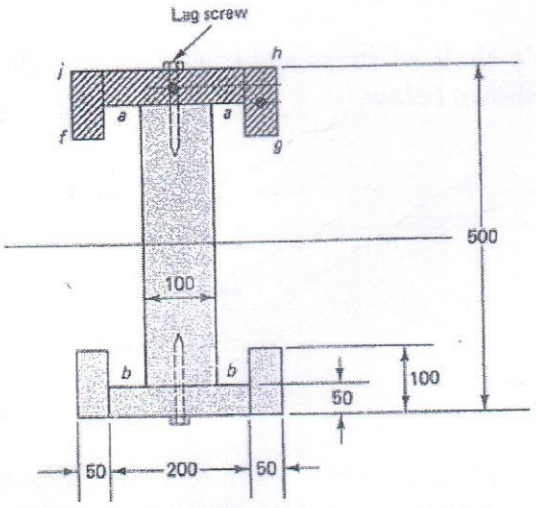


b) Two 2 x 6 in full-sized wooden planks are glued together to form a T-section, as shown in the figure. If a positive bending moment 2270 ft-lb is applied around the horizontal axis, (08)

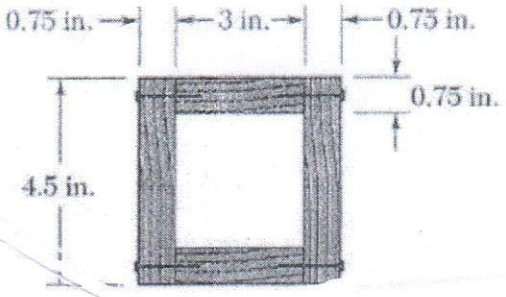
i. Find the stresses at the extreme fibers,
ii. Calculate the total compressive force developed by the normal stresses above the neutral axis,
iii. Find the total force due to tensile bending stresses and compare it with (ii).



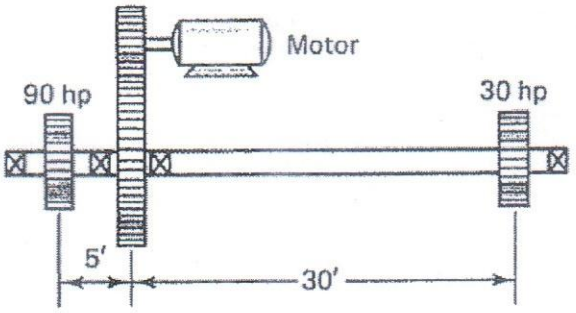
7. a) A simple beam on a 10 m span carries a load of 8 kN/m with an additional self-wt. of 2 kN/m. The beam is made of several wooden pieces. Specify the spacings for the 10 mm lag screws along the length of beam for x = 0 m, 2 m, 4 m, and 6 m. which are necessary to fasten this beam together. Assume that one 10 mm lag screw is good for 2 kN when transmitting lateral load paralel to the grain of the wood. For the entire section, I is equal to 2.36 x 10^9 mm^4. (*All dimensions in the figure are in mm*) (17)



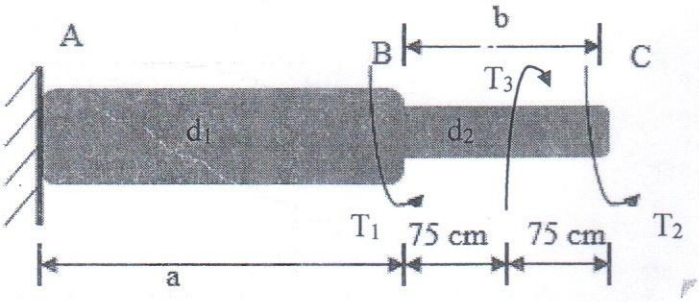
b) A square beam is constructed from four plans as shown. Knowing that the spacing between the nails is 2.5 in and the beam is subjected to a vertical shear of magnitude V = 800 lb, determine the shearing force in each nail. (08)



8. a) A motor through a set of gears, drives a line shaft as shown in the figure at 630 rpm, 30 hp are delivered to a machine on the right; 90 hp on the left. Select a solid round shaft of the same size throughout. The allowable shearing stress is 5750 psi. (17)



b) A stepped steel shaft ($G = 84 \times 10^4$ kg/m^2) as shown in the figure is subjected to a torque $T_1 = 7500\pi$ kg-cm, $T_2 = 2500\pi$ kg-cm, $T_3 = 1500\pi$ kg-cm. For this shaft, $a = 450$ cm, $b = 150$ cm, and diameter $d_2 = 5$ cm. Find the minimum permissible diameter d_1 for the shaft from A to B if the allowable shearing stress is 450 kg/cm^2 and the total twist between A and C is limited to 3^0. (08)



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B.Sc. Engg. (CEE)/ 3rd Sem.

25th May, 2018

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

Semester: Semester Final Examination — **Winter Semester: 2017-2018**

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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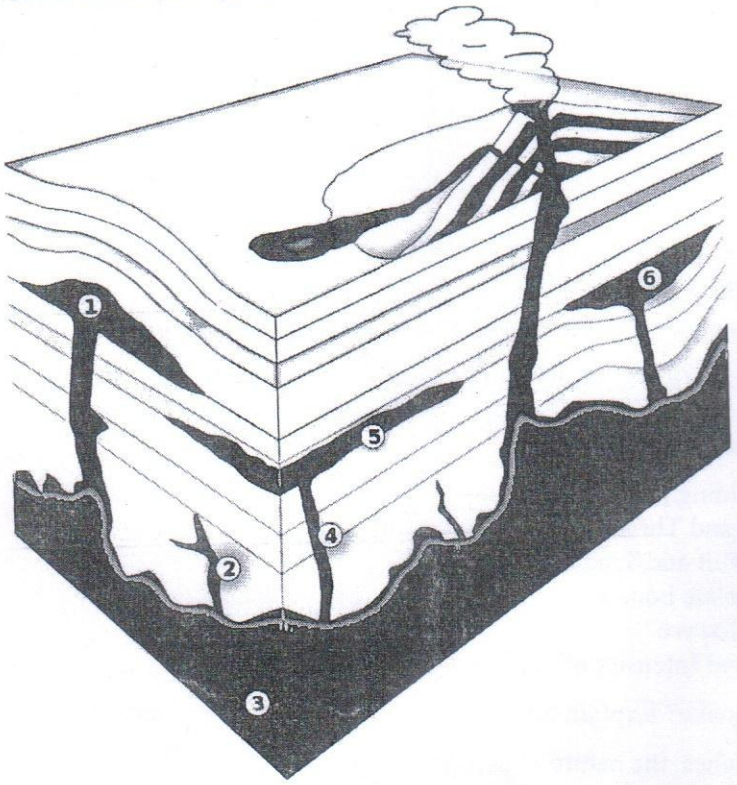
1 (a) Describe the composition and properties of the following minerals: (10)

(i) Olivine
(ii) Quartz

(b) Draw a sectional sketch illustrating the way SiO_4 tetrahedra are bound together in sheets that are joined by K, Na or Ca ions in Mica minerals. (10)

(c) What do you mean by hardness of a mineral? (05)
"A common misunderstanding of how to identify a diamond is that it will scratch glass." – Explain with reference to Mohs Hardness scale.

2 (a) Identify the different types of plutonic igneous rock masses in the following figure and write their names (no need to draw the figure): (03)



(b) Identify the type to which the following rocks belong and describe their composition and properties (answer any three): (09)

(i) Dolomite (ii) Basalt (iii) Sandstone (iv) Gabbro
(v) Gneiss (vi) Phyllite

(c) Write the uses of the following rocks as construction materials: (04)

(i) Granite (iii) Sandstone (iii) Limestone (iv) Quartzite

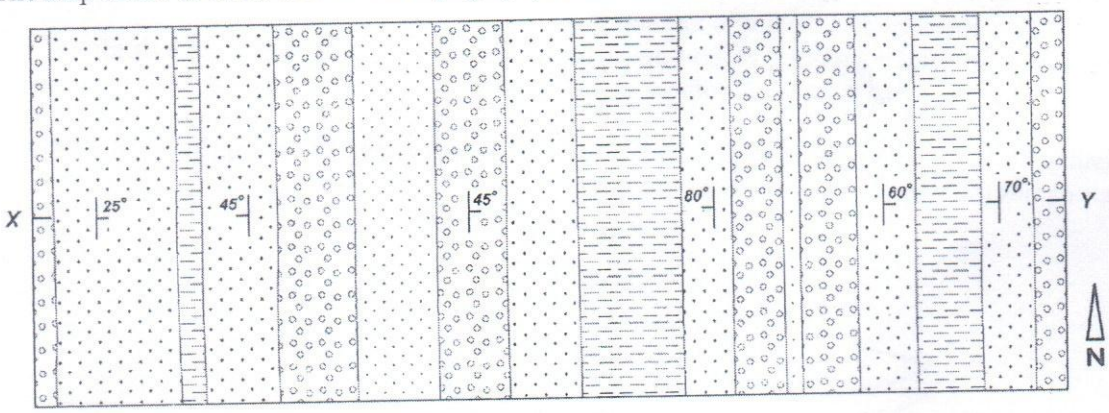
(d) Differentiate between: (09)

(i) Clastic and Non-clastic texture of sedimentary rock
(ii) Contact and Regional Metamorphism
(iii) Foliated and Non-foliated texture

3 (a) What is meant by the term "Texture" of a rock? Briefly describe different types of textures found in igneous rock and metamorphic rocks with examples. (18)

(b) "The rate of crystallization varies with depth and rate at which magma crystallizes, influences the extent to which Fractionation and Reaction takes place"- Explain briefly (07)

4 (a) The map below is of an area of flat topography. Draw the XY cross section. (08)



(b) Draw the map view and oblique schematic of a horizontal symmetrical anticline with all important parts and features labeled. (05)

(c) Describe the following terms/structures. Use neat sketch in each case. (12)

(i) Isoclinal Fold (ii) Recumbent Fold (iii) Strike-Slip Fault (iv) Oblique-Slip Fault

5 (a) Differentiate between (answer any 4): (12)

(i) Concentric folding and Flow folding
(ii) Normal fault and Thrust fault
(iii) Transform fault and Transcurrent fault
(iv) Convergent plate boundary and Divergent plate boundary
(v) P-wave and S-wave
(vi) Magnitude and Intensity of Earthquake

(b) What is an earthquake? Explain the elastic rebound theory of earthquake. Use neat sketches. (07)

(c) Explain with sketches, the nature of seismicity at different types of plate boundaries. (06)

6 (a) Explain using neat sketches how you would determine the magnitude of an earthquake and also the location of its epicenter. (15)

(b) Write down the names of the major faults in Bangladesh. What factors lead to the likelihood of a major earthquake in Bangladesh? (10)

7 (a) What is Rational Method? What are the assumptions of this method? Explain how to calculate the runoff coefficient of an area on the earth surface which has different land uses within the same basin. (12)

(b) With necessary diagrams, explain the channel cross-sectional changes during one flood season. (13)

8 (a) Write the names of the processes through which "Valley Deepening", "Valley Widening" and "Valley Lengthening" take place. (06)

(b) Classify valleys according to stage in geomorphic cycle. Mention the characteristics of each type. Show the types in a diagram. (07)

(c) Explain briefly the mechanisms of bed load movement. (06)

(d) Write the names of the factors controlling the equilibrium of a stream. Explain how the shape of a stream changes due to river bank erosion. (06)

B.Sc. Engg. (CEE)/ 3rd Sem. May 23, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : GS 4353 TIME : 3.0 Hours
COURSE TITLE: Numerical Analysis 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) What is numerical computing? Briefly discuss the characteristics of numerical computing. (5)

   (b) A simply supported beam is loaded in such a way that the value of Shear force (kip) at a distance x (ft) from the beam is, (15)

   $$V(x) = \frac{1}{4}Lw - \frac{w}{L}x^2 \ (for\ x = 0\ to\ x = L/2)$$

   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. (At x = 0 ft, bending moment M = 0 $kip - ft$)

   (c) The derivative $f'(x)$ of a function $f(x)$ can be approximated by the equation, (5)

   $$f'(x) = \frac{f(x+h) - f(x)}{h}$$

   If $f(x) = \sin(x)$ and $h = 0.15$, then find

   i) the approximated value of $f'\left(\frac{3}{4}\pi\right)$
   ii) true value of $f'\left(\frac{3}{4}\pi\right)$
   iii) true error of (i) and also relative true error.

2. (a) Write down the output of the following expressions in *Python 3.6.3* Shell. Also show the steps for calculation according to the operator precedence with proper explanations: (20)

   i) `4+round(11/3,3)**3//7*int(11/3,3)`
   ii) `bool(False)*4+2*float(3)//4**1.5`
   iii) `"Something"[0:-5]+"Anywhere"[3:8]`
   iv) `7**len('ijklmo qrst')//3%2`
   v) `53+(7!=4)**12-42>0`

(b) Use Newton-Raphson method to find the root of the equation $x^3 - x - 1 = 0$ using an initial guess of x = 1.5. ($\varepsilon_s = 10^{-7}\%$) (5)

3. (a) The Maclaurin series expansion for $\cos x$ is (8)

$$\cos x = 1 - \frac{x^2}{2} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} - \cdots$$

Starting with the simplest version, $\cos x = 1$, add terms one at a time to estimate $\cos(\frac{\pi}{3})$. 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.

(b) Find out the value of deflection at 'A' of the following simply supported beam as shown in **Fig. 1**: (17)

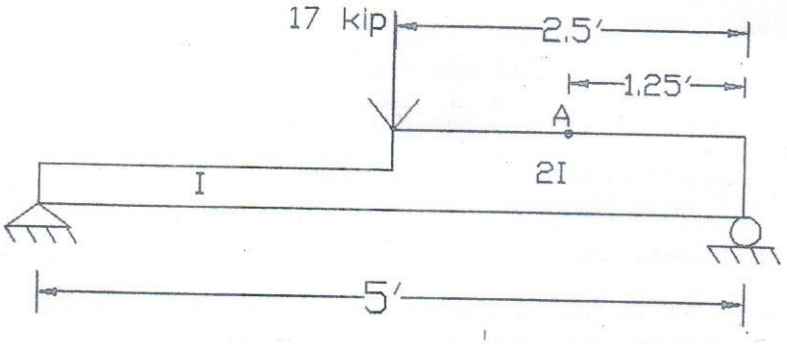

Fig. 1

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

Prepare Romberg's table to get satisfactory result until the stopping criteria ($\epsilon_s = 0.01$) is satisfied.

4. (a) Write down commands within a *Python 3.6.3* 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: (16)

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.

(b) Find out the errors/flaws within the following script statements which will hamper the desired program to be run properly in *Python 3.6.3* IDLE shell. (9)

```
'''A program to find out the greatest number among
three number''
x,y,z = float(input('Enter the first number: '))\
      float(input('Enter the second number: ')),
      float(input('Enter the third number: '))
If x>y and x<z
    print("x is the greatest)
elif y>z
    print("z is the greatest")
else
    print("y is the greatest")
```

5. (a) Roads and Highways Department (RHD) has decided to calibrate fundamental parameters of a specific highway based on Underwood's exponential model. For that, they've collected a few data of speed, $v\ (km/hr.)$ and density, $\rho\ (pcu/km)$ from a specific region of that highway which are provided below: (16)

Speed, $v(km/hr.)$	26.1	31.6	37.2	45.4	50.1
Density, $\rho(pcu/km)$	4137	3111	2341	1455	866

Fit the data according to Underwood's model and predict speed when density of the highway is 1000 pcu/km.

Note that, Underwood's exponential model is expressed by: $v = v_f e^{-\frac{\rho}{\rho_0}}$

where,

v_f = free flow speed $(km/hr.)$

ρ_0 = optimum density or density regarding maximum flow (pcu/km)

(b) Suppose a civil engineer needs to analyze a cantilever beam for his project. For solving that beam, different known conditions have been applied and the following equations are obtained: (9)

$$\begin{aligned} 5R_{ax} &+ 6R_{ay} - 8M = 11 \\ -7R_{ax} &- 9R_{ay} + 17M = 21 \\ 12R_{ax} &- 5R_{ay} + 3M = -1 \end{aligned}$$

What would be the solution of this system of linear equations? Use Gauss Elimination technique.

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6. (a) A programmer with civil engineering background has created two *Python 3.6.3* 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: (20)

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 3.6.3* 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) What do you understand by "Specifications" in Python programming? Why specifications should be used in programming? (5)

7. (a) Experimentally observed value of deflection of a beam are shown in **Fig. 2**. Estimate the bending moment at points: -2, -1, 0, +1, +2. (12)
Given, $E = 29 \times 10^6\ psi,\ I = 1000\ inch^4$

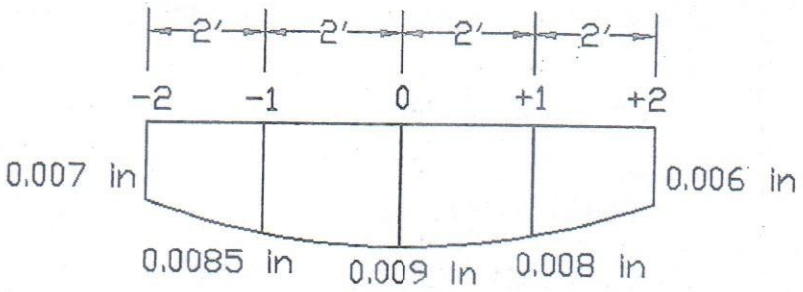

Fig. 2

(b) Write down a script using recursive algorithm in *Python 3.6.3* for the following series with appropriate specifications and assertions, which will generate summation upto n-th term: (9)

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

(c) Briefly discuss categories of bug in programming language? (4)

8. (a) A beam of length $L\ ft$ shown in **Fig. 3** is loaded with two different loading arrangements for which equations of bending moments are given below. (9)

$$M_1 = 2Lx - x^2 + L/5\ \ (kip - ft)$$
$$M_2 = 3Lx - x^3 + L/2\ \ (kip - ft)$$

Write down a function inscribed script in *Python 3.6.3* which will take length as function input and create two different Lists of moment for the points A, B, C and D respectively i.e., $[M_A, M_B, M_C, M_D]$ for two different loading arrangements for which equations have been provided. Finally using map function it will result in the maximum values of moments comparing two Lists for those specified points.

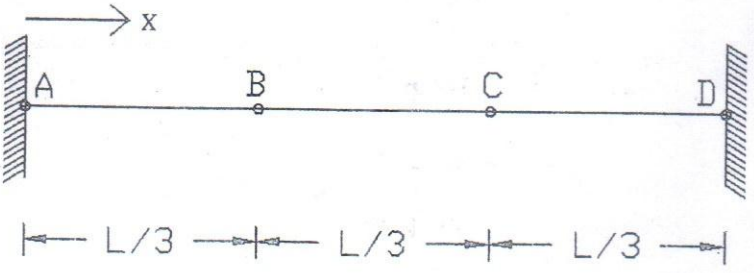

Fig. 3

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(b) Department of Civil and Environmental Engineering (CEE) of IUT has taken a scheme to develop a Python program to sum up students' obtained marks for sessional courses conforming to 1.5 credit hours/week; using weightages of attendance, lab-reports, viva and final quiz. Details information have been provided below: (16)

Sl. No.	Marks Category	Weightage	Full Marks
1	Attendance	0.10	15
2	Lab-reports	0.20	30
3	Viva	0.20	30
4	Final Quiz	0.50	75

Sometimes viva marks could exist as Grades; of which equivalent marks are shown below:

Viva Grades	Equivalent Marks
A+	30
A	25
A-	20
B+	15
B	10
C	5
D	2
F	0

Create a script inscribed by multiple functions in *Python 3.6.3* according to the following instructions:

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

`subject` will be a List having the names of the student and ID as well as 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 for every student.

Also allow exceptions for `ZeroDivisionError` to return 0.0 as students may be absent and also allow exceptions for `TypeError` for grades to convert into marks.

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B.Sc. Engg. (CEE)/ 3rd Sem. 31st May, 2018 (Group-A).

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

Semester Final Examination **Winter Semester: 2017-2018**
Course No.: CEE 4361 **Full Marks: 150**
Course Title: Fluid Mechanics **Time: 3 hours**

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

1(a) Define : i) Ideal fluid ii) Streamline iii) Unsteady flow iv) Center of Pressure (8)

(b) For a two dimensional flow, the stream function is given by $\Psi = 2x^2 - y^2$. Calculate the velocity at the point (2,3) (5)

(c) A space 16 mm wide between two large plane surfaces is filled with SAE 30 Western lubricating oil at 35°C (Figure 1). What force F is required to drag a very thin plate of 0.4 m^2 area between the surfaces at a velocity of 0.25 m/s for the following conditions: (Assume, μ 0.18 N. s/m^2) (12)

i) If the plate is equally spaced between the two surfaces.

ii) If the plate is at a 5 mm distance from one surface.

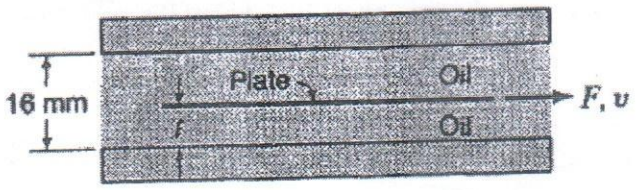


Figure 1

2 (a) Write short notes on : (5)

i) Differential manometer

ii) Flow net

(b) The velocity distribution in a 5 cm radius pipe is given by Figure 2 (10)

$$u = 5\left(1 - \frac{r^2}{25}\right) cm/s$$

where, r is in cm. Find the shear stress at the pipe wall if the fluid has a viscosity of 2 centipoise. What is the resistance force per km length of pipe due to flow?

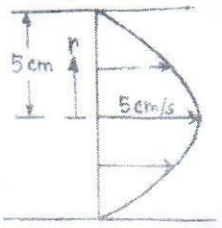


Figure 2

(c) A triangular plate of 1 m base and 1.5 m altitude is immersed in water as shown in Figure 3. The plane of the plate is inclined at 30^0 with the free surface of water and the base is parallel to and at a depth of 2 m from the free surface. Find the total pressure force on the plate and the position of the center of pressure. (10)

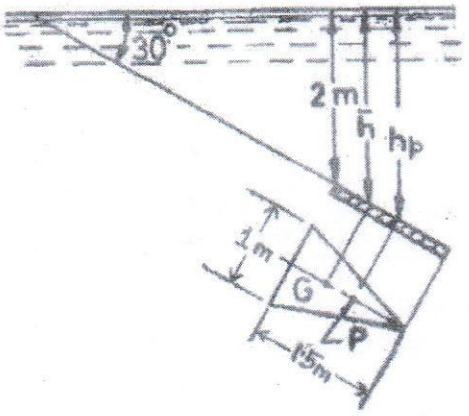


Figure 3

3 (a) Derive Bernoulli's equation for steady, incompressible and frictionless fluid. (10)

(b) A pipe AB branches into two pipes C and D as shown in Figure 4. The pipe has diameter of 40 cm at A, 25 cm at B, 20 cm at C and 25 cm at D. Determine the discharge at A, if the velocity at A is 3 m/s. Also, determine the velocity at B and D, if the velocity at C is 7 m/s. (8)

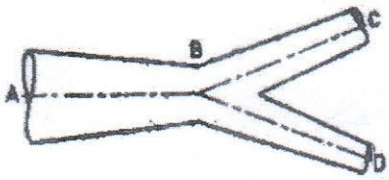


Figure 4

(c) A 20 HP pump working with 75% efficiency is discharging crude oil (sp. gr. = 0.9) to the overhead tank shown in Figure 5. If losses in the whole system is 1.5 m of flowing fluid, find the discharge. (7)

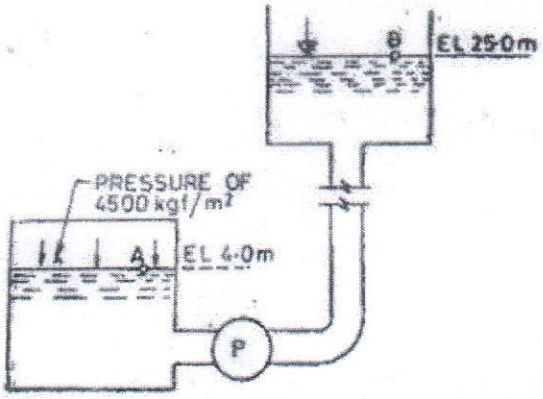


Figure 5

4 (a) Determine the magnitude and direction of the force on the double nozzle of the Figure 6. Both nozzle jets have a velocity of 12 m/s. The axes of the pipe and both nozzles all lie in a horizontal plane. Assume unit weight of water to be 9810 N/m^3. Neglect friction. (12)

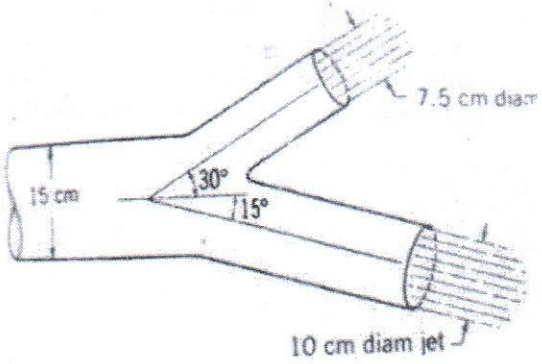


Figure 6

(b) A 70 cm pipe is supplied with water from a reservoir A (Figure 7), and at a point P it is divided into two branches of 50 cm and 35 cm in diameter, which discharges into reservoir B and C, respectively. Length of 70 cm pipe is 650 m, length of 50 cm pipe is 900 m and length of 35 cm pipe is 500 m. The surface level in A, B and C and the level at P are 35,24, 18 and 28 m above datum, respectively. Find the velocity of flow and discharge in each pipe. Tale f = 0.03. Neglect losses other than due to friction. (13)

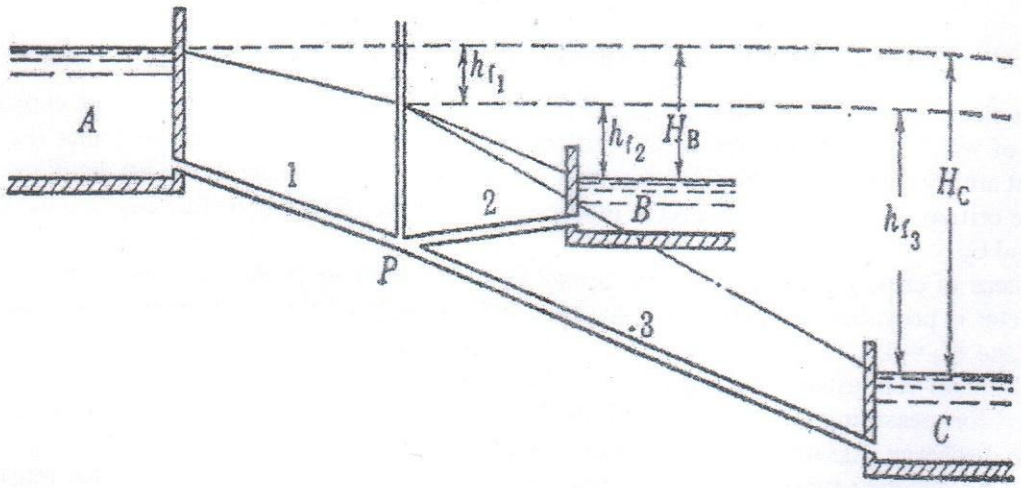


Figure 7

5 (a) Derive the Hazen-Poiseuille equation for laminar flow. (12)

(b) Water at 20^0 C flows in a 35 cm diameter welded steel pipe (k=0.045 mm). If the energy gradient is 0.008, determine the flow rate. Find also the nominal thickness of the viscous sub layer. Assume kinematic viscosity to be 10^{-6} m^2/s. Use the Moody diagram attached at the end of the question. (13)

6(a) A pipeline 45 m long is connected to a water tank at one end and discharges freely into the other end. For the first 25 m of its length from the the tank, the pipe is 12 cm in diameter and then its diameter suddenly enlarges to 30 cm. The height of water level in the tank is 10 m above the center of the pipe. Considering all losses of head which occur, determine the rate of flow. Assume, f = 0.020 for both the pipes. (10)

(b) Three pipes A, B and C are interconnected as shown in Figure 8. Find the rate at which water will flow in each pipe. Neglect minor losses. The pipe characteristics are as follows: (15)

Pipe	D (cm)	L (m)	f
A	20	620	0.020
B	15	500	0.032
C	25	1250	0.024

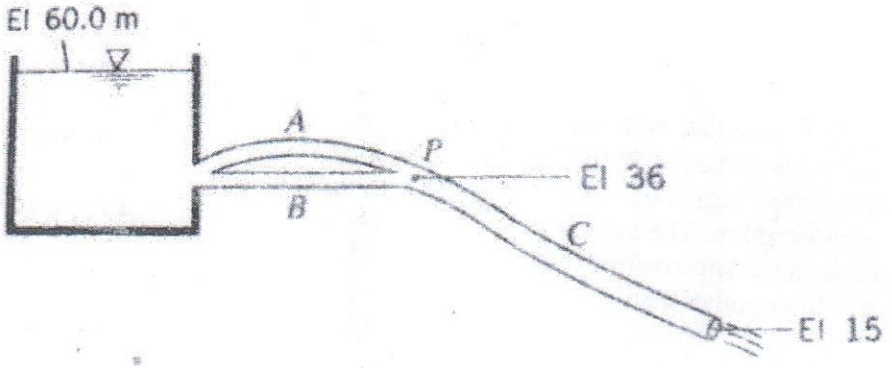


Figure 8

7 (a) What is vena contracta? Differentiate between external mouthpiece and internal mouthpiece. (5)

(b) Water flows through a circular orifice 3.5 cm in diameter in the side of a tank. The constant head of water above the center of the orifice is 70 cm. The coordinates of the center line of the jet are 25 cm horizontally from the vena contracta and 3 cm vertically below the diameter of the orifice. The discharge from the orifice is 1.2 liter/sec. Find the orifice coefficients C_d, C_v and C_c. (8)

(c) A cistern of cross-sectional area 1 m^2 contains water 5 m deep. A circular orifice 50 mm in diameter is provided at its bottom. What time will be required for the water level to fall 1.6 m? Take $C_d = 0.6$ (7)

(d) A horizontal venturimeter having a throat of 12 cm in diameter is installed in 25 cm pipe and is used for measuring the flow of oil. If the difference in pressure head is 2.5 m, calculate the actual discharge. Assume the discharge coefficient to be 0.98. (5)

8 (a) Name the different types of losses in pipe flow. Write down the two conditions that must be satisfied for the solution of pipe network problems. (5)

(b) If the flows into and out of a two-loop pipe systems are as shown in the Figure 9, determine the flow in each pipe. The K values for each pipe were calculated from the pipe and minor loss characteristics and from an assumed value of f. Assume, n=2. Perform at least 2 trials (20)

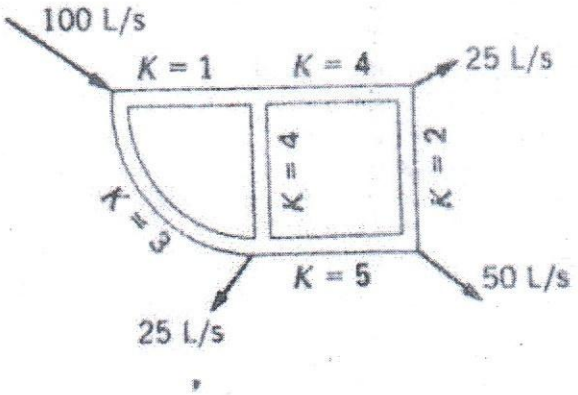
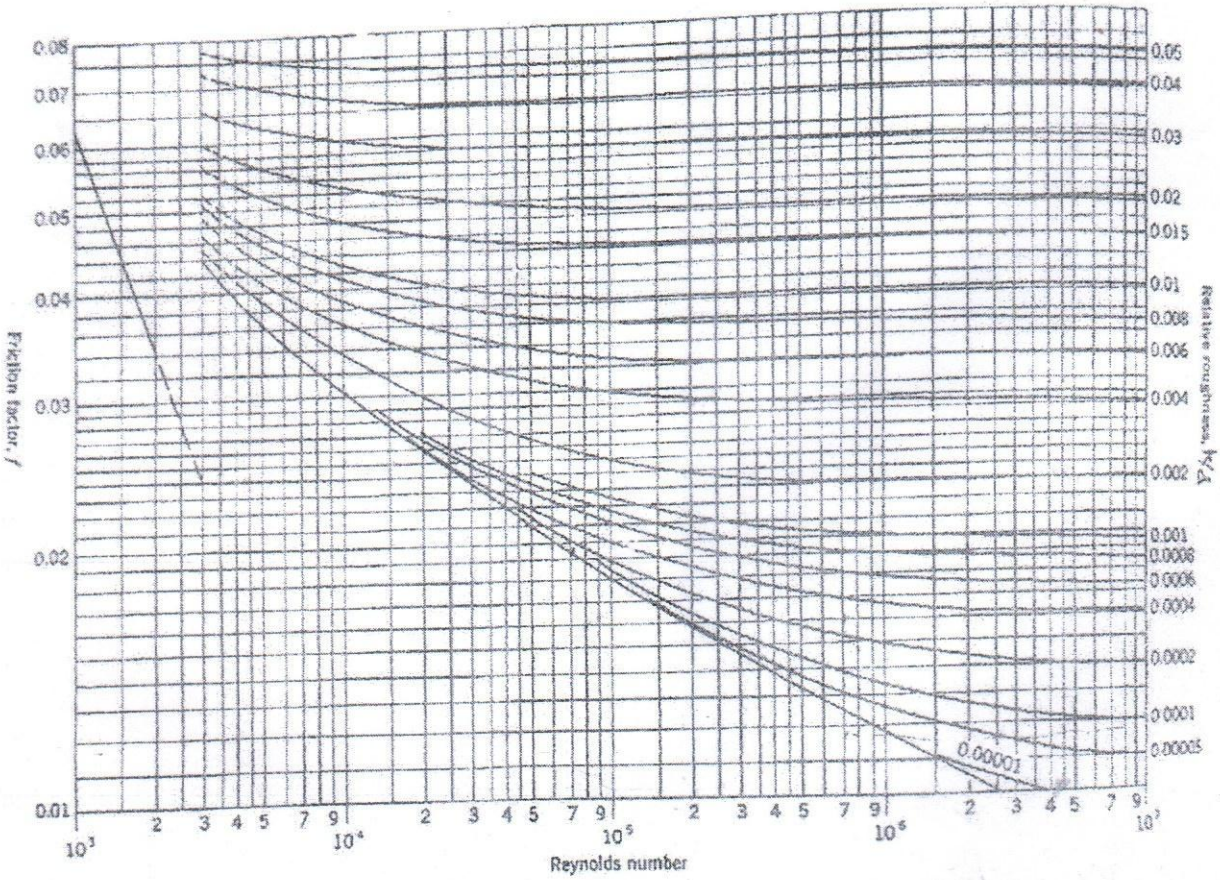


Figure 9



Moody diagram

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B. Sc. Engg. (CEE)/ 5th Sem. 28 May, 2018 (Group B)

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

Semester Final Examination **Winter Semester : 2017 - 2018**
Course No. CEE 4511 **Full Marks: 150**
Course Title: Design of Concrete Structures I **Time : 3 Hours**

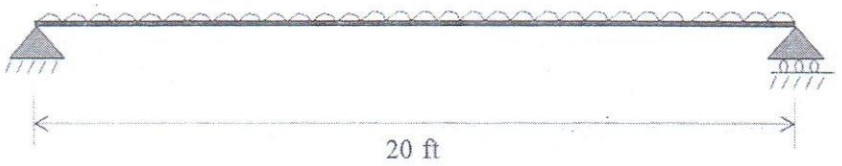
There are 8 (Eight) questions. Answer any 6 (Six) questions including Question No. 1. Question No. 1 is compulsory. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The symbols have their usual meaning.

1(a) Compare WSD and USD. (3)
(b) Define doubly reinforced beam and singly reinforced concrete beam. (3)
(c) Explain the requirements of temperature and shrinkage reinforcement in slabs. (3)
(d) "Bond strength of the top bars is lower than the same of the bottom bars of a RC beam" – why? (3)
(e) Explain the critical locations at which the flexural bond stress is to be checked. (3)
(f) "The design shear stress is considered at an effective depth from the face of the support"-why? (3)
(g) "Minimum clear covers of structural elements are to be maintained accordingly"- why? (2)
(h) Define balanced steel ratio. (2)
(i) Derive the following equation for the development length of steel in concrete: (3)

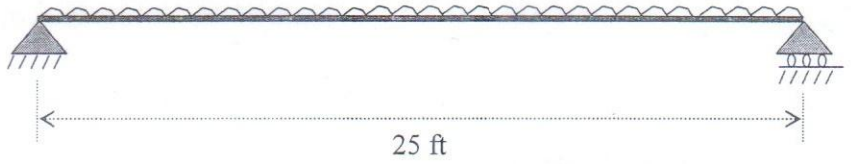
$$L_d = \frac{A_s f_y}{u_u \sum_o}$$

The symbols carry their usual meaning.

2 Design the following simply-supported RC beam 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=24,000 psi, and f_c' = 3,500 psi. **(25)**



3(a) Design the shear reinforcement for the simply supported beam shown below by WSD. Given: LL = 1500 lb/ft, DL = 1500 lb/ft (excluding self-weight), f_v = 20,000 psi, and f_c'= 3500 psi. Draw the layout of the stirrups in a neat sketch. Given: width =12 inch, depth = 25 inch. Consider two layers of tension reinforcements. **(19)**



(b) Draw the strain and stress variation across the section of a beam due to the pure flexure for the following conditions: **(6)**

I. Elastic stress-strain behavior, Very low strain level, tensile stress of concrete is less than the tensile strength of concrete
II. Tensile stress is higher than the tensile strength of concrete, elastic stress-strain behavior of concrete, stress in steel is less than the yield strength of steel
III. Tensile stress is higher than the tensile strength of concrete, inelastic stress-strain behavior of concrete, stress in steel is equal to the yield strength of steel

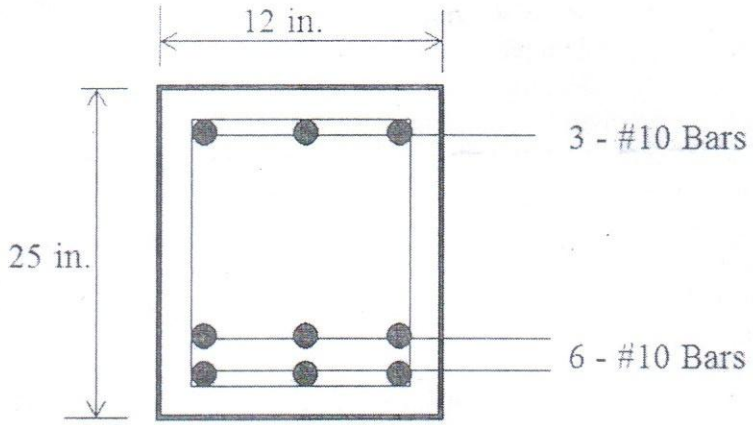
4(a) Derive the following equation for flexural bond stress over steel in concrete: **(8)**

$$u = \frac{V}{\sum_0 jd}$$

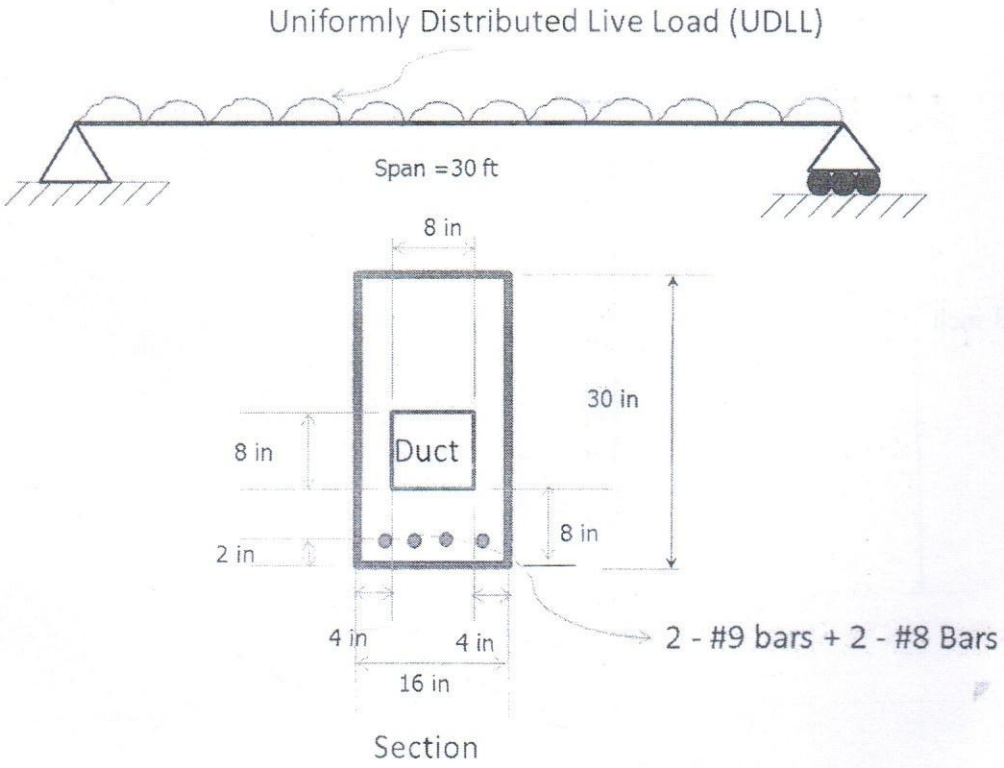
The symbols carry their usual meaning.

(b) Calculate the design positive moment capacity of the following beam **(17)**

section. Use USD. Given: $f_y = 60{,}000$ psi, $f_c' = 4000$ psi.



5 The cross-section of a reinforced concrete beam is given below. **(25)**



Section

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

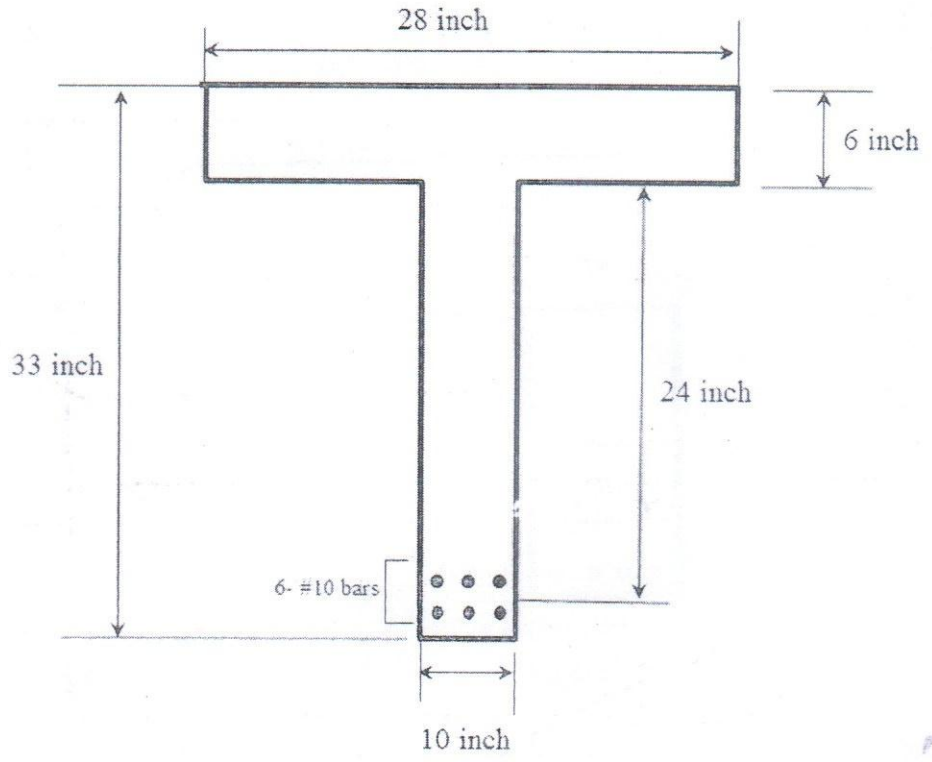
Determine the following:

(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, $f_c' = 3000$ psi. **(15)**



(b) Refer to the Question 6(a). If flange width is increased to 32 inch from 28 inch, calculate the moment capacity of the section. **(10)**

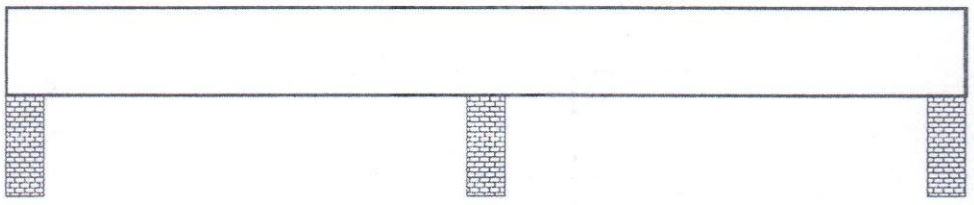
7(a) Define balanced steel ratio. Derive the following equation for balanced steel ratio: **(10)**

$$\rho_b = \alpha \frac{0.003}{\frac{f_y}{E_s} + 0.003} \frac{f_c'}{f_y}$$

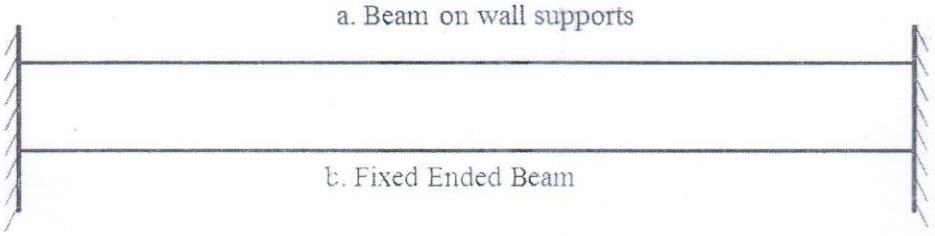
The symbols carry their usual meaning.

(b) Due to the architectural requirement the section of a beam is limited to 12 inch by 24 inch. For the design working moment of 3000 kip-inch, determine the required steel area. Use WSD. Given: f_s = 20,000 psi, f_c' = 4000 psi. **(15)**

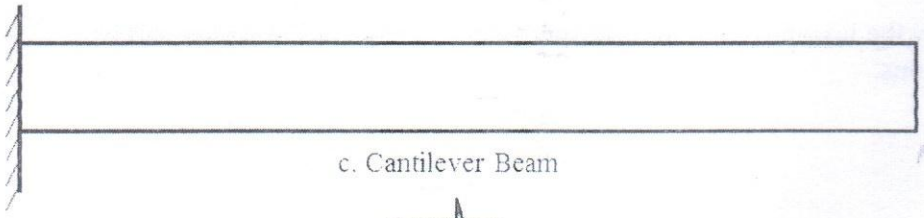
8(a) Refer to the following structural members. Locate the position of tension reinforcements (schematically). **(8)**



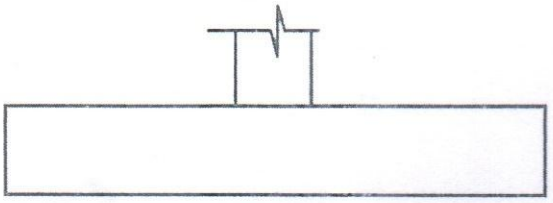
a. Beam on wall supports



b. Fixed Ended Beam



c. Cantilever Beam



d. Footing

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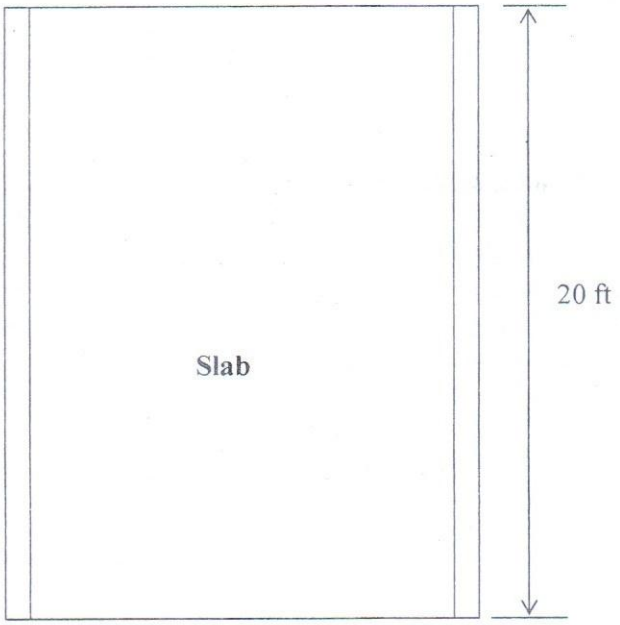
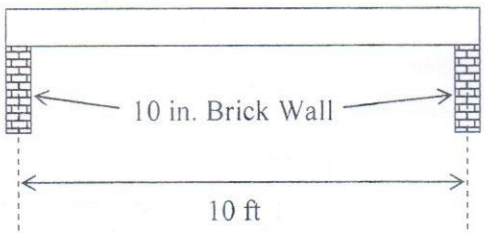
(b) Design the following simply supported slab by WSD. Given: $f_s = 20{,}000$ psi, $f_c' = 3500$ psi, LL = 80 psf, Floor Finish = 25 psf, Random partition Wall = 40 psf. **(17)**



Plan



Section

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

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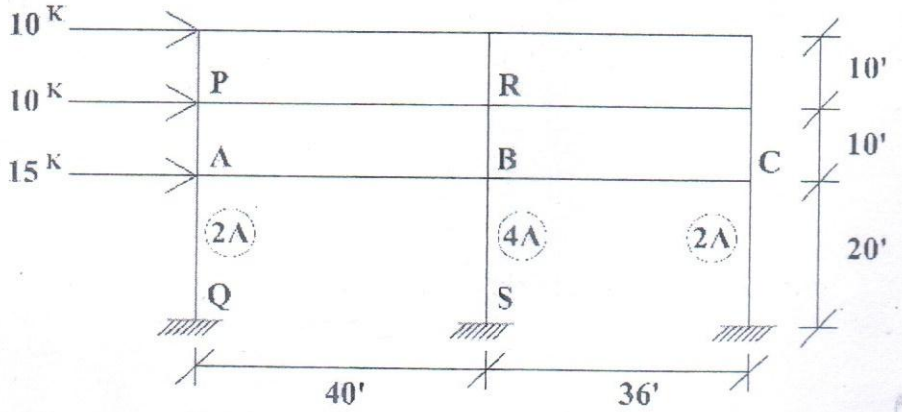
B. Sc. Engg. (CEE)/ 5th Sem. 24 May, 2018 (Morning)

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

Semester Final Examination **Summer Semester: 2017-2018**
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. 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. Using cantilever method draw shear force and bending moment diagrams for the girder ABC and columns PAQ of the building frame in figure below. Also draw axial force diagram for the column PAQ. Cross sectional areas of the columns are mentioned by the side of the columns. $(33\frac{1}{3})$



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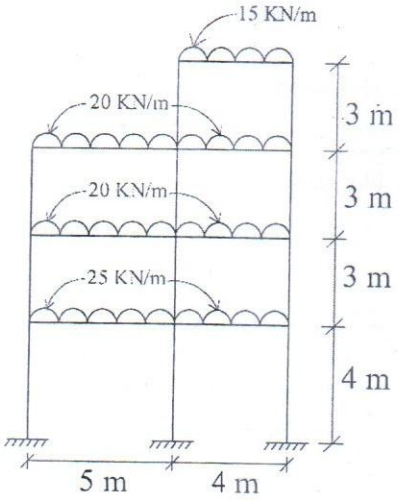
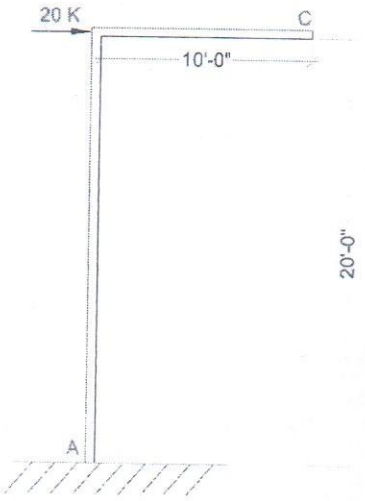
2. The frame shown in the figure below is subjected to vertical loads as shown. Write the assumptions to approximately analyze the structure and draw bending and shear force diagrams for the entire structure. (33 $\frac{1}{3}$)



3(a) Determine vertical deflection at "C" of the frame shown in figure below. Given: A= 10 in^2 and I= 300 in4 for all members. E= 30,000 ksi. Consider only flexural deformation). (23 $\frac{1}{3}$)



(b) State and derive the general cable theorem. (10)

4. Draw influence lines for (a) shear force in panel 1- 2 (b) bending moment at panel points 2 and 3 and (c) floor beam reaction of panel point 2 of the girder with floor beam system in the following figure. (33 $\frac{1}{3}$)

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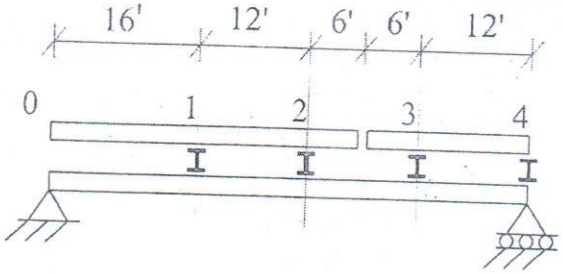
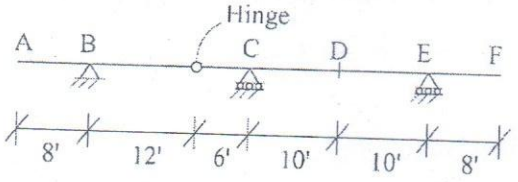


5. Draw the influence lines for:
   (a) Reaction at C
   (b) Shear force at D and the left of C
   (c) Bending moment at D and C of the beam in the figure below. $(33\frac{1}{3})$



6(a) Find maximum moment at one-third of a simply supported beam of 90 ft. for the load shown in the figure. $(18\frac{1}{3})$

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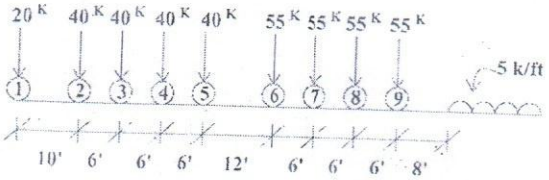
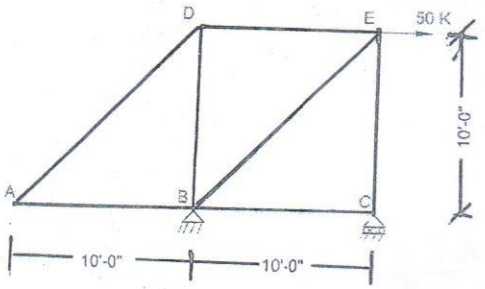
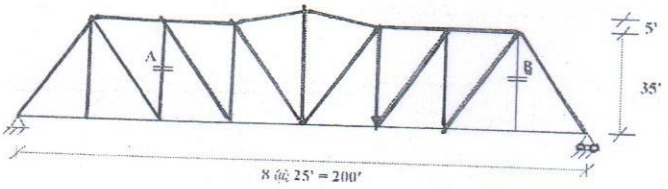


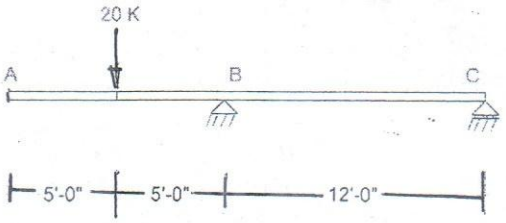
(b) Calculate horizontal deflection at joint "D" of the truss shown in the figure. Given: Cross-sectional area of all members= 5 in^2. Assume E= 30, 000 ksi. (15)



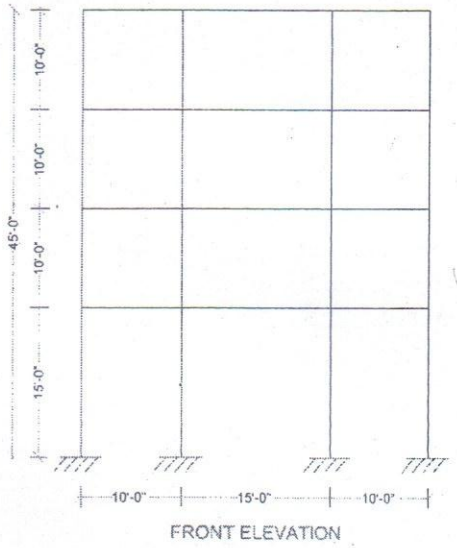
7(a) Calculate the force (maximum tension and compression) in bars A and B of the truss in the figure below due to a moving live load of 3 kips/ft accompanied by a roving concentrated load of 60 kip and the dead load of the truss of 2 kips/ft. (20 $\frac{1}{3}$)



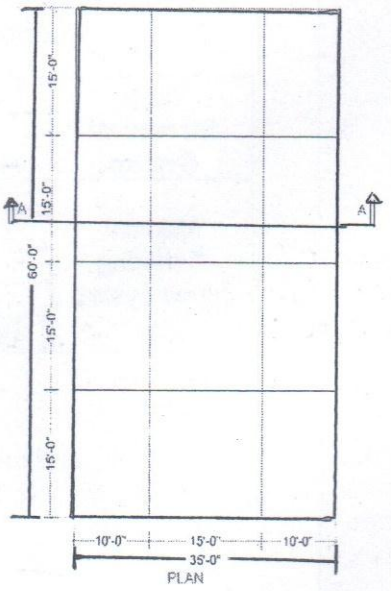
(b) Using unit load method, compute the rotation of the cross-section at "A" of the beam of the following figure. E= 30000 ksi, I=200 in^4 (13)



(8) Calculate the seismic load at frame A of a four- storied concrete made industrial building located in Tangail (Zone 2). Assume the structure to be an Ordinary Moment Resisting Frame(OMRF) built on soil condition S_2, carrying a Dead load of 170 lb/ft_2 and Live load of 60 lb/ft^2. Building plan and elevation is shown below. Relevant information and Tables are shown in Annexure. Assume missing value, if any. (25)



FRONT ELEVATION



PLAN

ANNEXURE

Earthquake

$$V = (ZIC/R)\, W$$
$$C = 1.25\, S/T^{2/3}$$
$$T = C_t (h_n)^{3/4}$$
$$F_x = (V - F_t)\,[w_x h_x / \Sigma w_i h_i]$$

Table: Site Coefficient for seismic Lateral forces

Soil Type	S
S_1	1
S_2	1.2
S_3	1.5
S_4	2

Table: Response Modification Coefficient for Structural Systems

Basic Structural System	Description of Lateral Force Resisting System	R
Moment Resisting Frame System	SMRF (steel)	12
	SMRF (concrete)	12
	IMRF	8
	OMRF (steel)	6
	OMRF (concrete)	5

C_t = 0.083 for steel moment resisting frames
= 0.073 for reinforced concrete moment resisting frames,
= 0.049 for all other structural systems

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

Seismic Dead Load

Seismic dead load W is the total dead load of a building or a structure including permanent partitions. A minimum of 25 percent of the floor live load should be considered.

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

f_2 \ f_1	A L	L B	A L	A L B	A C B L
a L	AaL	BaL/2	AaL/2	(A+B)aL/2	[A+4C+B]aL/6
L b	AbL/2	BbL/3	AbL/6	[A+2B]bL/6	[2C+B]bL/6
a L	AaL/2	BaL/6	AaL/3	[2A+B]aL/6	[A+2C]aL/6
a L b	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

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

Semester Final Examination — **Summer Semester: 2017-2018**
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) Write down the objectives of site exploration. (5)

(b) A footing, 2.0 m square, will carry a load of 400 kPa and will be founded at a depth of 1.0 m in a deep deposit of cohesionless granular soil. Water table is located at 3.0 m from the surface of the ground. The distributions of SPT N value and unit weight are shown in Fig.1. Determine the settlement at the center of the foundation taking the effect of the load up to 4B below the foundation. Use, De Beer and Martens's method. Use, Griffith influence factor I_a in calculating stress increment. (20)

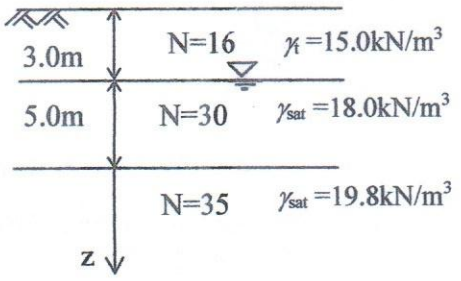


Fig.1

2 (a) A square footing of 2.5 m square with a 0.5 m square column. It is loaded with axial load of 3000 kN, moments of M_x=500 kN-m and M_y=400 kN-m. The properties of the ground are $\phi = 28°$ and c =40 kPa. The footing depth is 1.5 m and the depth of the water table is 10 m from the ground surface. Above the water table γ_t =15.0kN/m^3. Compute the allowable soil pressure for FS=3.0. Use, Meyerhof equations for bearing capacity factors, shape factors and depth factors. (20)

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

(b) Compute the foundation depth for a fully compensated mat foundation (30m X 50m) in saturated clay ground having γ_{sat} =18.8kN/m^3 to carry dead load of 30.0MN, and live load of 20.0MN. Use, γ_w =9.8kN/m^3. (5)

3 The plan for a mat foundation with column loads shown in Fig.2. Calculate the soil pressures at points A, B, C, D, E, F, G, and H. All columns are 50cm X 50cm in section. Net allowable bearing capacity is 60.0kPa. 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. (25)

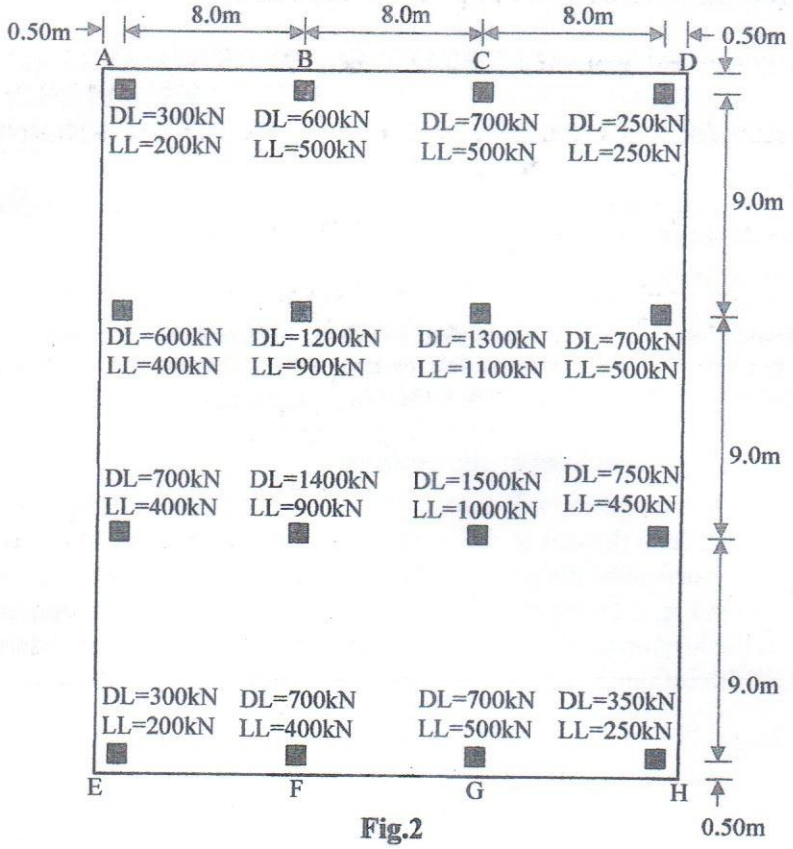


Fig.2

4 (a) Briefly describe some features of *Cone Penetration Test.* (5)

(b) Find the allowable bearing capacity of a group pile (diameter of each pile is 0.60 m, spacing between the piles is 3.0 m center to center, and length of each pile is 25.0 m) shown in Fig.3. The piles are constructed after boring the ground consisting medium sand. The K and δ values are found to be 0.70 and 0.90ϕ, respectively. The angle of internal friction of soil, $\phi = 28°$. Use factor of safety FS=3.0 for both skin friction and end bearing. Use, $N_q = \tan^2(45^o + \frac{\phi}{2})\exp(\pi \tan\phi)$, $\eta = 1 - \frac{\theta}{90^0}\frac{(n-1)m+(m-1)n}{mn}$ (20)

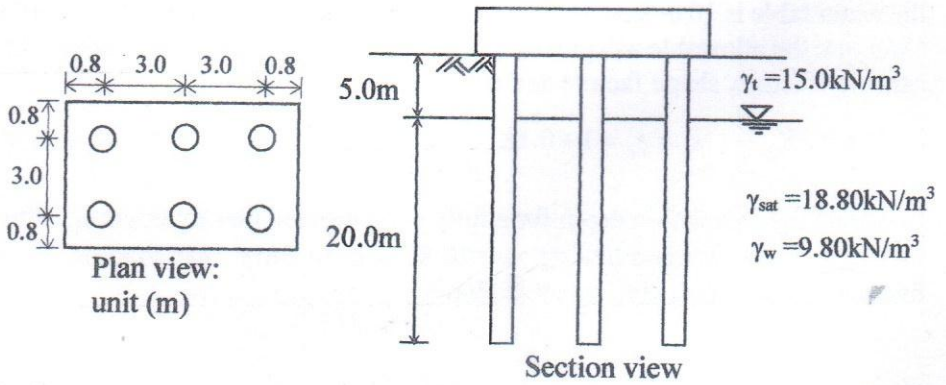


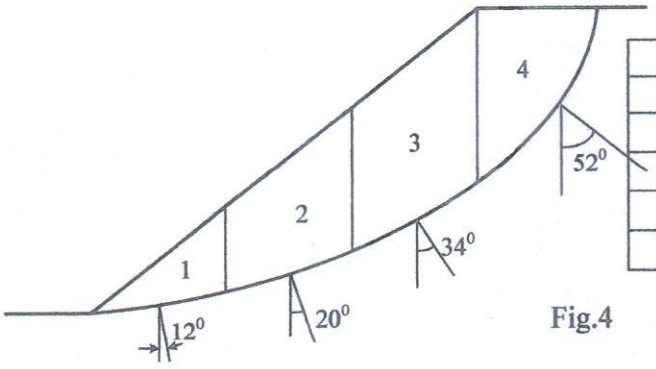
Fig.3

5 (a) Briefly describe five major categories of slope failure with sketch. (7)

(b) Show the critical depth of an infinite slope is $H_r = \frac{c'}{\gamma}\frac{1}{\cos^2\beta(\tan\beta - \tan\phi')}$, where the water table is at a great depth and does not have effect on the factor of safety. The symbols have their usual meaning. (12)

(c) Briefly describe the sampling methods of *Thin-Wall Tube* and *Piston Sampler*. (6)

6. Fig. 4 gives details of the cross-section of an embankment. The soil has the following properties: the cohesion of soil and the angle of shearing resistance to be 20 kPa and 30°, respectively. Unit weight of the ground is 16.0 kN/m^3. For the slice shown, determine the factor of safety for the pore pressure ratio, r_u=0.2, 0.5 and 0.8 using Bishop Method. Plot the variation of factor of safety with r_u. (25)



Slice no	Breadth b (m)	α (degree)	Weight W (kN)
1	3.0	7	60
2	3.5	20	180
3	3.5	34	220
4	3.0	52	140

Fig.4

7 (a) Derive the equation of factor of safety for a slope in Fellenius Method. (15)

(b) What do the 'short piles' and 'long piles' mean? Calculate the ultimate lateral load for a short pile having the embedment length of 8m in cohesive soil. The diameter of the circular pile is 0.5 m. Undrain shear strength is 80 kPa. The height of the line of action of the force above ground surface is 2.0m. (10)

8 (a) Calculate the ultimate and allowable bearing capacities for a rectangular footing (2.5m X 3.0m) placed at a depth of 1.50m for the conditions shown in Fig.6 for local shear failure, having cohesion of 100.0kN/m^2, and angle of internal friction of 30°. Use, FS=3.0. Use Meyerhof equations for bearing capacity factors. (15)

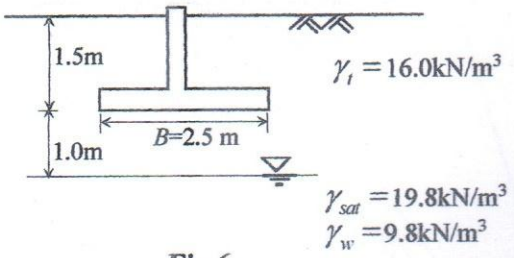


Fig.6

(b) What is negative skin friction in pile foundation? Why does it occur? How it is accommodated in pile design? (6)

(c) What should be the borehole depths for (i) footing, (ii) pile, (iii) embankment, and (iv) retaining wall (4)

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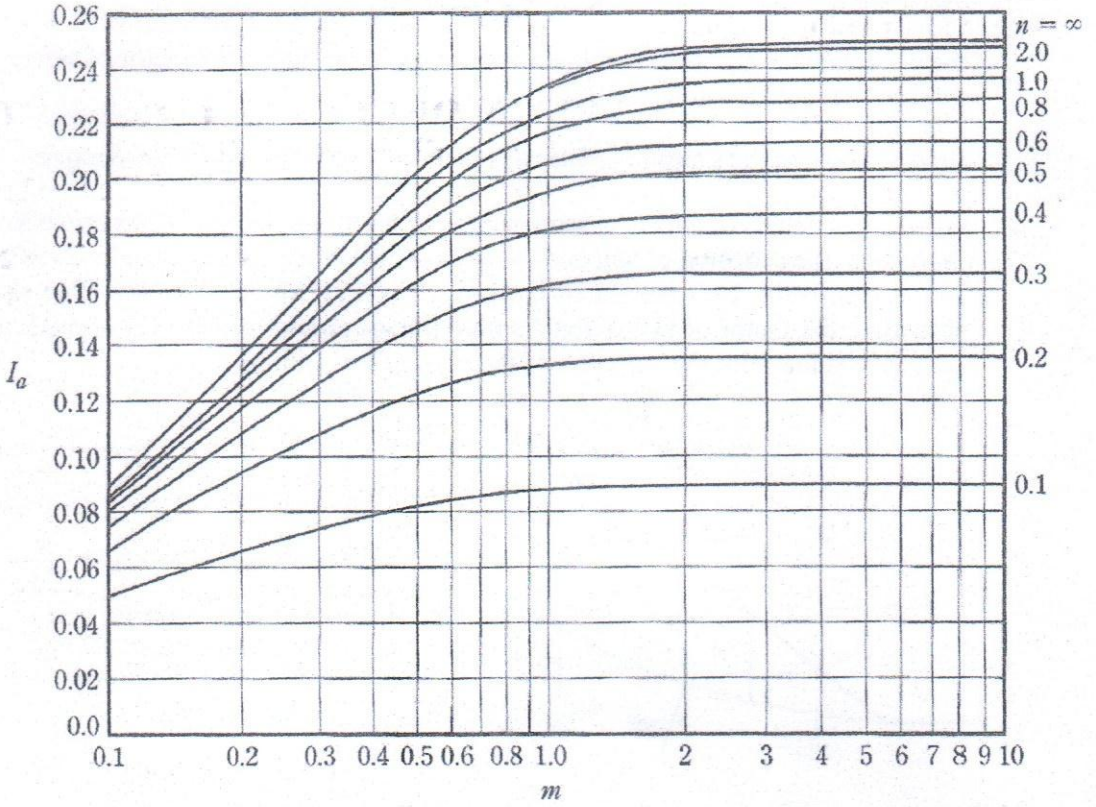

Figure for question 1(b), Griffith influence factor I_a

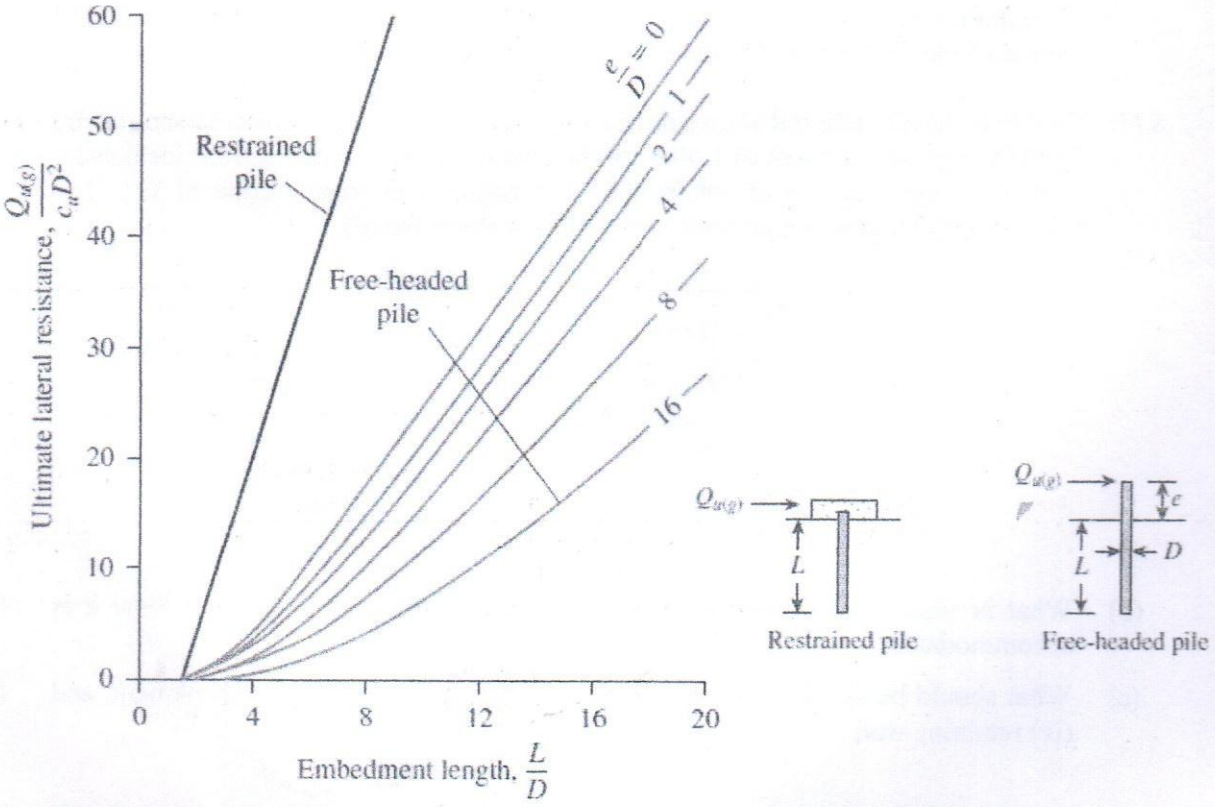

Figure for question 7(b): Broms solution for lateral resistance of short pile in cohesive soil

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B.Sc. Engg. (CEE)/ 5th Sem. 07 June, 2018 (Group B).

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

Semester Final Examination **Winter Semester: 2017-2018**
Course No.: CEE 4551 **Full Marks: 150**
Course Title: Transportation and Traffic Engineering **Time: 3.0 hours**

There are **8 (Eight)** Questions. Answer **6 (Six)** questions including Question no. 1, i.e., Question no. 1 is compulsory. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. The examination is **OPEN BOOK** and students are allowed to carry two books with them.

1(a) Imagine that due to climate change, snow has started falling in Bangladesh. Roads and Highways department has set a guideline allowing super elevation for icy conditions to be maximum 0.10. What will be the minimum radius of curve for a ramp with design speed = 50 mph and 5% super-elevation? What is your comment about this newly proposed maximum allowable super elevation value? (5)

(b) Draw the schematic diagram of a SPUI for left hand driving. (5)

(c) What are the major differences between two phase and three phase traffic flow theories? (5)

(d) In this era of information technology, why do we still need to do manual counting in traffic flow studies? Mention example of two such situations. (5)

(e) What is the relationship between count interval and cycle time in a delay study? (5)

(f) What are the factors on which LOS depend? (5)

(g) Name the common methods of sobriety test. Is it possible that someone is sober, however, failed the sobriety test? If yes then mention one such situation. How can you avoid that? (5)

(h) What are Type I and Type II errors in speed study? Which one is dangerous and why? (5)

(i) Can the capacity of a road be more than its theoretical capacity? Present your logic. (5)

(j) In which situations can you use growth factor methods and in which situations should you use gravity model for trip distribution in four step travel demand forecasting? (5)

2 A spot speed study was conducted on Dhaka-Chittagong highway where the flow was 1500 vehicles/lane/hour. The data are aggregated as follows: (20)

Speed (mph)	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70
Vehicles	0	3	8	17	22	37	48	33	27	12	0

i. Plot frequency and cumulative frequency curves for these data and label it appropriately.
ii. Calculate all major indicators of speed and show them on the plot.
iii. What are the confidence bounds on the estimate of the true mean speed of the underlying distribution with 95% and 99.7% confidence?
iv. Do you think a 5 mph split to tally the data is appropriate for a speed study?

3 Draw the conflict diagram of a five-leg intersection where four of the legs have both way traffic movements but the fifth leg is one way (choose any direction of flow). Also, propose a phase diagram to increase safety of this intersection. (20)

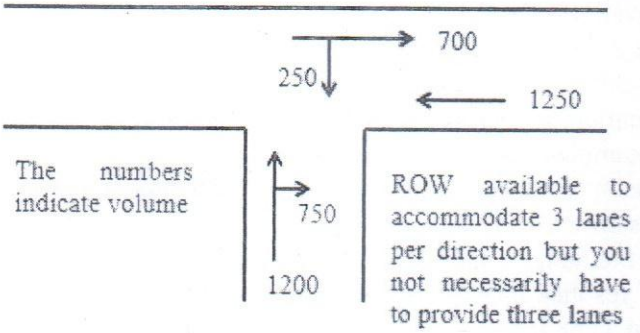
4 A section of highway has the following flow-density relationship: (20)

$$q = 48k - 0.17k^2$$

Calculate all basic parameters of the relationship along with speed-density and speed-flow relationships. Represent the results diagrammatically.

5 A vertical curve of 1,000 ft is designed to connect a grade of +5% to a grade of -5%. The V.P.I is located at station 3,300+50 and has a known elevation of 200 ft. Find the following: (20)
i) The station of the V.P.C and the V.P.T.
ii) The elevation of the V.P.C and the V.P.T.
iii) The elevation of points along the vertical curve at 100-ft intervals.
iv) The location and elevation of the high point on the curve.

6 Below is the layout of a T-intersection along with the volumes of conflicting movements. Signalize the intersection. Your design should have the phase diagram(s) along with the green time, amber time, red time, etc. Show all calculations. Draw the phase diagram(s). (20)



7 What are the inputs and outputs of a travel demand forecasting model? Which survey is done to collect data of which inputs? Draw sample survey form for a typical household survey. (20)

8 You have 5 points to cover in a traffic flow study of which one can be used as a counter and the other four can be used as coverage. Your manpower consists of four people and it was found out that having 2 people at each site is enough to conduct the survey. Generate hypothetical data and show a 4-day traffic count plan. Present the result in a tabular form and report AADT at each of the five locations. (20)

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B.Sc. Engg. (CEE)/ 5th Sem. June 1, 2018 (Group B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : CEE 4563 TIME : 3 Hours
COURSE TITLE : HYDROLOGY 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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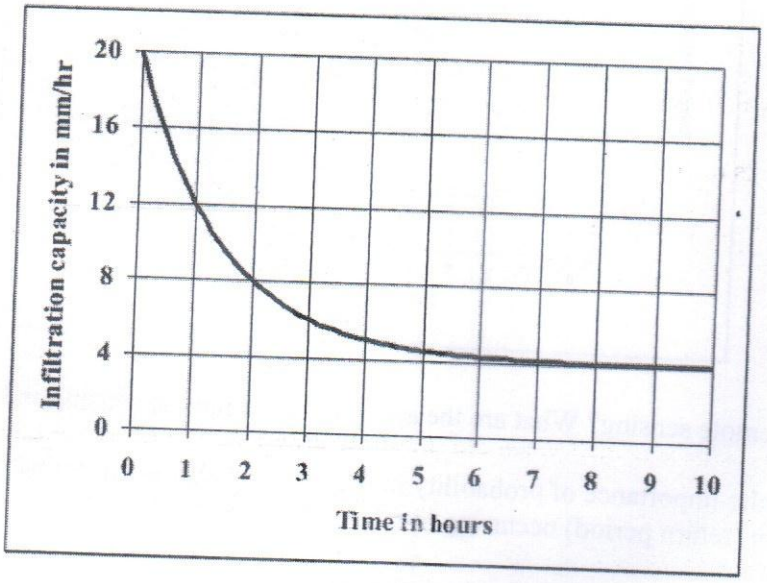
1. (a) Define hydrology. Explain how each path of hydraulic cycle involves one or more of the following aspects: i) transportation of water, ii) temporary storage, iii) change of state. [8]

   (b) Explain the precipitation formation process. [7]

   (c) The relation between infiltration capacity in mm/hour and the time (in hours) since the start of the experiment as measured with an infiltrometer is depicted in the below figure. The relationship may be described with the empirical formula of Horton, where fp, fc and fo in mm/h, t in min. and k in min-1. [10]
   Derive the parameter values fo, fc and k from the measured relationship.
   Estimate from the graph below the total amount of water that will infiltrate into the soil during a rainstorm with a duration 20 minutes and a constant intensity of 20 mm/h.
   Answer the same question for a constant rainfall intensity of 12 mm/h.



2. (a) Why is infiltration a major concern in hydrology? Describe the factors that affect the rate of infiltration? [8]

   (b) What is river stage? What are the methods used for measuring the river stage? [7]

(c) Consider the following annual maximum daily rainfall data. The rainfall depth is given in mm unit.: [10]

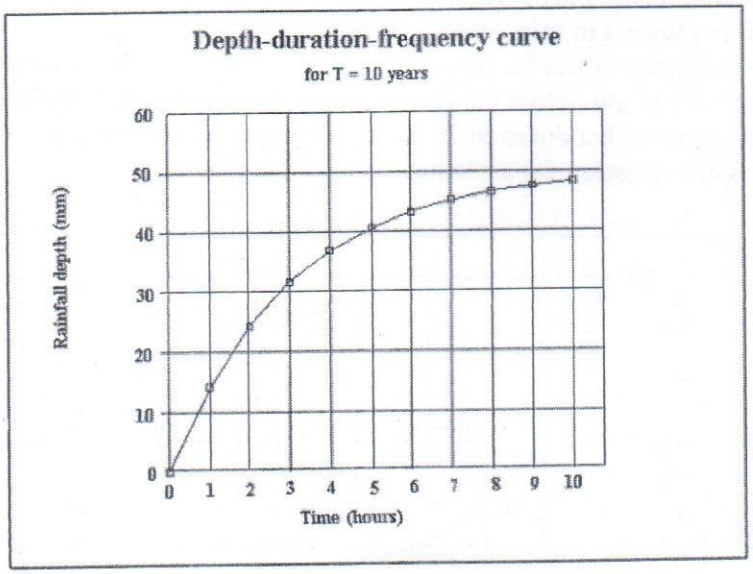
Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Depth	82	78	110	89	74	80	86	99	93	76

Estimate the annual maximum daily rainfall with a return period of 20 years.

3. (a) Suppose, a developer company wants to build a shopping mall, but its parking lot for the customers who will visit the shopping mall will increase the amount of storm water on the neighbourhood of the mall area. If you are a civil engineer of this developer company, how would you solve the problem? [8]

(b) Explain the differences between hydrograph and hyetograph using appropriate figures. [7]

(c) Consider a rainstorm with a constant intensity falling uniformly over a catchment of 6 km^2. The time of concentration of the catchment is 3 hours. The runoff coefficient is 0.4. The Depth-Duration-Frequency curve for the T = 10 years that applies to this catchment is given below. [10]
Use the Rational Method to compute the maximum peak runoff in $m^3.s\text{-}1$ with a return period of 10 years.



4. (a) What is remote sensing? What are the applications of remote sensing in hydrology? [8]

(b) Describe the importance of probability in hydrology. What is the probability of a 20 year storm (return period) occurring in a one year period? [7]

(c) If you were asked to design a bridge to be safe during a 50 Year flood, what is the chance that the design flood will be exceeded one or more times in a 100 year period? Again, calculate the chance that the design flood will be exceeded four or more times in a 100 year period? [10]

5. (a) What are the objectives of doing frequency analysis of hydrologic data? What are the applications of remote sensing in hydrology of Bangladesh? [8]

(b) Explain the elements of a hydrograph using appropriate figures. [7]

(c) The flood hydrograph Q (mm/d) at the outlet, as given below, was produced by a rainstorm of 50 mm. [10]

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q (mm/d)	1.72	1.50	1.31	1.14	1.00	6.00	10.0	6.00	4.00	3.00	2.62	2.29	2.00	1.75

Plot the hydrograph and separate direct runoff from base flow by a straight line. Estimate the direct runoff in mm.

6. (a) What is a unit hydrograph (UH)? Describe the differences between a 3-hr UH and a 6-hr UH. [8]

(b) Explain briefly the four basic propositions of unit hydrograph theory. [7]

(c) Given below the ordinates of a 6-hr unit hydrograph for a catchment. Calculate the ordinates of the direct runoff hydrograph (DRH) due to a rainfall excess of 3.5 cm occurring in 6 hours. [10]

Time (h)	0	3	6	9	12	15	18	24	30	36	42	48	54	60	69
UH ordinate (m3/s)	0	25	50	85	125	160	185	160	110	60	36	25	16	8	0

7. (a) A town is surrounded by a river. At some time of each year the river water increases and causes flood problems for the town. They hire you, as a civil engineer to solve the problem. What measures would you take to solve this issue? [8]

(b) Which one has the higher runoff peak between a fan shaped watershed and a fern shaped watershed and why? [7]

(c) Two storms each of 6-hr duration and having rainfall excess (ER) values of 3.0 and 2.0 cm respectively occur successively. The 2.0cm ER rain follows 3.0cm rain. The 6-hr unit hydrograph for the catchment is given below. Calculate the resulting direct runoff hydrograph (DRH). [10]

Time (h)	0	3	6	9	12	15	18	24	30	36	42	48	54	60	69
UH ordinate (m^3/s)	0	25	50	85	125	160	185	160	110	60	36	25	16	8	0

8. (a) What is flood routing? What are the objectives of flood routing? [8]

(b) What is risk and reliability of a designed event? What factors should be considered while selecting a site for a rain-gauge station? [7]

(c) The following inflow and outflow hydrographs were observed in a river reach. Estimate the value of K and x applicable for this reach for use in the Muskingum equation. [10]

Time(h)	0	6	12	18	24	30	36	42	48	54	60	66
Inflow(m^3/s)	5	20	50	50	32	22	15	10	7	5	5	5
Outflow(m^3/s)	5	6	12	29	38	35	29	23	17	13	9	7

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B.Sc. Engg. (CEE)/ 5th Sem. 05 June, 2018 (Group-B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

SEMESTER FINAL EXAMINATION — WINTER SEMESTER: 2017-18
COURSE NO. : CEE 4565 — TIME : 3.0 Hours
COURSE TITLE: Open Channel Flow — 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) State the assumptions made in the derivation of the dynamic equation for gradually varied flow. What are the data necessary to compute the GVF profiles? (03)

(b) Show that equation of gradually varied flow in a wide rectangular channel with Manning's equation can be written as: (10)

$$\frac{dy}{dx} = s_b \frac{1 - \left(\frac{y_n}{y}\right)^{10/3}}{1 - \left(\frac{y_c}{y}\right)^3}$$

where, the symbols have their usual meanings.
Explain also the behavior of flow profiles when $y \rightarrow 0$ and $y \rightarrow y_c$.

(c) Show the following relationship in GVF in frictionless rectangular channel: (06)

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

(d) Water flows at a depth of 1.1m in a circular channel 2.7m in diameter. If the Froude number of flow is 0.25, compute the discharge. (06)

2(a) What are the best dimensions for a rectangular brick channel designed to carry 6.0 m^3/s of water in uniform flow with $S_0 = 0.001$? (06)
If a half-hexagon and semicircle of the same area of rectangular section is provided, how much flow will be increased or decreased by providing a half-hexagon or semicircle?

(b) Derive the equation $V = C\sqrt{RS}$, where the notations have this usual meaning. What are the assumptions made in deriving this equation? (06)

(c) A trapezoidal channel has a bottom width of 6m, side slopes of 2V: 1H and is laid on a slope of 0.0001. The channel is made of concrete (Ks = 2.0 mm) and carries water at a depth of 1.0 m. Compute: (i) mean velocity of flow and (ii) Manning's n and Chezy's C. (06)

(d) Show that the relation between the alternative depths y_1 and y_2 for a rectangular channel is given by (07)

$$y_c^3 = \frac{2y_1^2 y_2^2}{y_1 + y_2}$$

Where y_c is the critical depth of flow.

3 (a) Show that for a given area A, the best hydraulic rectangular and triangular sections have the same wetted perimeters. (05)

(b) Compute the hydraulic exponent for uniform flow computation (N) for rectangular channel where the conveyance is computed by Manning equation. Show that values of N for a triangular channel and a narrow rectangular channel are 16/3 and 2, respectively. (10)

(c) Explain the following terms: (03)
i. Sequent depth
ii. Backwater curve
iii. Economic channel section

(d) An irrigation lined canal is trapezoidal in shape with 3H:2V. It carries a discharge of 10 m^3/sec on a bed slope of 1 in 5000. If Manning's n = 0.012, find the dimension of most economic channel section to carry the discharge. (07)

4 (a) Show that for a channel with large slope, the pressure distribution is less than the hydrostatic pressure. (05)

(b) The velocity distribution in a rectangular channel is represented by (10)

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

Where n is an exponent. Show that $\alpha = \frac{(n+1)^3}{n^2(n+3)}$; $\beta = \frac{(n+1)^2}{n(n+2)}$

(c) Compute the critical depth and velocity in a (i) wide rectangular channel with q = 4 m^2/s, (ii) rectangular channel with b = 6 m and Q = 35 m^3/s, (iii) triangular channel with z = 1 and Q = 5 m^3/s. In all cases assume $\alpha = 1.12$. (06)

(d) What is stilling basin? What are the functions of the various appurtenances of a stilling basin? (04)

5 (a) A trapezoidal channel with side slopes 1: 1 is required to carry 15 m^3/sec of flow with a bed slope of 1 in 4000. If the channel is lined, the Manning's n will be 0.014, and it will be 0.028 if the channel is unlined. What percentage of earthwork is saved in a lined section relative to unlined section, when the hydraulically efficient section is used in both cases? The free board is assumed to be 0.50 m in both cases and lining is assumed to be up to the top of the section. (10)

(b) A wide river has an average depth of 5m, an average slope of 1 in 10,000 and n = 0.025. A dam increases the water depth by 1.0 m. Find out the length of the flow profile created by the dam assuming that the upstream end of the profile is at a depth of 10% higher than the average depth. Use the Bresse method. (09)

(c) An open channel is to be designed to carry 1.0 m^3/s at a slope of 0.0065. The channel material has an n value of 0.011. Find the optimum hydraulic cross-section for (i) a semi-circular section and (ii) triangular section. (06)

6 (a) A most efficient trapezoidal section is required to give a maximum discharge of 21.5 m^3/sec of water. The slope of the channel bottom is 1 in 2500, taking C = 70 $m^{1/2}$/sec in Chezy's equation, determine the dimensions of the channel. Also determine the value of Manning's n, taking the value of velocity of flow as obtained for the channel using Chezy's equation. (08)

(b) Water flows in 15 m wide rectangular channel at a rate of 115 m^3/sec. Bed slope is 0.001 and n = 0.0125. A dam placed downstream raises the height to 6.8 m immediately behind the dam. What is the distance upstream to a point where depth is 3.7m using direct step method in two steps? (08)

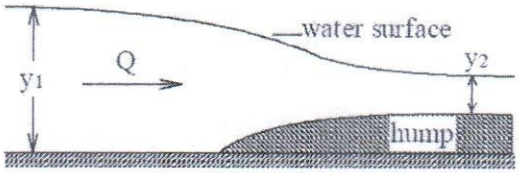
(c) Derive an expression for correction of hydrostatic pressure for pressure distribution in case of curvilinear flow. (04)

(d) Water flows at a depth of 1.0m in a horizontal trapezoidal channel having b = 5.0m and side slope of 1:1 and Q = 30 m^3/sec. If a hydraulic jump occurs in this channel, compute the sequent depth and the loss of KE. (05)

7 (a) In a hydraulic jump occurring in a horizontal, rectangular channel it is desired to have an energy head loss equal to 6 times the supercritical flow depth. Calculate the Froude number of the flow necessary to have this jump. (06)

(b) Design a concrete lined channel to carry a discharge of 350 cumecs at a slope of 1 in 5000. The side slopes of the channel may be taken as 1.5:1 and the value of n is 0.014. Assuming limiting velocity in the channel as 2.0 m/sec. (07)

(c) A rectangular channel is 4.0 m wide and carries a discharge of 20 m^3/s at a depth of 2.0 m. At a certain section, it is proposed to build a hump as shown. Calculate the water surface elevations at upstream of the hump (y_1) and over the hump (y_2) if the hump height is 0.33 m. (Assume no loss of energy at the hump.) (07)



(d) A broad-crested weir is built in a rectangular channel of width 2.0 m. The height of weir crest above the channel bed is 1.20m and the head over the weir is 0.80m. Calculate the discharge over the weir considering the velocity approach. (05)

8 (a) Show that the relative height of hydraulic jump in a rectangular horizontal floor can be expressed as $\frac{h_j}{E_1} = \frac{\sqrt{1+8Fr_1^2}-3}{Fr_1^2+2}$ (07)

where h_j is the height of jump, E_1 is the specific energy and Fr_1 is the Froude number of the approaching flow.

(b) Design a regime channel for a discharge of 50 m^3/sec and silt factor 1.1, using Lacey's theory. (06)

(c) Show that the condition for critical flow in a channel is given by (05)

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

Where Q is the discharge, A is the cross-sectional area and T is the top width of the channel.

(d) A trapezoidal channel with b = 6 m and side slope z = 2 is laid on a slope of 0.0025 and carries a discharge of 30 m^3/sec. The depth produced by a dam immediately upstream of it is 2.50 m. Determine the depth of flow 150 m upstream of the dam using Euler and the modified Euler methods. Take $\alpha = 1.12$ and n = 0.025. (07)

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B.Sc. Engg. (CEE)/ 7th Sem. June 07, 2018 (Group B)

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

TERM: Semester Final Examination **WINTER SEMESTER: 2017-2018**
COURSE NO.: CEE 4701 **TIME: 3.0 Hours**
COURSE TITLE: Professional Practice and Communications **FULL MARKS: 100**

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) Define project. Briefly describe three measures of project activity. (05)

   (b) Enumerate the characteristic features of the project. Explain the typical Project life cycle curve with sketch. (08)

   (c) Who are the three key players in project development and delivery process? Who are the fourth group that co-exist with the three key players? $(3\frac{2}{3})$

2. (a) A tender data sheet is to be prepared for inviting a tender for construction of a 20 storied office building with an estimated cost of 10 billion taka. Prepare following TDS items: (15)
   (i) Specific experience required, (ii) General experience required, (iii) Turnover required, (iv) Tender security required, (v) Liquid asset required.

   (b) What is proposal? Write down the different types of proposal. $(1\frac{2}{3})$

3. (a) Suppose that as an outcome of a tender process 'X Ltd.' has been found as the lowest responsive bidder for construction work of a residential hall at IUT. In this connection, prepare a Notification of Award on behalf of the procuring entity. (10)

   (b) Which organizational plan will you use to announce favorable or neutral information? Describe this situation. $(6\frac{2}{3})$

4. Briefly answer and explain the following questions based on the code of ethics for engineers: $(16\frac{2}{3})$

   (i) According to section 2, what issues should the Engineer have proper regard to and what shall he do if observed conditions endanger those issues?
   (ii) According to section 4, what should the Engineer endeavor to extend and what should he protect the engineering profession from?
   (iii) According to section 6, when will an Engineer undertake engineering assignments and when should he engage or advise engaging experts?
   iv) According to section 8, what should an Engineer endeavor to do in case of conflict of interest?
   (v) According to section 12, what should an Engineer NOT attempt to do regarding another engineer?

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5. (a) Suppose, you are the chief engineer of LGED. Write a memo to your colleagues encouraging to participate them in a seminar titled as **Hi-tech land survey & GIS mapping** organized by the department of Civil and Environmental Engineering of Islamic University of Technology (IUT). (08)

   (b) Write short notes on: $(8\frac{2}{3})$
   (i) Abstracting
   (ii) Inferring
   (iii) Denotation and Connotation.

6. (a) Suppose, You are the president of industry association and received the following inquiry from an out of town member. (07)

   "I think I would like to attend my first meeting of the association even though I am not acquainted with your city. Will you please tell me where the next meeting is being held?"

   How would you reply to this letter keeping in mind the completeness of the message?

   (b) What is the problem associated with the following statement during effective communication and how will you solve this problem? (07)

   Dear X,
   I would like to talk to you about the new client's project which the engineering team had discussed yesterday. I might need the help of Y from your team.
   Regards,
   Z

   (c) What are the 7C's of communication? $(2\frac{2}{3})$

7. (a) What are the different delivery styles of oral presentations? Which one will you use to give a presentation regarding recent advances in civil engineering? (03)

   (b) Under Quality- and Cost-Based Selection (QCBS), the technical scores obtained by three participants A, B and C are 75, 85 and 90 respectively. The financial proposal submitted by each of the participants are Tk. 10 million, 12 million and 15 million respectively. Workout the total score and ranking of the applicants. The qualifying mark for technical score is 75% and weightage of technical score is 80%. (07)

   (c) Give a complete chronological description of the various steps followed during the entire process of a major solicited proposal. $(6\frac{2}{3})$

8. Suppose, a bridge is proposed to be built over 'X' river of Bangladesh. In the planning process of the bridge project, a focus group discussion (FGD) has to be conducted to obtain in-depth information (qualitative data) from the stakeholders of the project about their opinions, beliefs, perceptions and attitudes towards the proposed project. You have been assigned as the moderator/facilitator of the FGD. Design the FGD (member invitation, questions to be asked, location and duration of FGD, etc.) and prepare a meeting minutes based on the findings of the meeting. $(16\frac{2}{3})$

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B. Sc. Engg. (CEE)/ 7th Sem. 24 May, 2018 (Group-B)

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

Semester Final Examination — **Winter Semester: 2017-2018**
Course No.: CEE 4711 — **Full Marks: 150**
Course Title: Structural Analysis and Design II — **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 question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1. Determine the reactions at the supports A and D shown in Fig.1 using flexibility method. Support A is roller, and D is fixed. Here, $E = 200$ GPa. (25)

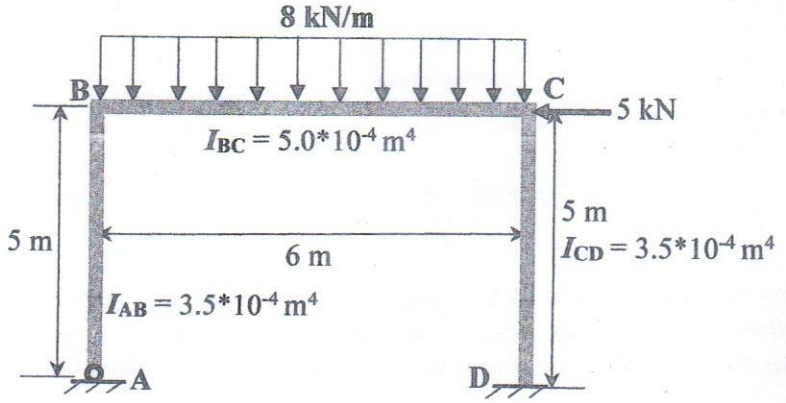


Fig. 1

2(a). Draw the influence line for the vertical reaction at B for the beam shown in Fig.2(a). Plot numerical values at the peaks. Support A is fixed, and B is a roller. Here, *EI* is constant. (12)

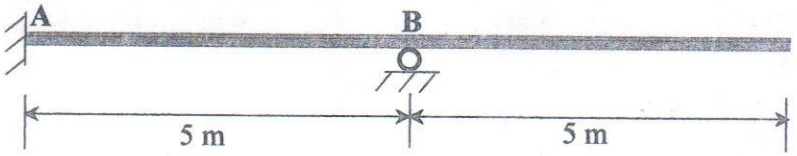


Fig.2(a)

2(b). Draw the influence line for the moment at D for the beam shown in Fig.2(b). Plot numerical values at every 4.0 m. Here, *EI* is constant. (13)

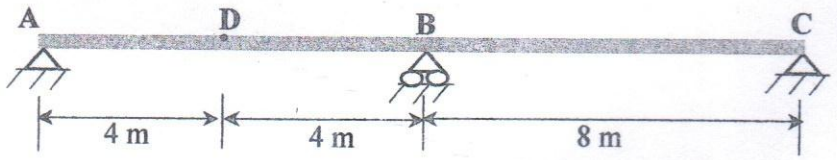


Fig.2(b)

3(a). Using flexibility method determine the reactions at all supports of the beam shown in Fig.3(a). Here, EI = constant. (17)

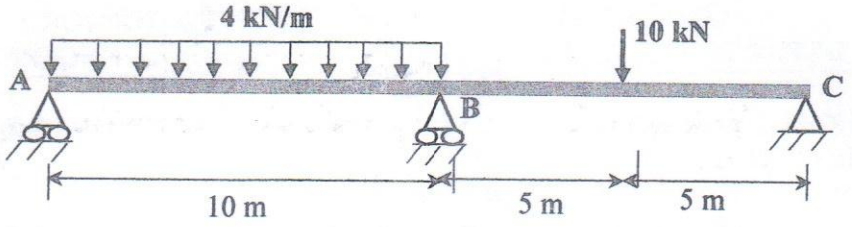


Fig.3(a)

3(b). Use the Muller-Breslau principle to sketch the general shape of the influence line for (i) the positive moment at A, and (ii) the positive shear at B shown in Fig.3(b) (8)

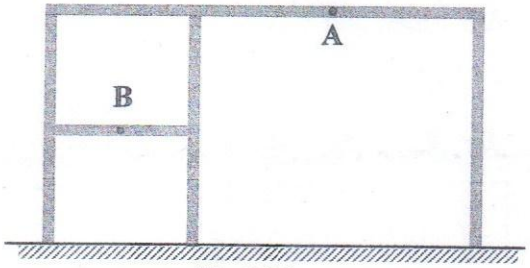


Fig.3(b)

4. Using the moment distribution method determine the moments at joints B and C for the frame shown in Fig.4. Also, draw the bending moment diagram for member BCE of the frame. Supports A and D are pins, and E is fixed. Here, EI is constant. (25)

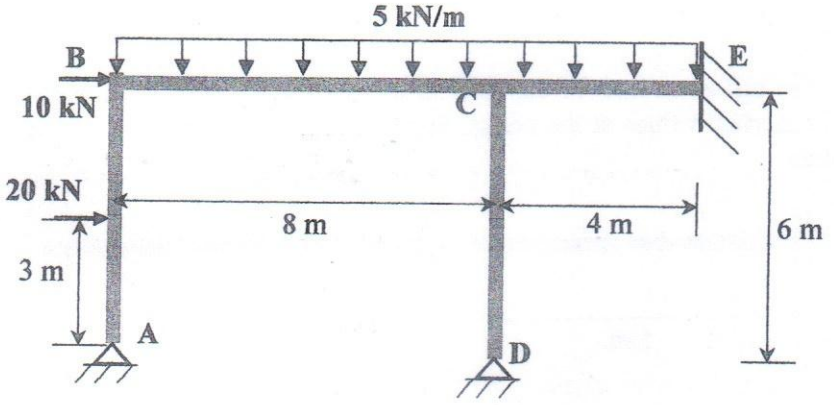


Fig.4

5(a). Determine the moment at B, then draw the bending moment diagram for the beam shown in Fig.5(a) using the moment distribution method. Assume the support at A is pinned, B is roller and C is fixed. Here, *EI* is constant. (14)

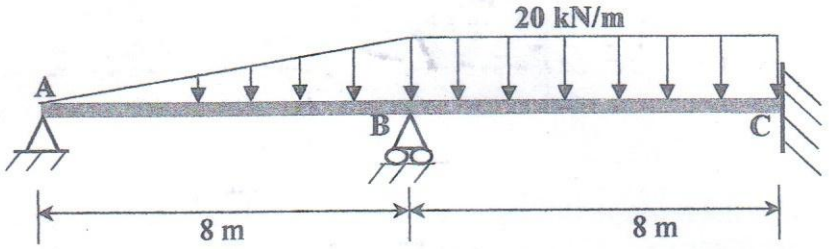


Fig.5(a)

5(b). Determine the moments at B and C for the beam shown in Fig.5(b) using the moment distribution method. All connections are pins. Assume the horizontal reactions are zero. Here, *EI* is constant. (11)

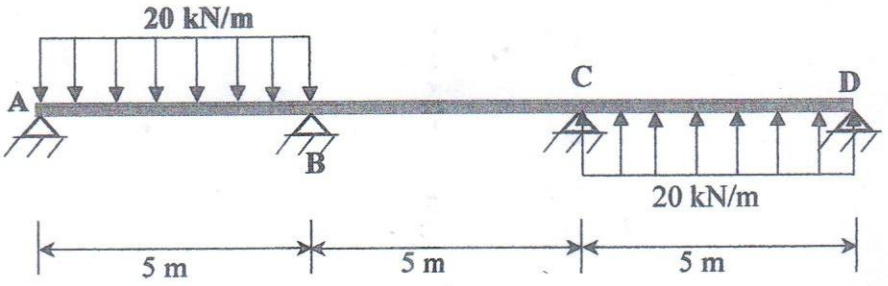


Fig.5(b)

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

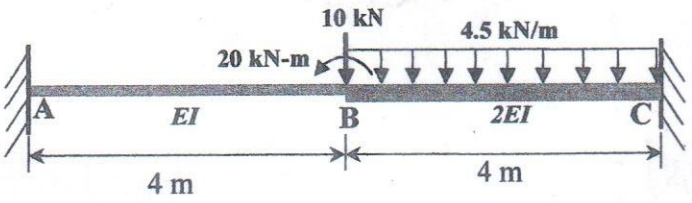


Fig.6

7(a). Determine all the reactions at support A of the beam shown in Fig.7(a) using the stiffness method. Assume, *EI* is constant. (18)

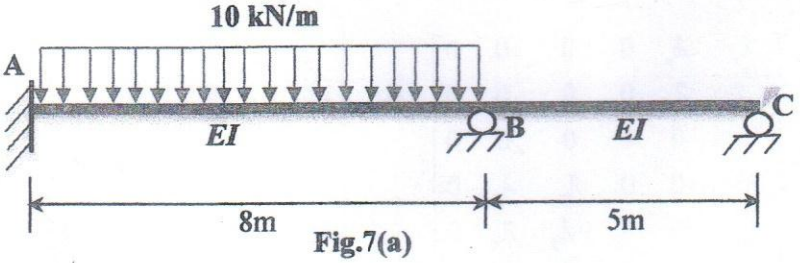


Fig.7(a)

7(b). Write down algorithms of stiffness matrix and load vector for the beam according to the degree of freedom indicated in Fig.7(b). (7)

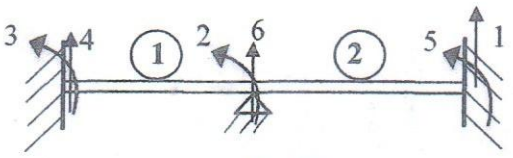


Fig.7(b)

8. Determine the structure stiffness matrix (global) and support reactions at pin support A for the frame shown in Fig.8 according to the degree of freedom indicated in the figure. Take $E = 200$ GPa, $I = 350(10^6)$ mm^4, $A = 15(10^3)$ mm^2 for both members. (25)

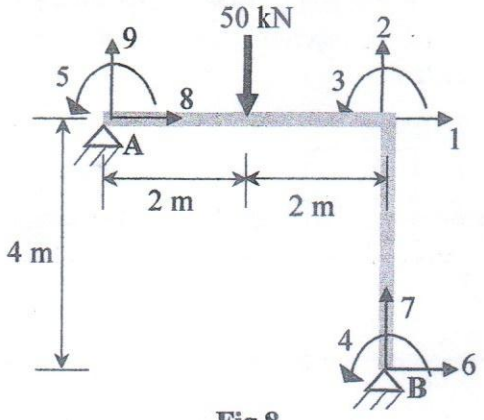


Fig.8

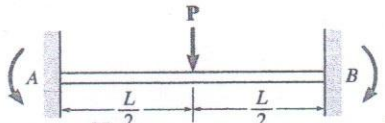
Necessary equations

For frame:

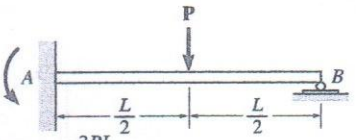
$$[k]=\begin{bmatrix}
\left(\frac{EA}{l}\lambda_x^2+12\frac{EI}{l^3}\lambda_y^2\right) & \left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y & -6\frac{EI}{l^2}\lambda_y & -\left(\frac{EA}{l}\lambda_x^2+12\frac{EI}{l^3}\lambda_y^2\right) & -\left(\frac{EA}{l}-12\frac{EI}{l^3}\right)\lambda_x\lambda_y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

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

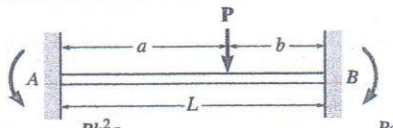
Fixed End Moments



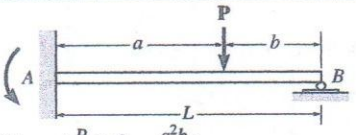
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



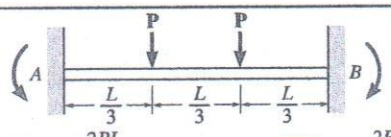
$(FEM)'_{AB} = \frac{3PL}{16}$



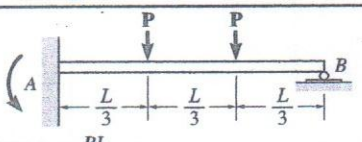
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



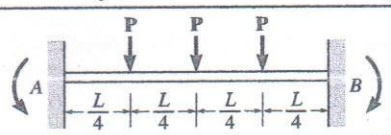
$(FEM)'_{AB} = (\frac{P}{L^2})(b^2a + \frac{a^2b}{2})$



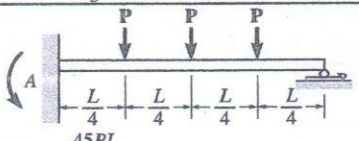
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



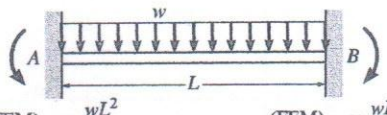
$(FEM)'_{AB} = \frac{PL}{3}$



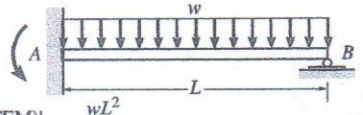
$(FEM)_{AB} = \frac{5PL}{16}$ $(FEM)_{BA} = \frac{5PL}{16}$



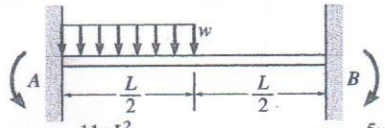
$(FEM)'_{AB} = \frac{45PL}{96}$



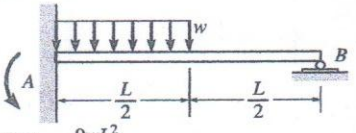
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



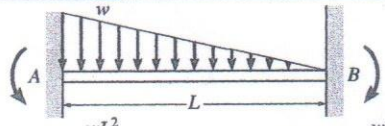
$(FEM)'_{AB} = \frac{wL^2}{8}$



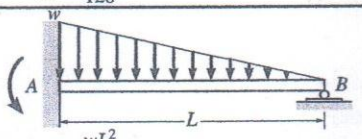
$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



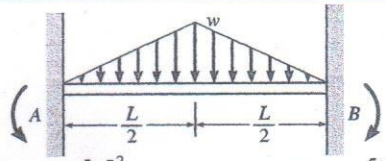
$(FEM)'_{AB} = \frac{9wL^2}{128}$



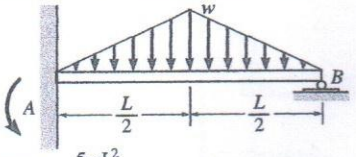
$(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$



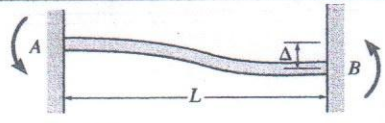
$(FEM)'_{AB} = \frac{wL^2}{15}$



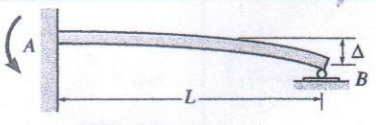
$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$



$(FEM)'_{AB} = \frac{5wL^2}{64}$

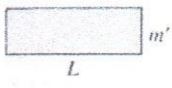
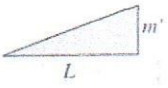
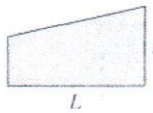
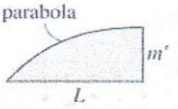
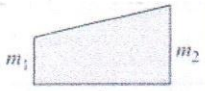
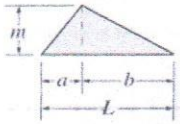
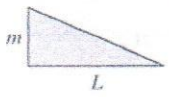


$(FEM)_{AB} = \frac{6EI\Delta}{L^2}$ $(FEM)_{BA} = \frac{6EI\Delta}{L^2}$

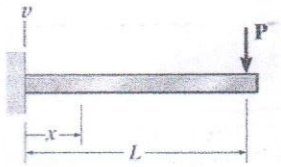
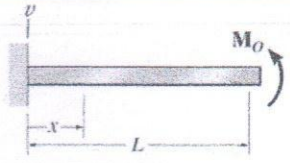


$(FEM)'_{AB} = \frac{3EI\Delta}{L^2}$

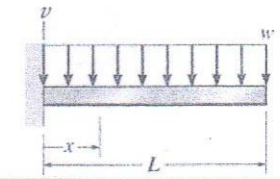
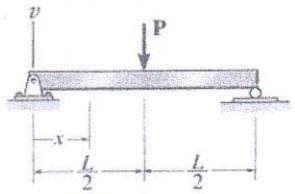
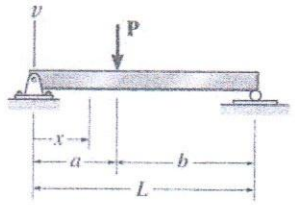
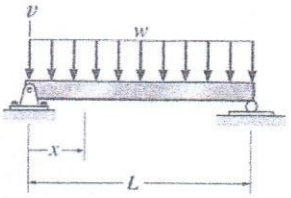
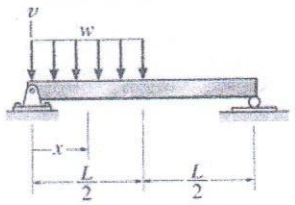
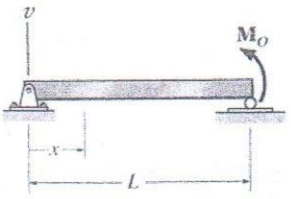
Table for Evaluating $\int_0^L m\,m'\,dx$

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

Beam Deflections and Slopes

Loading	$v +$ ↑	$\theta +$ ↶	Equation + ↑ + ↶
	$v_{max} = -\frac{PL^3}{3EI}$ 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 30, 2018 (Group B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO : MCE 4717 TIME: 3 Hours
COURSE TITLE: ENGINEERING ECONOMY FULL MARKS: 100

There are 8 (Eight) questions. **Question no. 1 (One) is compulsory.** Answer any 5 (Five) from the remaining 7 (Seven) 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 multinational company in cement sector named "Cemex Ltd" which wishes to expand their business in Bangladesh from 2019. You are hired as a strategic analyst in this company. You have been given the responsibility to prepare the feasibility report based on the available data given in the chart below. You must have to show the *Payback Period Analysis, Break Even Point Analysis* in the feasibility report which will help the mother company to proceed their decision. The net revenue per unit is expected to be 4 dollar and the investors expect a rate of return from the business at least 8% per year. They are also interested to know the net *Future Worth* of the company after one decade (in 2031). (20)

Along with the economic analysis, you are also responsible to produce a case study using different planning tools/technique like *SWOT, Competitor Analysis* (with Shah Cement, Holcim Cement) etc. which will enable the investors to understand the overall market scenario in this industry.

Initial investment	$ 20,00,000
Total cost per year	$ 12,000
Return per year	$ 25,000
Annual O-M cost	$ 4,000
Overhaul cost after every five years	$ 1,000

[Hint: For Break Even Point analysis there is no consideration of interest rate.]

2.(a) You are a new project engineer with the Roads and Highways Department (RHD). Based on annual worth relations, you have to performed the conventional B/C analysis of the two separate proposals shown below for finding out if these are economically justified. (5)

Bypass proposal	Upgrade proposal
Initial investment: $40 million. Annual maintenance: $1.5 million. Annual benefits to Public: $6.5 million. Expected life: 20 years. Discount Rate: 8% per year	Initial investment: $4 million. Annual maintenance: $150,000. Annual benefits to public: $650,000. Expected life: 12 years. Discount Rate: 5% per year

(b) The RAJUK is considering three proposals for increasing the capacity of the main drainage canal of Purbachal New Town. Compare the alternatives on the basis of annual worth, using an interest rate of 5% per year. (8)

Proposal A requires dredging the canal in order to remove sediment and weeds which have accumulated during previous years' operation. The capacity of the canal will have to be maintained in the future near its design peak flow because of increased water demand. The Bureau is planning to purchase the dredging equipment and accessories for $650,000. The equipment is expected to have a 10 year life with a $17,000 salvage value. The annual operating costs are estimated to total $50,000. To control weeds in the canal itself and along the banks, environmentally safe herbicides will be sprayed during the irrigation season. The yearly cost of the weed control program is expected to be $120,000.

Proposal B is to line the canal with concrete at an initial cost of $4 million. The lining is assumed to be permanent, but minor maintenance will be required every year at a cost of $5,000. In addition, lining repairs will have to be made every 5 years at a cost of $30,000.

Proposal C is to construct a new pipeline along a different route. Estimates are: an initial cost of $4 million, annual maintenance of $3000 for right-of-way, and a life of 20 years.

(c) What do you understand by market equilibrium in theory of supply and demand? How do you analyze the changes in market equilibrium? (3)

3.(a) A construction enterprise is investigating the purchase of a new dump truck. Interest rate is 9%. The cash flow for the dump truck are as follows: (8)
Initail cost = $50,000, annual operating cost = $2000, annual income = $9,000, salvage value = $10,000, expected life is 10 years.
(i) What are the present worth benefit and present worth of cost?
(ii) Is this investment worth undertaking? If not, what should be the minimum annual benefit for making it a worthy of investment at 9% rate of return?

(b) Engineers at SeaWorld, a division of Busch Gardens, Inc., have completed an innovation on an existing water sports ride to make it more exciting. The modification costs only $8000 and is expected to last 6 years with a $1300 salvage value for the solenoid mechanisms. The maintenance cost is expected to be high at $1700 the first year, increasing by 11% per year thereafter. Determine the equivalent present worth of the modification and maintenance cost by hand. The interest rate is 8% per year. (5)

(c) If you wished to have $800 in a savings account at the end of four years, and 5% interest we paid annually, how much should you put into the savings account? (3)

4.(a) Define Engineering Economy. Write down the uses and the seven principles of Engineering Economy. (6)

(b) After drawing the cash flow diagram apply Present Worth (PW) Analysis to find out which of the following machine is the best option from economic perspective? [Value of IRR= 5% per year] (10)

Specifications	Defender	Challenger-1	Challenger-2
Initial cost (3 years ago)	$ 7,00,000	-	-
Current Value	$ 3,00,000	$ 6,00,000	$ 9,00,000
Annual operating and maintenance cost	$ 80,000	$ 60,000	$ 50,000
Salvage value	-	$ 70,000	$ 40,000
Remaining life	4 years	5 years	10 years

5.(a) You are assigned to find out which of the following two routes can be selected for a new project of LGED at Sreepur. Here you have to apply *Incremental Benefit Cost* ratio with respect to the short route. The traffic volume in this project is projected to be 400,000 vehicle per year and operating cost of one vehicle will be $0.27 per km. [i =6% per year] (7)

Long Route	Short Route
Initial Cost: $21 million Length of the route: 25 km Maintenance cost: $40,000 per year	Initial Cost: $45 million Length of the route: 10 km Maintenance cost: $15,000 per year

(b) How much you must deposit in your retirement account starting now and continuing each year through year 9 (i.e., 10 deposits) if you want to be able to withdraw $80,000 per year forever beginning 30 years from now? Assume the account earns interest at 8% per year. (4)

(c) A philanthropist working to set up a permanent endowment wants to deposit money each year, starting now and making 10 more (i.e., 11) deposits, so that money will be available for research related to planetary colonization. If the size of the first deposit is $ 1 million and each succeeding one is $ 100,000 larger than the previous one, how much will be available forever beginning in year 11, if the fund earns interest at a rate of 8% per year? (5)

6.(a) A project engineer with "EnvironCare" is assigned to start up a new office in a city where a 6-year contract has been finalized to take and to analyze ozone-level readings. Two lease options are available, each with a initial cost, annual lease cost, and deposit-return estimates shown below. (12)

	Location A	Location B
Initial cost, $	15,000	18,000
Annual lease cost, $ per year	3,500	3,100
Deposit return $	1,000	2,000
Lease term, years	6	9

(i) Determine which lease option should be selected on the basis of a present worth comparison, if the MARR is 15% per year.

(ii) EnvironCare has a standard practice of evaluating all projects over as-year period. If a study period of 5 years is used and the deposit returns are not expected to change, which location should be selected?
(iii) Which location should be selected over a 6-year study period if the deposit return at location B is estimated to be $6000 after 6 years?

(b) CE, Inc., leases large earth tunneling equipment. The net profit from the equipment for each of the last 4 years has been decreasing, as shown below. Also shown are the annual rates of return on invested capital. The return has been increasing. Determine the present worth (PW) and equivalent uniform series (AW) of the net profit series. Take the annual variation of rates of return into account. (4)

Year	One	Two	Three	Four
Net Profit	70,000	70,000	25,000	35,000
Annual Rate (effective)	5%	8%	9%	8%

7.(a) What do you understand by term depreciation? Write down the uses of depreciation from personal, private and government perspectives. (6)

(b) Freeport-McMoRan Mining Company has purchased a computer-controlled gold ore grading unit for $80,000. The unit has an anticipated life of 10 years and a salvage value of $10,000. Use the Declining Balance Method (DB) and Double Declining Balance Method (DDB) methods to compare the schedule of depreciation and book values for each year. (10)

8.(a) For a MARR of 15% per year and budget constrain of $20,000, select the best possible solution from the following independent projects (are not mutually exclusive). (10)

Project	Initial Investment ($)	Annual Cash Flow ($)	Project life
A	8,000	3,870	6
B	15,000	2,930	9
C	8,000	2,680	5
D	8,000	2,540	4

(b) For the past 7 years, a quality manager has paid $500 every 6 months for the software maintenance contract of a LAN. What is the equivalent amount after the last payment, if these funds are taken from a pool that has been returning 20% per year, compounded quarterly? (6)

8% TABLE 13 Discrete Cash Flow: Compound Interest Factors 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
21	5.0338	0.1987	0.01983	50.4229	0.09983	10.0168	73.0629	7.2940
22	5.4365	0.1839	0.01803	55.4568	0.09803	10.2007	76.9257	7.5412
23	5.8715	0.1703	0.01642	60.8933	0.09642	10.3711	80.6726	7.7786
24	6.3412	0.1577	0.01498	66.7648	0.09498	10.5288	84.2997	8.0066
25	6.8485	0.1460	0.01368	73.1059	0.09368	10.6748	87.8041	8.2254
26	7.3964	0.1352	0.01251	79.9544	0.09251	10.8100	91.1842	8.4352
27	7.9881	0.1252	0.01145	87.3508	0.09145	10.9352	94.4390	8.6363
28	8.6271	0.1159	0.01049	95.3388	0.09049	11.0511	97.5687	8.8289
29	9.3173	0.1073	0.00962	103.9659	0.08962	11.1584	100.5738	9.0133
30	10.0627	0.0994	0.00883	113.2832	0.08883	11.2578	103.4558	9.1897

9% TABLE 14 Discrete Cash Flow: Compound Interest Factors 9%

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	1.0900	0.9174	1.00000	1.0000	1.09000	0.9174		
2	1.1881	0.8417	0.47847	2.0900	0.56847	1.7591	0.8417	0.4785
3	1.2950	0.7722	0.30505	3.2781	0.39505	2.5313	2.3860	0.9426
4	1.4116	0.7084	0.21867	4.5731	0.30867	3.2397	4.5113	1.3925
5	1.5386	0.6499	0.16709	5.9847	0.25709	3.8897	7.1110	1.8282
6	1.6771	0.5963	0.13292	7.5233	0.22292	4.4859	10.0924	2.2498
7	1.8280	0.5470	0.10869	9.2004	0.19869	5.0330	13.3746	2.6574
8	1.9926	0.5019	0.09067	11.0285	0.18067	5.5348	16.8877	3.0512
9	2.1719	0.4604	0.07680	13.0210	0.16680	5.9952	20.5711	3.4312
10	2.3674	0.4224	0.06582	15.1929	0.15582	6.4177	24.3728	3.7978

5% TABLE 10 Discrete Cash Flow: Compound Interest Factors 5%

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	1.0500	0.9524	1.00000	1.0000	1.05000	0.9524		
2	1.1025	0.9070	0.48780	2.0500	0.53780	1.8594	0.9070	0.4878
3	1.1576	0.8638	0.31721	3.1525	0.36721	2.7232	2.6347	0.9675
4	1.2155	0.8227	0.23201	4.3101	0.28201	3.5460	5.1028	1.4391
5	1.2763	0.7835	0.18097	5.5256	0.23097	4.3295	8.2369	1.9025
6	1.3401	0.7462	0.14702	6.8019	0.19702	5.0757	11.9680	2.3579
7	1.4071	0.7107	0.12282	8.1420	0.17282	5.7864	16.2321	2.8052
8	1.4775	0.6768	0.10472	9.5491	0.15472	6.4632	20.9700	3.2445
9	1.5513	0.6446	0.09069	11.0266	0.14069	7.1078	26.1268	3.6758
10	1.6289	0.6139	0.07950	12.5779	0.12950	7.7217	31.6520	4.0991
11	1.7103	0.5847	0.07039	14.2068	0.12039	8.3064	37.4988	4.5144
12	1.7959	0.5568	0.06283	15.9171	0.11283	8.8633	43.6241	4.9219
13	1.8856	0.5303	0.05646	17.7130	0.10646	9.3936	49.9879	5.3215
14	1.9799	0.5051	0.05102	19.5986	0.10102	9.8986	56.5538	5.7133
15	2.0789	0.4810	0.04634	21.5786	0.09634	10.3797	63.2880	6.0973
16	2.1829	0.4581	0.04227	23.6575	0.09227	10.8378	70.1597	6.4736
17	2.2920	0.4363	0.03870	25.8404	0.08870	11.2741	77.1405	6.8423
18	2.4066	0.4155	0.03555	28.1324	0.08555	11.6896	84.2043	7.2034
19	2.5270	0.3957	0.03275	30.5390	0.08275	12.0853	91.3275	7.5569
20	2.6533	0.3769	0.03024	33.0660	0.08024	12.4622	98.4884	7.9030

15% TABLE 19 Discrete Cash Flow: Compound Interest Factors 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

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B.Sc. Engg. (CEE)/7th Sem. 28 May, 2018 (Group B)

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 4731 TIME: 3 Hours
COURSE TITLE: Environmental Pollution & its Control 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. Page 6 of this question paper contains necessary formulas. Use where necessary. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1. (a) What is environmental pollution? Explain shortly the following categories of water pollutants: [12]
   i. Oxygen demanding wastes
   ii. Microbial wastes
   iii. Nutrients
   iv. Persistent organic pollutants
   (b) Distinguish between CBOD and NBOD. [6]
   (c) A river stream receives waste water from different discharge points (A, B and C) as shown in **Figure 1**. Draw qualitative diagrams showing the changes in the concentration of persistent pollutants, biodegradable organic pollutants and microbial pollutants at different waste discharge points in the downstream. [7]

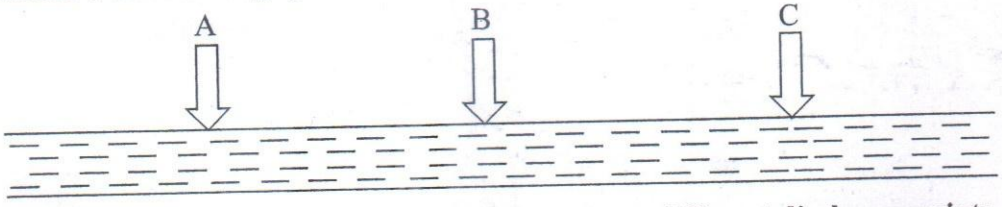

Figure 1: A river is receiving waste water from different discharge points

2 (a) In a lab measurement of BOD, 10 ml of a wastewater is diluted to 300 ml. The initial DO level (after dilution) is 10 mg/L. The test bottle is incubated at 20°C, but after 3 days the incubator malfunctions and the temperature changes to 25°C. After 5 days a DO level of 4 mg/L is measured. If the 20°C rate constant (k) is 0.2/day and $\theta = 1.05$, find the correct BOD_5 at 20^0C of the wastewater. [9]
   (b) Sketch DO sag curve and explain its different phases. [7]
   (c) Explain the concept of natural succession in lakes. [5]
   (d) What are factors controlling eutrophication? [4]

3. 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 18°c at which DO saturation value is 9.0 mg/L. The average velocity in the stream is 0.41 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 70 km reach.

4. (a) What is waste assimilation capacity of streams? What are the factors that affect the self-purification capacity of stream? **[5]**
(b) What are the major sources of ground water pollution? Discuss water pollution control measures in general. **[6]**
(c) Discuss thermal stratification and overturn phenomenon in lake. Explain briefly different layers of a thermally stratified lake with sketch in summer season. **[9]**
(d) **Figure 2** shows the typical diurnal variation of O_3, NO and NO_2 concentrations of a metro city. Explain the reason behind the changes of concentrations with time of above mentioned parameters. **[5]**

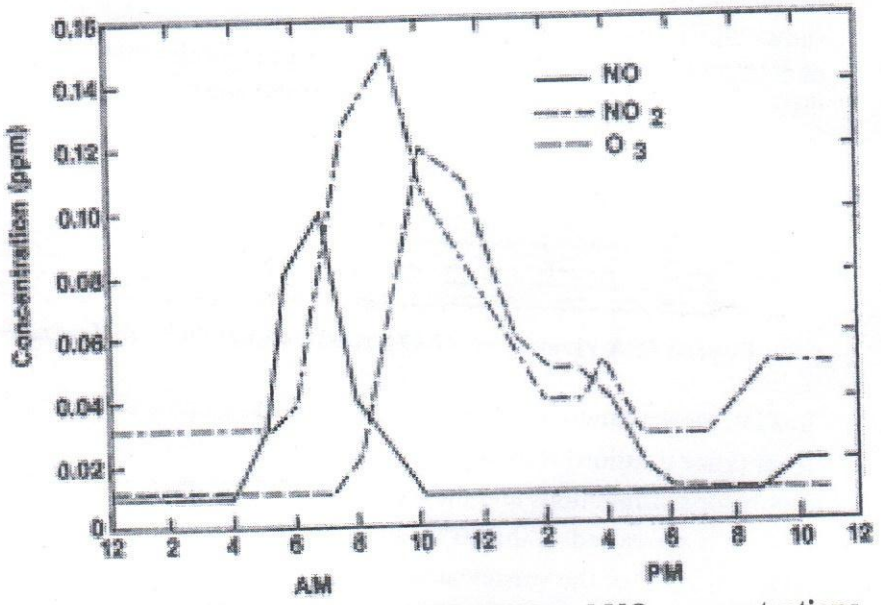

Figure 2: Diurnal variation of O_3, NO and NO_2 concentrations

5. (a) Identify, define and briefly explain the plume patterns from **Figure 3 and Figure 4** where the velocity and adiabatic laps rate profiles are shown. **(8)**

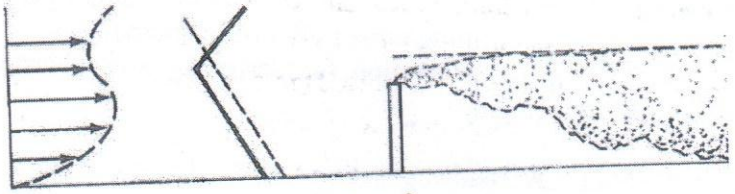

Figure 3

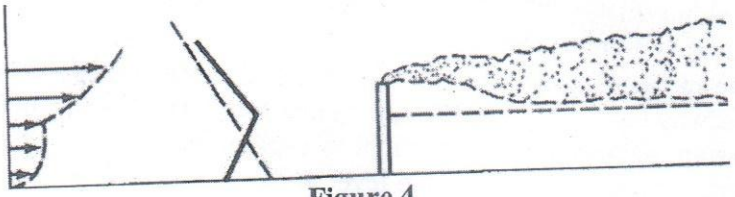

Figure 4

(b) What are the possible control measures for thermal pollution? Discuss briefly. [6]
(c) What are the sources, activities and pathways to marine pollution? [5]
(d) 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? [6]

6. (a) What are the major groups of control devices for particulate contaminants? Calculate the minimum size of particle that will be removed with 100% efficiency from a settling chamber under the following conditions: [7]
   - Horizontal velocity and viscosity of air is 0.3 m/s and $2.1*10^{-5}$ kg/m.s respectively.
   - Specific gravity of the particle is 2.0
   - Length and height of gravitational chamber is respectively 7.5m and 15m.

   (b) What are noise and sound pressure level? A statistical distribution of noise level of a class room is shown in **Figure 5**. Find out the equivalent noise level and noise climate of the room. [7]

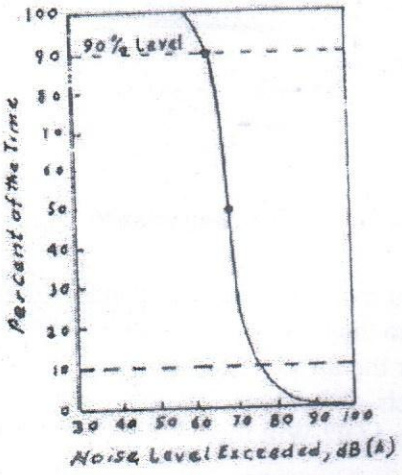

Figure 5: Statistical distribution of noise level

(c) How can be a point source or line source is identified of a propagated sound? What are the techniques for controlling noise pollution at source? [4]

(d) Discuss the design consideration for designing noise barrier according to Federal Highway Administration. [7]

7. (a) Define REMEL. A roadway segment (two lanes, 12 ft each) from has a traffic composition as follows: [25]

Heavy truck: 50 vph each lane, speed=65 mph
Medium truck= 247 vph each lane, speed=55 mph
Auto= 404 vph each lane, speed=60 mph
The surrounding ground can be considered exerting moderate reflection ($\alpha = 0.25$). The roadway has 8.5 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 ground level of a residential house 60 ft distance from the centerline of the roadway. Use **Table 1** for modeled height for different vehicle types and **Figure 6** for barrier attenuation.

(3)

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	2.4

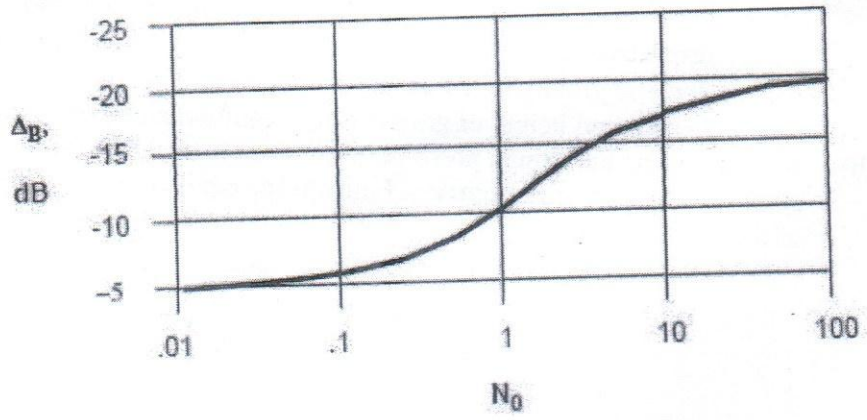

Figure 6: Barrier attenuation vs Fresnel Number for infinitely long barrier

8. (a) What do you mean by Absorption and Adsorption? Mention with examples. [4]

(b) According to the pollutant concentration what AQI and air quality description should be reported for the air pollution on the days given in **Table 2**? Also mention what are the health effects and who are at most risks due to the responsible pollutant for resultant (maximum) AQI? Will there be any emergency declaration for obtained AQI value? [16]

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Table 2: Criteria pollutant concentration in three consecutive days

Pollutant	9th October	10th October	11th October
O_3, 1hr (ppm)	0.15	0.10	0.19
PM_{10}, 24hr, ($\mu g/m^3$)	260	255	320
CO (ppm)	16	13	14
SO_2, (ppm)	0.035	0.030	0.230
NO_2, (ppm)	0.5	0.55	0.45

Use the following chart to calculate AQI values.

These Breakpoints						equal these PSIs...	
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	CO (ppm)	SO_2 (ppm)	NO_2 (ppm)	PSI
0.000 - 0.069	-	0 - 54	0.0 - 15.4	0.0 - 4.4	0.000 - 0.034	([2])	0 - 50
0.070 - 0.084	-	55 - 154	15.5 - 65.4	4.5 - 9.4	0.035 - 0.144	([2])	51 - 100
0.085 - 0.104	0.125 - 0.164	155 - 254	65.5 - 100.4	9.5 - 12.4	0.145 - 0.224	([2])	101 - 150
0.105 - 0.124	0.165 - 0.204	255 - 354	100.5 - 150.4	12.5 - 15.4	0.225 - 0.304	([2])	151 - 200
0.125 - 0.374 (0.155 - 0.404)[4]	0.205 - 0.404	355 - 424	150.5 - 250.4	15.5 - 30.4	0.305 - 0.604	0.65 - 1.24	201 - 300
([3])	0.405 - 0.504	425 - 504	250.5 - 350.4	30.5 - 40.4	0.605 - 0.804	1.25 - 1.64	301 - 400
([3])	0.505 - 0.604	505 - 604	350.5 - 500.4	40.5 - 50.4	0.805 - 1.004	1.65 - 2.04	401 - 500

(c) What is soil pollution? Briefly explain the methods for soil conservation. **[5]**

Necessary Formulas:

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

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

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)

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B.Sc. Engg. (CEE)/ 7th Sem. 5 June, 2018 (Group-B)

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

SEMESTER FINAL EXAMINATION WINTER SEMESTER: 2017-18
COURSE NO. : CEE 4737 TIME : 3.0 Hours
COURSE TITLE: **Industrial Wastewater Treatment** 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.

1.(a) Why the treated wastewater need disinfection before reuse? What are the options available for the disinfection of the treated wastewater? (04)

(b) What is reclaimed water? What are the factors to be considered in reusing of the reclaimed water? List the 7 categories of the treated wastewater reused. (07)

(c) Design a complete mixed activated sludge process aeration tank for treatment of 4 MLD sewage having BOD concentration of 180 mg/L. The effluent should have soluble BOD of 20 mg/L or less. Consider the following: (10)
MLVSS/MLSS = 0.8
Return sludge SS concentration = 10000 mg/L
MLVSS in aeration tank = 3500 mg/L
Mean cell residence time adopted in design is 10 days.

(d) The concentration of mixed-liquor suspended solids (MLSS) is often taken as the concentration of active biomass (represented by the variable X in the AST modeling equations). What are at least two shortcomings to the assumption that X = MLSS? (04)

2.(a) Explain the differences between (06)
(i) Grit chamber and primary settling basin
(ii) Anaerobic and anoxic process.

(b) Design a flotation thickener without and with pressurized recycle to thicken the solids in activated sludge mixed liquor from 0.3% to about 5% using the following data: (10)
Optimum A/S ratio = 0.08 mL/mg
Temperature of water = $20^{o}C$
Air solubility = 18.7 mL/L
Recycle-system pressure = 275 kPa
Fraction of saturation = 0.55
Surface loading rate = 8 L/m^2-min
Sludge flow rate = 425 m^3/day.

(c) An industrial wastewater treatment plant processes an average of 14,000 m^3/d. The peak flow is 1.75 times the average flow. The wastewater contains 190 mg/L BOD_5 and 210 mg/L SS at average flow and 225 mg/L BOD_5 and 365 mg/L SS at peak flow. Using the figure below, determine the following for a primary clarifier with a 20-m diameter. (09)

(i) Surface overflow rate and approximate removal efficiency for BOD_5 and SS at average flow condition.

(ii) Surface overflow rate and approximate removal efficiency for BOD_5 and SS at peak flow condition.

(iii) Mass of solids (kg/d) that is removed as sludge for average and peak flow conditions.

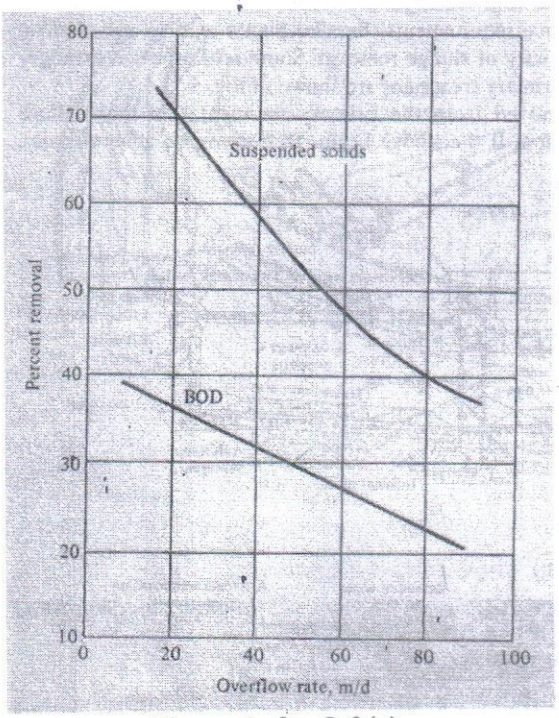

Figure 1. for Q.3(c).

3(a) A wastewater flow of 5000 m^3/d is treated in a facultative oxidation pond that is 2.0 m deep with a surface area of 20 ha. The wastewater has a soluble BOD_5 of 150 mg/L and a reaction rate coefficient of 0.30 d^{-1}. Determine the soluble BOD_5 of the effluent (assuming a completely mixed reactor without solids recycle). (05)

(b) What are the objectives of flotation? "Particles with sp. gravity > 1.0 can be removed by flotation"- explain the removal mechanism. (05)

(c) Why anaerobic digestion is preferable than aerobic digestion? Draw a diagram of an anaerobic digester. (06)

(d) A granular activated carbon absorber is designed to reduce 12 µg/L of chlorobenzene to 2 µg/L. The following conditions are given: K = 100 (mg/g) $(L/mg)^{1/n}$, 1/n = 0.35 and ρ_{GAC} = 480 gm/L. Determine the GAC bed life and carbon usage rate. (09)

4.(a) The operational records at a conventional activated sludge plant are given below. (15)

Wastewater flow Q	7570 m^3/day
Wastewater temperature	20°C
Volume of aeration tanks	2260 m^3
Influent BOD_5	143 mg/L
Influent TSS	125 mg/L
Influent TS	513 mg/L
Effluent TS	418 mg/L
Effluent TSS	24 mg/L
Effluent BOD_5	20 mg/L
Return sludge flow Q_r	3180 m^3/day
MLSS	2600 mg/L
TSS in waste sludge	8900 mg/L
Volume of waste sludge	200 m^3/day

Calculate the following operational parameters: (i) volumetric BOD_5 loading rate, (ii) F/M ratio, (iii) hydraulic retention time, (iv) mean cell retention time, (v) return activated sludge ratio and (vi) removal efficiency of BOD_5, TSS and TS.

(b) Determine the size of anaerobic digester required to treat primary sludge under the conditions given below, using a complete mixed reactor. Also checking the loading rate and estimate the methane gas production. (10)

Average design flow	3785 m^3/day
Dry solid removed	0.15 kg/m^3
Ultimate BOD_5 removed	0.14 kg/m^3
Sludge solids content	5%
Sp. Gravity of solids	1.01
θ_c	15 days
Temperature	35°C
Y	0.5 kg cells/kg BOD_L
K_d	0.04 per day
Efficiency of waste utilization	0.66

5.(a) The operations staff at a sewage treatment plant has decided to reduce the SRT of their activated sludge process from 6 days to 3 days by increasing the recycle rate. The goal is to reduce the oxygen requirement. You have been called in as an expert to give a qualitative assessment of this plan. (06)

(i) Will the oxygen requirement actually be reduced?
(ii) Will the MLVSS increase, decrease or stay about the same?
(iii) Will the sludge settling characteristics improve, stay about the same, or worsen?
(iv) Will the effluent BOD concentration increase, decrease, or stay about the same?

(b) What are the different types of flotation systems? Which one is commonly used in industrial wastewater treatment? (04)

(c) What types of microorganisms are present in anaerobic digester? Also mention the roles of these microorganisms in anaerobic digester. (05)

(d) A wastewater flow of 3550 m^3/day is to be treated in a facultative pond system. The reaction rate coefficient at the average operating temperature is 0.35 d^{-1}.The pond is expected to operate at a dispersion factor of 0.5. Determine the surface area required for 85% removal of soluble BOD for a pond depth of 2.0 m with (i) a single cell pond and (ii) a 4-cell system. (10)

6.(a) State with a flow diagram, the methods used for the treatment of sludge. (04)

(b) What are the objectives of sludge thickening? What are the methods used for sludge thickening? (03)

(c) A wastewater treatment plant consists of primary treatment units followed by an activated sludge secondary system as shown below. The primary and secondary sludge are mixed, thickened in a gravity thickener and send to further treatment. Wastewater, treatment plant and sludge characteristics are as follows: (14)

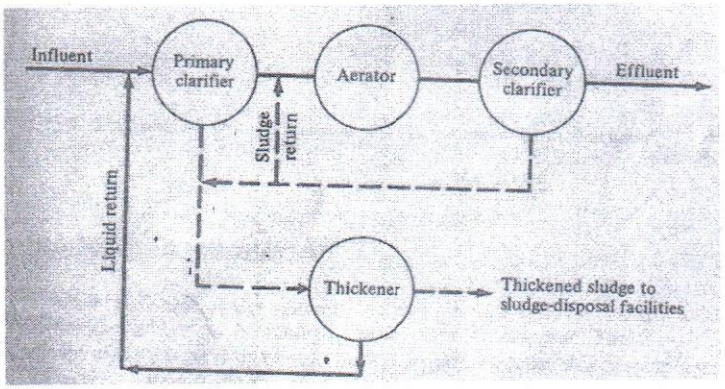

Figure 2 for Q.6(c)

Wastewater	Treatment Plant	Sludge
Influent SS = 200 mg/L	Primary clarifier diameter = 25 m	Primary = 5.0% solids
Influent BOD = 225 mg/L	Aerator volume = 2900 m^3	Secondary = 0.75% solids
Effluent BOD = 20 mg/L	MLSS in aerator = 3500 mg/L	Thickened = 4.0% solids
Flow = 19,000 m^3/d		

Determine (i) the solids loading (kg/d) to the sludge disposal facilities and (ii) the percent volume reduction by the thickener. Use **Figure 1** to estimate the efficiency of the clarifier for SS and BOD.

(d) List the methods used for the ultimate disposal of sludge? What are the factors to be considered for each final disposal options? (04)

7.(a) What are the treatment processes used for the removal of (i) dissolved inorganic constituents and (ii) dissolved organic constituents from the treated wastewater? (04)

(b) What are the significance of BOD/COD ratio in selecting biological treatment process of industrial wastewater? Mention the BOD/COD ratio for various wastewater. (04)

(c) List the major physical, chemical and biological characteristics of industrial wastewater. What are the factors to be considered in selecting a particular treatment unit/process? (05)

(d) A column analysis was run to determine the settling characteristics of an activated sludge suspension. The results of the analysis are given below. (12)

MLSS Con. (mg/L)	1400	2200	3000	3700	4500	5200	6500	8200
Velocity (m/h)	3.0	1.85	1.21	0.76	0.45	0.28	0.13	0.089

The influent concentration of MLSS is 3000 mg/L, and the flow rate is 8000 m^3/d. Determine the size of the secondary clarifier that will thicken the solids to 10,000 mg/L.

8.(a) A processing industry disposes off its effluent into a river. Characteristics of the effluent and the river are shown below: (15)

	Industry	**River**
Flow, m^3/day	1000	19000
Dissolved oxygen, mg/L	0	10.0
Temperature, ^oC	50	2.0
BOD_5 at 20^oC, mg/L	1250	2.0
k_1 at 20^oC, day-1	0.35	-
k_2 at 20^oC, day-1	-	0.55

(i) What will be the DO and BOD_5 after the mixing?

(ii) What will be the lowest DO level in the river as a result of the discharge?

(iii) The river standards require a minimum DO of 5.0 mg/L, what is the maximum BOD_5 (20^oC) that can be discharged by the industry?

(b) What are the two mechanisms known to contribute dissolved oxygen to surface water bodies? Draw a typical DO sag curve for a stream. (04)

(c) List the categories of reused of the reclaimed water? Mention also the considerations of each category of reclaimed water reused. (06)

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B.Sc. Engg. (CEE)/ 7th Sem.

5 June, 2018
(Group B)

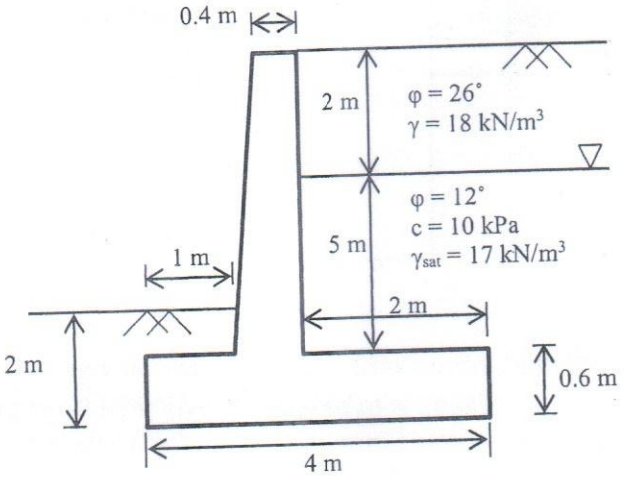
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination — **Summer Semester: 2017-2018**
Course No. : CEE 4741 — **Time : 3.0 Hours**
Course Title: Earth Retaining Structures — **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 symbols have their usual meaning.

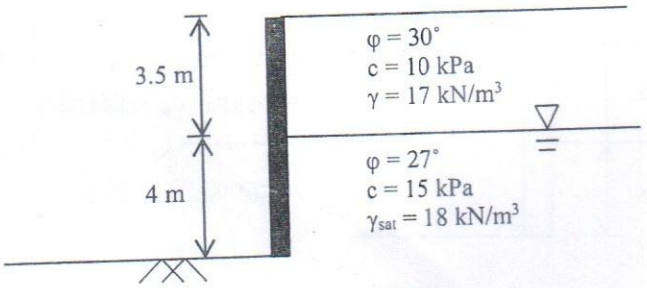
1(a) What is the difference between stress and pressure? (5)

(b) For the cantilever retaining wall shown below, analyze and comment on safety against bearing capacity failure. Use Meyerhof's bearing capacity equation. Ignore the passive resistance in front of wall. (Unit weight of concrete=22.5 kN/m^3. (20)



2(a) Does reinforced earth system is beneficial for Bangladesh? Justify your answer. (5)

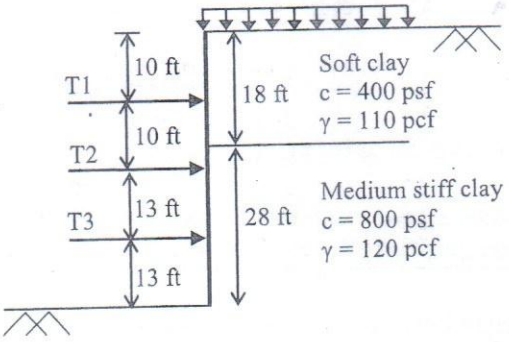
(b) For the retaining wall shown below, determine the active force per unit width of the wall for Rankine state. Also find the location of the resultant. (20)



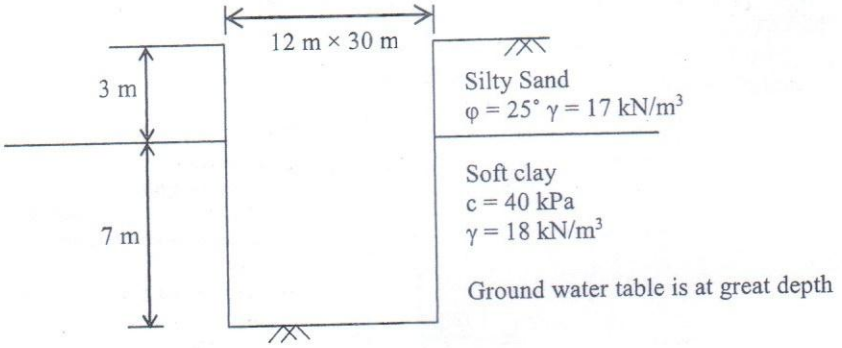
3(a) Show that earth pressure on braced cofferdam in clay can be expressed by the following equation. (5)

$$P_b = \frac{1}{1.55}(\gamma H - 2q_u)$$

(b) Determine the load in the strut T1, T2 and T3 of the following cofferdam based on the maximum average pressure. Total depth of the excavation is 46 ft. Horizontal spacing of the strut is 16 ft each way. (20)

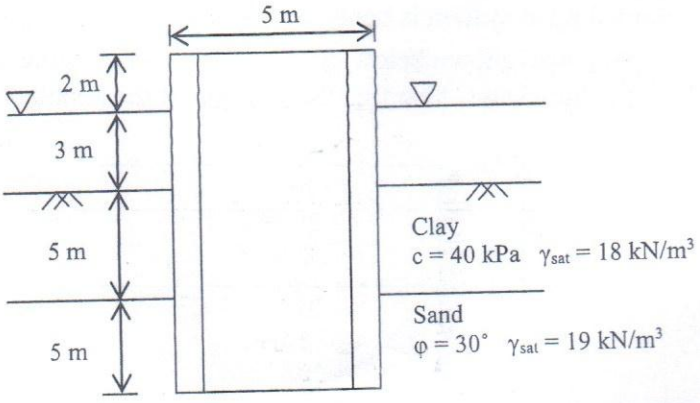


4(a) Determine the possibility of bottom heaving for the excavation shown in the figure below? (13)



(b) Mention principal types of retaining walls with neat sketches. (12)

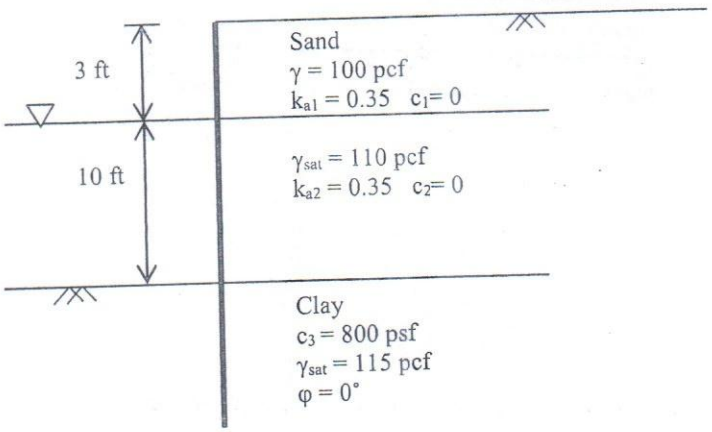
5(a) A concrete caisson foundation is to be constructed for a bridge pier shown in the following figure. Analyze to determine the wall thickness for the caisson to be self-sinking. (13)



(b) Describe the types of caissons with Schematic diagrams. (12)

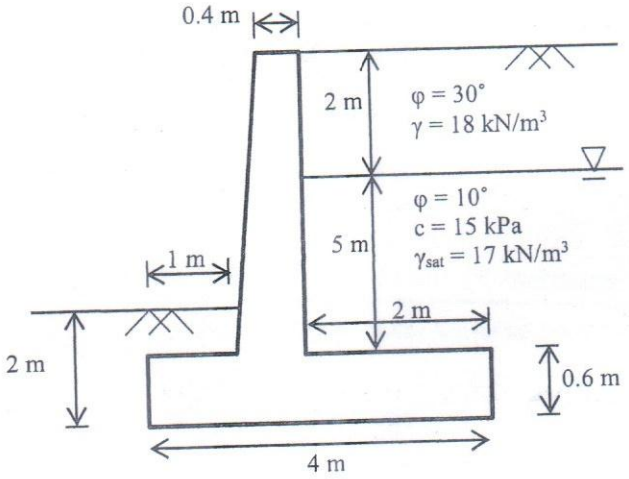
6(a) Write down the applications of sheet pile walls. (5)

(b) For the sheet pile system shown in the following figure, determine the length of sheet pile (Use simplified pressure diagram). (20)



7(a) What is mechanically stabilized retailing walls? (5)

(b) Find the safety against sliding and overturning moment of the cantilever retaining wall shown below. Ignore the passive resistance in front of wall. (20)



8(a) Define active condition and passive condition of earth pressure. (5)

(b) A cantilever sheet-pile wall system is to be designed as shown the following figure. Compute the depth of embedment. Use conventional method. (20)

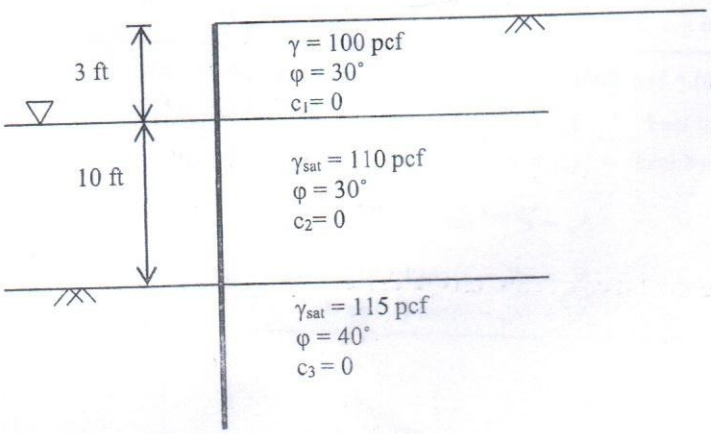
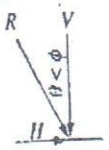


TABLE 4-3
Shape, depth, and inclination factors for the Meyerhof bearing-capacity equations of Table 4-1

Factors	Value	For
Shape:	$s_c = 1 + 0.2K_p\frac{B}{L}$	Any ϕ
	$s_q = s_\gamma = 1 + 0.1K_p\frac{B}{L}$	$\phi > 10°$
	$s_q = s_\gamma = 1$	$\phi = 0$
Depth:	$d_c = 1 + 0.2\sqrt{K_p}\frac{D}{B}$	Any ϕ
	$d_q = d_\gamma = 1 + 0.1\sqrt{K_p}\frac{D}{B}$	$\phi > 10$
	$d_q = d_\gamma = 1$	$\phi = 0$
Inclination:	$i_c = i_q = \left(1 - \frac{\theta°}{90°}\right)^2$	Any ϕ
	$i_\gamma = \left(1 - \frac{\theta°}{\phi°}\right)^2$	$\phi > 0$
	$i_\gamma = 0$ for $\theta > 0$	$\phi = 0$

Where $K_p = \tan^2(45 + \phi/2)$ as in Fig. 4-2
θ = angle of resultant R measured from vertical without a sign; if $\theta = 0$ all $i_i = 1.0$.
B, L, D = previously defined

TABLE 4-1
Bearing-capacity equations by the several authors indicated

Terzaghi (1943). See Table 4-2 for typical values and for $K_{p\gamma}$ values.

$$q_{ult} = cN_c s_c + \bar{q}N_q + 0.5\gamma BN_\gamma s_\gamma$$

$$N_q = \frac{a^2}{a\cos^2(45 + \phi/2)}$$

$$a = e^{(0.75\pi - \phi/2)\tan\phi}$$

$$N_c = (N_q - 1)\cot\phi$$

$$N_\gamma = \frac{\tan\phi}{2}\left(\frac{K_{p\gamma}}{\cos^2\phi} - 1\right)$$

For:	strip	round	square
s_c =	1.0	1.3	1.3,
s_γ =	1.0	0.6	0.8

Meyerhof (1963).* See Table 4-3 for shape, depth, and inclination factors.

Vertical load: $q_{ult} = cN_c s_c d_c + \bar{q}N_q s_q d_q + 0.5\gamma B' N_\gamma s_\gamma d_\gamma$

Inclined load: $q_{ult} = cN_c d_c i_c + \bar{q}N_q d_q i_q + 0.5\gamma B' N_\gamma d_\gamma i_\gamma$

$$N_q = e^{\pi\tan\phi}\tan^2\left(45 + \frac{\phi}{2}\right)$$

$$N_c = (N_q - 1)\cot\phi$$

$$N_\gamma = (N_q - 1)\tan(1.4\phi)$$

Hansen (1970) * C...

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M. Sc. Engg. (CEE) 24 May 2018 (Group B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

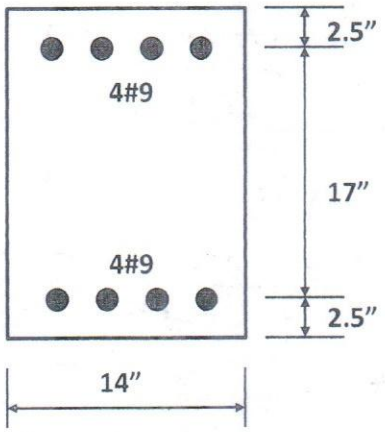
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination **Winter Semester: 2017-2018**
Course No.: CEE 6107 **Full Marks: 150**
Course Title: Advanced Design of Concrete Structures **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 meanings.

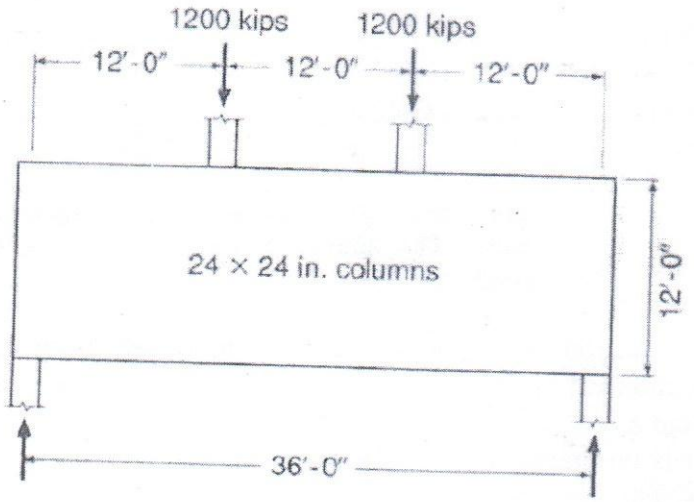
1. The column section shown in the following figure carries an axial load P_D = 136 kips and a moment of M_D = 116 ft-kips due to dead load and an axial load P_L = 110 kips and a moment M_L = 93 ft-kips due to live load. The column is part of a frame that is un-braced against side sway and bent in single curvature about its major axis. The unsupported length is l_u = 16 ft, and the moments at both ends of the column are equal. Check the adequacy of the column using f_c' = 4 ksi, f_y = 60 ksi, Ψ_A = 0.8, Ψ_B = 2.0, K=1.4 and a sway moment of 64 ft-kips. (25)



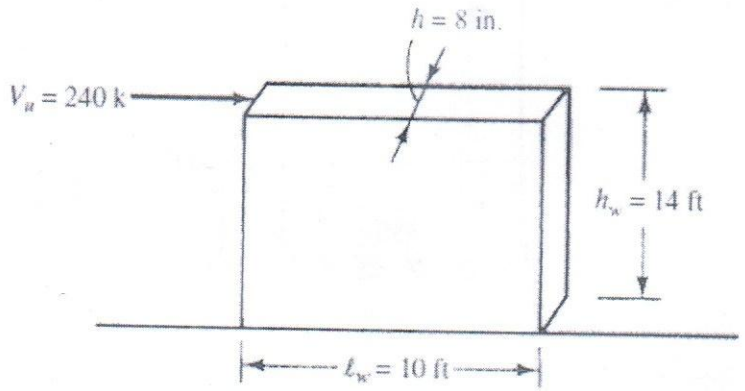
2. Design a waffle floor system that consists of square panels without beams considering the following data: (25)

Span, center to center of columns = 33 ft.
Width of rib = 6 in., spaced at 36 in. on centers.
Depth of rib = 14 in. and slab thickness = 3 in.
Voided volume of 14 in. rib = 6.54 ft^3
Column size = 20 in. × 20 in.
Size of solid head = 12.5 ft × 12.5 ft.
Column and middle strips consist of five and six ribs, respectively.
Dead load (excluding selfweight) = 50 psf.
Live load = 100 psf.
f_c' = 5 ksi, f_y = 60 ksi, λ = 1.
Assume reasonable values for missing data, if any.

3. A transfer girder is to carry two 24 in. square columns, each with factored loads of 1200 kips located at the third points of its 36 ft span, as shown in the following figure. The beam has a thickness of 2 ft and a total height of 12 ft. Design the beam for the given loads, ignoring the self-weight, using $f_c' = 5$ ksi and $f_y = 60$ ksi. (25)



4. Design the reinforced concrete shear wall shown in the following figure if $f_c' =$ 3,000 psi and $f_y = 60{,}000$ psi. (25)

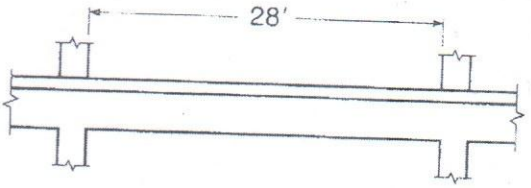


5. Design a circular beam supported on eight equally spaced columns. The center line of the columns lies on a 40-ft diameter circle. The beam carries a uniform dead load of 6 k/ft and live load of 5 k/ft. Use normal weight concrete with $f_c' =$ 4 ksi, $f_y = 60$ ksi and b = 14 inch. (25)

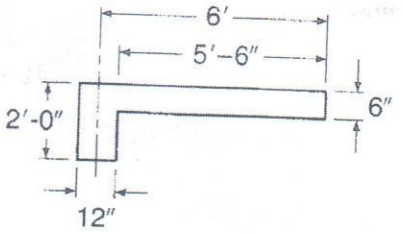
6. Design the side walls and hopper bottom of a 4 m by 4 m square bunker to store 40 tonnes of coal. Density of coal = 9 kN/m^3. Angle of repose of coal = 30°. Adopt M-15 grade concrete ($f_c' = 15$ MPa; $f_c = 5$ MPa; j = 0.903; R = 0.659; m = 19) and ribbed tor steel ($f_y = 415$ MPa; $f_s = 230$ MPa). Sketch the details of reinforcements in the bunker. (25)

7. The 28 ft span beam shown in the following figure carries a monolithic slab cantilevering 6 ft past the beam centerline. The resulting L beam supports a live load of 900 lb/ft along the beam centerline plus 50 psf uniformly distributed over the upper slab surface. The effective depth to the flexural steel centroid is 21.5 (25)

in, and the distance from the beam surfaces to the centroid of stirrup steel is 1.75 in. Material strengths are $f_c' = 5000$ psi and $f_y = 60{,}000$ psi. Design the torsional and shear reinforcement for the beam.

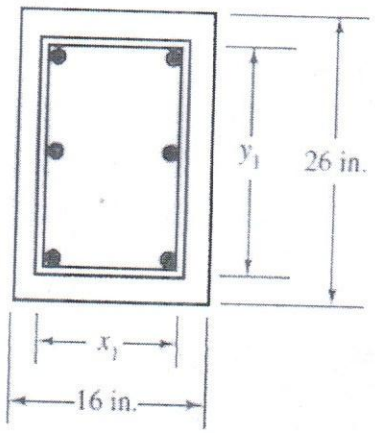


Longitudinal section



Cross-section

8. Design the torsional reinforcing needed for the beam shown in the following figure if $f_c' = 4000$ psi, $f_y = 60{,}000$ psi, $T_u = 30$ ft-k, and $V_u = 60$ k. Assume 1.5-in. clear cover, #4 stirrups, and a required A_s for M_u of 3.52 in^2. Select #8 bars for flexural reinforcing. Normal-weight concrete is specified. (25)



Given Equations and Tables (CEE-6107)

$$\frac{kl_u}{r} \le 34 - 12\left(\frac{M_1}{M_2}\right);\ \delta_s = \frac{1}{1-\frac{\sum P_u}{0.75\sum P_c}} \ge 1;\ EI = \frac{0.2E_c I_g + E_s I_{se}}{1+\beta_d};\ C_m = 0.6 + 0.4\frac{M_1}{M_2} \ge 0.4;$$

$$M_{2,min} \ge P_u(0.6 + 0.03h);$$

$$V_u = \emptyset V_n \le \emptyset 10\sqrt{f_c'}hd\ ;\ d = 0.8l_w\ ;\ V_c = 2\sqrt{f_c'}hd\ ;\ V_u = \emptyset V_c + \emptyset V_s$$

$$V_c = 2\lambda\sqrt{f_c'}hd + \frac{N_u d}{4l_w};\ V_c = \left[0.6\lambda\sqrt{f_c'} + \frac{l_w\left(1.25\lambda\sqrt{f_c'} + \frac{0.2N_u}{l_w h}\right)}{\left(\frac{M_u}{V_u}\right) - \left(\frac{l_w}{2}\right)}\right]hd$$

$$\frac{A_{vv}}{s_1} \ge \left[0.0025 + 0.5\left(2.5 - \frac{h_w}{l_w}\right)\left(\frac{A_{vh}}{s_2 h} - 0.0025\right)\right]h;$$

$$\rho_l = 0.0025 + 0.5\left(2.5 - \frac{h_w}{l_w}\right)(\rho_h - 0.0025);\ \frac{z}{l_w} = \frac{1}{2+\frac{0.85\beta_1 l_w h f_c'}{A_{st} f_y}};$$

$$M_u = \emptyset\left[0.5A_{st}f_y l_w\left(1 - \frac{z}{l_w}\right)\right];\ A_s = \frac{M_u'}{f_y(l_w - c_w)}$$

$$T_u \le \emptyset\lambda\sqrt{f_c'}\left(\frac{A_{cp}^2}{p_{cp}}\right);\ \sqrt{\left(\frac{V_u}{b_w d}\right)^2 + \left(\frac{T_u p_h}{1.7A_{oh}^2}\right)^2} \le \emptyset\left(\frac{V_c}{b_w d} + 8\sqrt{f_c'}\right);\ A_t = \frac{T_u s}{2\emptyset A_o f_{yt}\cot\theta}$$

$$A_v(min) = \frac{0.75\sqrt{f_c'}b_w s}{f_{yt}} \ge \frac{50 b_w s}{f_{yt}};\ A_l = \frac{A_t}{s}p_h\frac{f_{yt}}{f_y}(\cot\theta)^2\ ;\ A_l(min) = \frac{5\sqrt{f_c'}A_{cp}}{f_y} - \left(\frac{A_t}{s}\right)p_h\frac{f_{yt}}{f_y}$$

$$\frac{A_t}{s} \ge \frac{25 b_w}{f_{yt}};\ V_c = \left(2 + \frac{4}{\beta}\right)\sqrt{f_c'}b_o d\ ;\ V_c = \left(\frac{\alpha_s d}{b_o} + 2\right)\sqrt{f_c'}b_o d\ ;\ V_c = 4\lambda\sqrt{f_c'}b_o d$$

$$p = wh\cos^2\emptyset;\ M = \frac{pl^2}{12};\ M = \frac{pl^2}{24};\ d = \sqrt{\frac{(M - Tx)}{Rb}};\ A_{st} = \frac{M - Tx}{f_s jd} + \frac{T}{f_s};$$

$$p_n = wh(\cos^2\theta + \cos^2\emptyset\sin^2\theta)$$

Table-1:

β_s values for strut strength

Condition	β_s
Strut with uniform cross section over its entire length	1.0
Strut with the width at midsection larger than the width at the nodes (bottle-shaped strut) and with reinforcement satisfying transverse requirements	0.75
Strut with the width at midsection larger than the width at the nodes (bottle-shaped strut) and reinforcement not satisfying transverse requirements	0.60λ[†]
Struts in tension members or in the tension flange of members	0.40
All other cases, Fig. 10.11	0.60λ

[†] λ equals 1.0 for normalweight concrete, 0.85 for sand-lightweight concrete, and 0.75 for all-lightweight concrete.

Table-2:

β_n values for node strength

Nodal Zone Condition	Classification	β_n
Bounded by struts or bearing area	*C-C-C*	1.0
Anchoring one tie	*C-C-T*	0.80
Anchoring two or more ties	*C-T-T* or *T-T-T*	0.60

Table-3:

Minimum Thickness of Slabs Without Interior Beams

	Without Drop Panels[a]			With Drop Panels[a]		
	Exterior Panels			Exterior Panels		
Yield Stress f_y psi (1)[b]	Without Edge Beams	With Edge Beams	Interior Panels	Without Edge Beams	With Edge Beams[c]	Interior Panels
40,000	$\frac{l_n}{33}$	$\frac{l_n}{36}$	$\frac{l_n}{36}$	$\frac{l_n}{36}$	$\frac{l_n}{40}$	$\frac{l_n}{40}$
60,000	$\frac{l_n}{30}$	$\frac{l_n}{33}$	$\frac{l_n}{33}$	$\frac{l_n}{33}$	$\frac{l_n}{36}$	$\frac{l_n}{36}$

[a] For values of reinforcement, yield stress between 40,000 and 60,000 psi minimum thickness shall be obtained by linear interpolation.

[b] Drop panel is defined in ACI Sections 13.3.7 and 13.2.5.

[c] Slabs with beams between columns along exterior edges. The value of α_f for the edge beam shall be not less than 0.8.

Table-4:

Distribution of Moments in an End Panel

	Exterior Edge		Slab with Beams between All Supports	Slab without Beams between Interior Supports	
	Unrestrained (1)	Fully Restrained (2)	(3)	With Edge Beam (4)	Without Edge Beam (5)
Exterior negative factored moment	0	0.65	0.16	0.30	0.26
Positive factored moment	0.63	0.35	0.57	0.50	0.52
Interior negative factored moment	0.75	0.65	0.70	0.70	0.70

Table-5:

Force Coefficients of Circular Beams

Number of Supports, n	$\theta = \frac{\pi}{n}$	K_1	K_2	K_3	$\alpha°$ for T_u (max)
4	90	0.215	0.110	0.0330	19.25
5	72	0.136	0.068	0.0176	15.25
6	60	0.093	0.047	0.0094	12.75
8	45	0.052	0.026	0.0040	9.50
9	40	0.042	0.021	0.0029	8.50
10	36	0.034	0.017	0.0019	7.50
12	30	0.024	0.012	0.0012	6.25

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M. Sc. Engg. (CEE) June 01, 2018 (Group B)

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

TERM : FINAL EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : CEE 6109 TIME : 3 Hours
COURSE TITLE: Advanced Concrete Technology 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 = 0.40
Cement Type: CEM Type I
Air Content = 1.5 % (non-air-entrained concrete)
Specific gravity of cement = 3.1 (for CEM Type I cement)
Specific gravity of sand (SSD) = 2.65
Specific gravity of coarse aggregate (SSD) = 2.60
Design compressive strength (28 days) = 5000 psi
Minimum required slump = 175 mm
Maximum aggregate size = ¾ inch, Aggregate type = Stone chips
Dosage of superplasticizer = 7 ml/kg of cement if W/C is less than 0.45.
FM of Coarse Aggregate = 6.6, FM for Fine Aggregate = 2.6

The following graphs are provided :

- Variation of compressive strength (28 days) with W/C (**Fig. 1**),
- Variation of cement content with compressive strength (28 days) for different aggregate size and slump value (**Fig. 2**).

(i) Prepare a mix design for the specified concrete.
(ii) Calculate the unit weight of fresh concrete.
(iii) Calculate the volume ratio of the mix. Assume 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. 450, cost of 1 cft sand is Tk. 30, and cost of 1 cft stone chips is Tk. 180.
(v) Calculate the compaction factor of the mix.
(vi) If s/a is changed to 0.44, discuss the possible changes in fresh and hardened properties of concrete.
(vii) If CEM Type II B-M cement is used instead of CEM Type I cement, discuss the possible changes in fresh and hardened properties of concrete at the early stage and after a long term.

(viii) Explain the changes in properties of fresh and hardened concrete, if FM of sand is reduced to 2.0 instead of 2.6.

(ix) If the specific gravity of coarse aggregate is increased to 2.85 from 2.60; what changes will occur in the mix design of concrete.

(x) If wet sand is used, how will you modify the mixture proportion of concrete?

2 The specified FM of fine aggregate of a bridge project is 2.6. The sieve analysis data of a fine aggregate sample collected for the bridge project are summarized below: 20

ASTM Sieve	Materials Retained (g)
3 inch	0
1.5 inch	0
1.0 inch	0
¾ inch	0
½ inch	0
3/8 inch	0
#4	40
#8	70
#12	60
#16	30
#30	50
#40	0
#50	0
#100	40
#200	20
Pan	90

(i) Calculate the FM of the sample,

(ii) Draw the grading curve of the sample,

(iii) Make a brief discussion on the FM, sieve analysis data, and grading curve,

(iv) What measures are necessary to improve the grading of the sand sample?

(v) In what ratio the sand sample is to be mixed with another sand sample of FM 2.0 to obtain the required fineness modulus of 2.6?

Sieve openings for ASTM sieves are provided in **Table 1**.

3 The following data (carbonation depth with time) were recorded for a structure in Dhaka City: 20

Time (Year)	Carbonation Depth (mm)
0	0
5	15
10	12
15	23
20	22
30	32
40	35
50	43

(i) Define carbonation of concrete with chemical reactions.
(ii) Briefly explain carbonation induced corrosion of steel in concrete with chemical reactions.
(iii) Discuss the factors which will influence carbonation depth of concrete.
(iv) "In Bangladesh, carbonation induced corrosion of steel is generally found under the soffit/bottom of slab after a short period of service life"-Explain the reasons.
(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?
(vii) Draw the depth of carbonation versus square root of time curve in a plain graph paper,
(viii) Determine the carbonation coefficient of concrete,
(ix) Determine the time necessary to break down the passivation film over the steel bars inside concrete, if cover depth is 20 mm.
(x) What will be the depth of carbonation after 70 years of service life?

4 A structure was constructed in the marine environment of Cos's Bazar. Concrete samples were collected to determine chloride profile in concrete after 20 years of service life. Mixture proportion of concrete and data associated with the chloride profile are given in **Table 2** and **Table 3**. 30

i) Draw chloride profiles with units of chloride concentration as kg/m^3 and % of cement mass.
ii) If cover concrete depth over steel bar is 50 mm, make comments on the possibility of initiation of corrosion over the steel bar.
iii) How will you determine apparent diffusion coefficient of chloride from the given data (write steps only)?
iv) How will you predict the chloride profile after 30 years of exposure (write steps only)?

v) How will you predict the time to initiate corrosion (write steps only)?

5 You have added 33 g of water with 100 g of cement. For under water curing of the cement paste, calculate the following: 20

(i) Amount of un-hydrated cement
(ii) Gel-to-space ratio
(iii) Make a brief discussion on the change in microstructure of cement paste with W/C
(iv) "W/C is a key factor related to strength, permeability, and durability of concrete"-Justify.
(v) "For sustainable development of Blue Economy, we need to consider durability of concrete seriously" – Explain.

6(a) "Concrete industries pollute our environment significantly" – Justify. 5

(b) Write the name of the mineral admixtures that are recommended to be used in cement in addition to clinker and gypsum as per **BDS EN 197-1 2003**. Also, discuss the function of these materials in cement. 5

(c) "Silica fume is a pozzolanic material"-Why? 5

(d) Discuss the following type of cement (composition only): 5

(i) CEM Type I
(ii) CEM Type II A-M
(iii)CEM Type II B-M
(iv)CEM Type II A-S
(v) CEM Type II A-L

Table 1 Traditional American and British Sieve Sizes

Aperture mm or μm	Approximate Imperial equivalent in.	Previous designation of nearest size	
		BS	ASTM
125 mm	5	—	5 in.
106 mm	4.24	4 in.	4.24 in.
90 mm	3.5	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.
75 mm	3	3 in.	3 in.
63 mm	2.5	$2\frac{1}{2}$ in.	$2\frac{1}{2}$ in.
53 mm	2.12	2 in.	2.12
45 mm	1.75	$1\frac{3}{4}$ in.	$1\frac{3}{4}$ in.
37.5 mm	1.50	$1\frac{1}{2}$ in.	$1\frac{1}{2}$ in.
31.5 mm	1.25	$1\frac{1}{4}$ in.	$1\frac{1}{4}$ in.
26.5 mm	1.06	1 in.	1.06
22.4 mm	0.875	$\frac{7}{8}$ in.	$\frac{7}{8}$ in.
19.0 mm	0.750	$\frac{3}{4}$ in.	$\frac{3}{4}$ in.
16.0 mm	0.625	$\frac{5}{8}$ in.	$\frac{5}{8}$ in.
13.2 mm	0.530	$\frac{1}{2}$ in.	0.530 in.
11.2 mm	0.438	—	$\frac{7}{16}$ in.
9.5 mm	0.375	$\frac{3}{8}$ in.	$\frac{3}{8}$ in.
8.0 mm	0.312	$\frac{5}{16}$ in.	$\frac{5}{16}$ in.
6.7 mm	0.265	$\frac{1}{4}$ in.	0.265 in.
5.6 mm	0.223	—	No. $3\frac{1}{2}$
4.75 mm	0.187	$\frac{3}{16}$ in.	No. 4
4.00 mm	0.157	—	No. 5
3.35 mm	0.132	No. 5	No. 6
2.80 mm	0.111	No. 6	No. 7
2.36 mm	0.0937	No. 7	No. 8
2.00 mm	0.0787	No. 8	No. 10
1.70 mm	0.0661	No. 10	No. 12
1.40 mm	0.0555	No. 12	No. 14
1.18 mm	0.0469	No. 14	No. 16
1.00 mm	0.0394	No. 16	No. 18
850 μm	0.0331	No. 18	No. 20
710 μm	0.0278	No. 22	No. 25
600 μm	0.0234	No. 25	No. 30
500 μm	0.0197	No. 30	No. 35
425 μm	0.0165	No. 36	No. 40
355 μm	0.0139	No. 44	No. 45
300 μm	0.0117	No. 52	No. 50
250 μm	0.0098	No. 60	No. 60
212 μm	0.0083	No. 72	No. 70
180 μm	0.0070	No. 85	No. 80
150 μm	0.0059	No. 100	No. 100
125 μm	0.0049	No. 120	No. 120
106 μm	0.0041	No. 150	No. 140
90 μm	0.0035	No. 170	No. 170
75 μm	0.0029	No. 200	No. 200
63 μm	0.0025	No. 240	No. 230
53 μm	0.0021	No. 300	No. 270
45 μm	0.0017	No. 350	No. 325
38 μm	0.0015	—	No. 400
32 μm	0.0012	—	No. 450

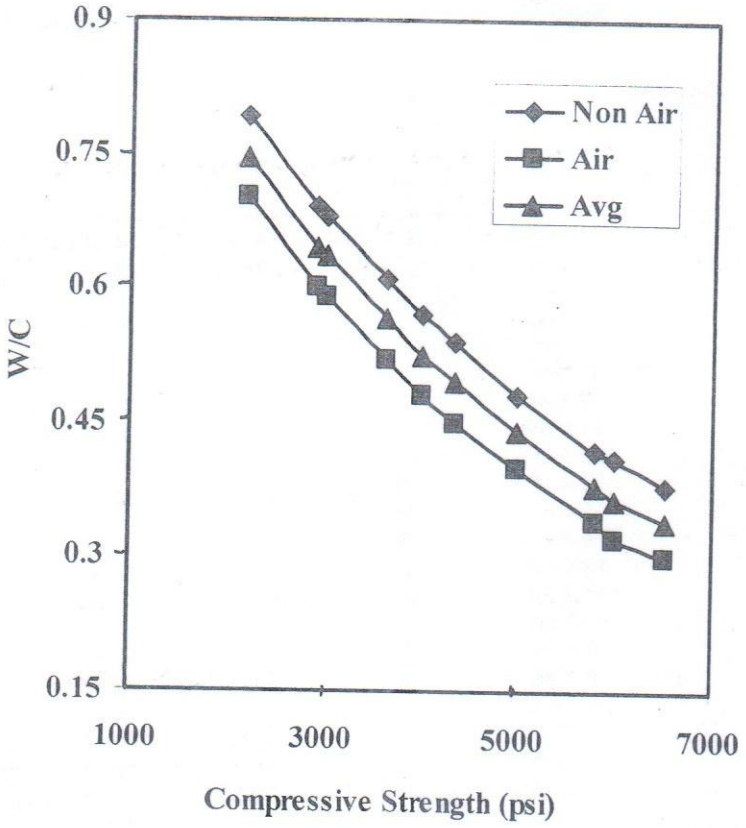

Fig. 1 W/C versus Compressive Strength (aggregate type = stone chips)

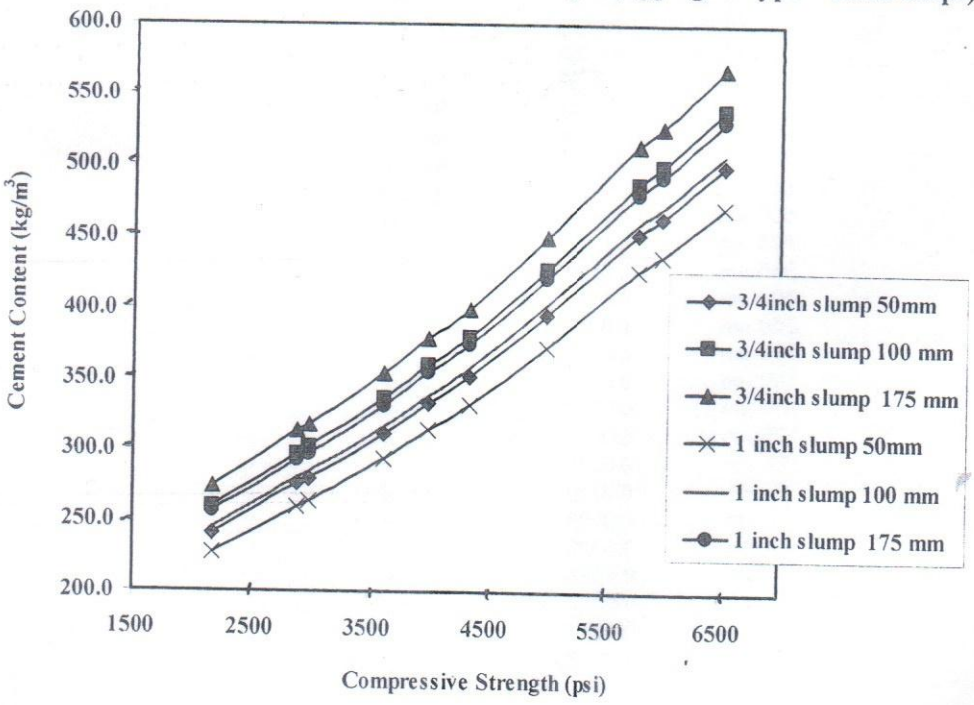

Fig. 2 Cement Content versus Compressive Strength (aggregate type = stone chips)

Table 2 - 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	375	187.5	700	1037.5

Table 3 : 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)
5	10	100	2	5
15	20	100	4	4
25	20	100	6	3
40	20	100	9	2
50	20	100	20	1

Concentration of $AgNO_3$ solution is N/200.

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

Semester Final Examination — **Summer Semester: 2017-2018**
Course No.: CEE 6505 — **Full Marks: 150**
Course Title: Transportation Planning — **Time: 3.0 hours**

There are 5 (Five) Questions. Answer all the questions. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume any missing values. The examination is open book. Students are allowed to bring books and materials to be used during the examination.

1 (a) Prepare a table and present the input variables, surveys to collect data on those input variables and the outputs of a classical 4-step travel demand forecasting model. (15)

(b) Design the questionnaires for all the major surveys conducted in a 4-step travel demand forecasting study for a city master plan project. Fill each form up with one sample data point (e.g., for household survey, the demographic and trip data of a family). (30)

2. Generate 10 hypothetical samples for a household survey considering 5 major socio-economic and demographic variables. Now, using only one independent variable, develop a trip generation model using simple linear regression technique. (25)

3. Imagine a study area consisting of three zones. Each zone in the base year generates 75, 85 and 120 and attracts 80, 100 and 100 trips. In the horizon year, they generate 95, 90 and 145 trips and attracts 110, 80 and 140 trips. The cost function is: (35)

$$f(c_{ij}) = 1/c_{ij}^3$$

and the associated costs to travel between the O-D pairs are:

1.0 1.2 1.4
1.2 1.0 1.7
1.4 1.7 1.0

Generate the horizon year trip matrix. Assume any values as needed.

4. Let the number of trips between an OD pair be 10,000. The available modes between the OD pair are bus, rail and cars. The generalized costs of these modes can be calculated using the values in the following table: (25)

	In veh. time	Walk time	Transfer	Fuel/Fare	Parking
Coefficient	0.03	0.04	0.08	0.12	0.15
Train	24	10	15	8	-
Bus	32	5	2	5	-
Car	18	-	-	20	3

Calculate the mode share. How can you increase the ridership of rail by 5% (provide policy level suggestions only. No need to show calculations.) How much revenue will rail generate after this ridership boost?

5. Assume that there are three routes available to travers an OD pair. The travel time required in each route are as follows: (20)

$t_1 = 8 + 3x_1$

$t_2 = 10 + 5x_2$, and,

$t_3 = 12 + x_3$

The OD matrix suggest that around 20 units of trips travel between this OD pair where Route 2 and 3 together cater for 40% of the total trips. How many trips will be served by each route?