188

B.Sc. Engg. (CEE)/ 1st Sem. 28 September, 2022(Morning)

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

Mid Semester Examination **Winter Semester: 2021-2022**
Course No.: CEE 4103 **Full Marks: 100**
Course Title: Surveying **Time: 1.5 hours**

There are 4 questions. Answer any one question from question number 1 and 2. Question no. 3 and 4 are compulsory. Programmable calculators are not allowed. Do not write on this question paper. The figures in the write margin indicate full marks.

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 the missing data and fill up the table. Apply necessary checks and draw diagram of the stations based on their R.L. (20) (CO2- PO2)

Station	B.S(m)	I.S.(m)	F.S.(m)	Rise(m)	Fall(m)	R.L.(m)	Remarks
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) A level is used to take readings between station A and station B. The combined correction due to curvature and refraction is 0.129 m. Find the distance between A and B. (08) (CO2- PO2)

(c) Compute the area of the closed traverse from the following data: (12) (CO2- PO2)

Side	Latitude	Departure
AB	-116.1	-44.4
BC	+6.8	+58.2
CD	+80.5	+17.2
DA	+28.8	-31.0

2(a) Complete the following level-book and find RL of BM-A. Also apply the arithmetical check. (20) (CO2- PO2)

B.S.	I.S.	F.S.	Ht. of the Instrument Axis	R.L.	Remarks
3.415					BM-A
	2.725				
0.975		1.855			
1.365		2.450			
	0.475				
2.825		2.405			
3.065		1.685			
1.500		1.400			
		2.750		512.00	BM-B

(b) Two pegs A and B are fixed 100 m apart. A level is set up near A. Observations on a staff held at A and B gave the following readings: A=1.650 m, B= 1.665 m. The level is then placed near B and observations on a staff held A and B gave the following: A=1.590 m, B=1.575 m. State whether the instrument is in adjustment or not. Also determine the correct difference in level between A and B. (10) (CO2- PO2)

(c) A 400 m2 square plot ABCD forms the plane of a pit excavated for road work. Calculate the volume of the excavation in cubic metres from the following data: (10) (CO2- PO2)

Point	A	B	C	D
Original level(m)	25	26	27	24
Final level(m)	21	20	22	19

3(a) A closed traverse ABCDEA was conducted and due to difficulties in the field, the bearing of line EA and length of line DE could not be measured..From the remaining data of the traverse, find the missing quantities. (20) (CO4-PO2)

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

(b) A rectangular plot was measured with a 20 m chain which was found 12 cm too long. The lengths of the sides were recorded as 280 m and 420 m. Find the true area of the plot. (10) (CO4-PO2)

(c) List the points on which 'Traverse Surveying' differs from 'Chain Surveying'. Describe the 'Graphical Method' for balancing a closed traverse. (3+7) (CO4-PO2)

4(a) For what type of project/area chain Surveying is suitable? State the purpose(s) of 'Check line' and 'Base line' in case of chain surveying? Differentiate clearly between plane and geodetic surveying. (3+4+3) (CO1-PO1)

(b) Define: (i) Level line (ii) Datum (iii) Elevation (iv) Station (10) (CO1-PO1)

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)× 90^o	27. $H = \frac{1}{2}[(h_a - h_b) + (h_a - h_b)]$
11. exclude angle=(2N+4)× 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. $\frac{Map\ Distance}{Photo\ Distance} = \frac{Map\ Scale}{Photo\ Scale}$

191

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

04 October, 2022
10:30 AM - 12:00 PM

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

Mid Semester Examination | **Winter Semester: 2021 - 2022**
Course No.: PHY 4153 | **Full Marks: 75**
Course Title: Physics I | **Time: 1.5 Hours**

There are **4 (Four)** questions. Answer any 3 **(Three)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Any other statements, if necessary.

---

1. (a) Define Lissajous figures. On which factors do they depend? (05) (CO1) (PO1)

(b) Find the general equation for the composition of two simple harmonic motions acting simultaneously at right angle to each other having frequency ratio 2:1. (15) (CO2) (PO2)

(c) A pendulum of mass m raised to a height h and then released. The pendulum hits a spring obeying non-linear force law, $F = -2x - 3x^3$, situated at equilibrium. Calculate the compression x of the spring. (05) (CO3) (PO2)

2. (a) State and explain free vibration and damped motion. (05) (CO1) (PO1)

(b) Find the general solution of damped motion. Illustrate different types of damped motion. (15) (CO2) (PO2)

(c) A massless spring, suspended from a rigid support, carries a mass of 600 gm at its lower end and the system oscillate with a frequency of 5 Hz. If the amplitude is reduced to half its undamped value in 25 s, calculate (i) the force constant of the spring, (ii) the relaxation time of the system and (iii) its quality factor. (05) (CO3) (PO2)

3. (a) Clarify the difference between constructive and destructive interferences of light. (05) (CO1) (PO1)

(b) (i) Describe in detail how you would find the wavelength of a monochromatic source using a Fresnel's biprism, and (ii) formulate the thickness of a thin film using Young's double-slit method. (15) (CO2) (PO2)

(c) Newton's rings are observed in reflected light of wavelength 590 nm. The diameter of the 10th black ring is 0.50 cm. Find the radius of curvature of the lens and the thickness of the air film. (05) (CO3) (PO2)

4. (a) (i) State what you understand by the diffraction of light, and (ii) illustrate with geometrical figures how diffraction occurs. (05) (CO1) (PO1)

(b) Discuss the Fraunhofer diffraction pattern due to a single slit and (ii) show mathematically and graphically how you can obtain the secondary maxima. (15) (CO2) (PO2)

(c) A parallel beam of monochromatic light is allowed to be incident normally on a double slit. The slit width is 0.2 cm and the opaque distance between the slits is 0.4 cm. A second order spectral line is observed to be deviated through 30°. Calculate the wavelength of the spectral lines. (05) (CO3) (PO2)

193

B.Sc. Engg. (CEE)/1st Sem. 5 October, 2022 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM: MID SEMESTER EXAMINATION
COURSE NO.: Chem - 4153
COURSE TITLE: Chemistry –1

WINTER SEMESTER: 2021-2022
TIME: 1.5 Hours
FULL MARKS: 75

There are **4 (Four)** questions. Answer any **3 (Three)** questions. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO in the brackets. Symbols convey their usual meanings. Assume reasonable values for any missing data.

---

1. (a) What are colligative properties? Why are they called colligative properties? Explain with a suitable figure why the vapour pressure of a solution is always lower than that of its solvent? **(8.33) (CO2) (PO1)**

(b) What are the basic differences between molality and solubility of a solution? Discuss the effects of temperature on the solubility of a solid in water. To explain this effect which principle is used? State that principle. **(8.67) (CO1) (PO1)**

(c) A aqueous sugar solution of 0.1M concentration is prepared. The density of the solution is 1.05g cm^{-3}. The solubility of sugar in water is 40.0 at 25°C How much extra amount of sugar is to be dissolved to make 1.0 dm^{-3} solution saturated at 25°C? **(8.0) (CO1) (PO1)**

2. (a) Write the characteristic points of the definition of aqueous solution. What are meant by solute and solvent? How are they distinguished? Define solubility and ,molarity. **(8.67) (CO1) (PO1)**

(b) State and explain different forms of Henry's law. Discuss the application and limitations of Henry's law **(8.0) (CO1) (PO1)**

(c) An aqueous solution is prepared by dissolving 1.80 gram glucose in 100 g solvent. The crioscopic constant of the solvent is 0.53°C $mole^{-1}$ dm^{-3}. Calculate the freezing point of the solution. **(8.33) (CO2) (PO2)**

3. (a) Who is regarded as the father of modern chemistry and state why he is? Write the postulates of Bohr\s atomic model? **(04) (CO1) (PO1)**

(b) What is phase rule? Define the terms involved therein. Derive phase rule. **(6.67) (CO1) (PO1)**

(c) Calculate the energy difference between the first and third energy level of hydrogen atom. **(6.0) (CO1) (PO1)**

(d) What do you understand by semi-permeable membrane, osmotic pressure and **(8.33)**

reverse osmosis? Discuss with suitable figures. Mention an important application of reverse osmosis. **(CO2) (PO2)**

4. (a) Draw the phase diagram of sulfur and describe it at length **(10.67) (CO1) (PO1)**

(b) Derive a mathematical expression by which one can calculate the radius of an atom. **(6) (CO1) (PO1)**

(c) A solution is prepared by dissolving 3.0g urea in 50.0g water. The vapour pressure of the solution at 40°C is 710 mm(Hg). Calculate the lowering of vapour pressure of the solution. **(5) (CO2) (PO1)**

(d) Define boiling point of a liquid. Why the boiling point of a solution of non-volatile solute is higher than that of its solvent. **(3.33) (CO2) (PO2)**

195

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

30 September, 2022
10:30 A.M to 12:00 P.M

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid-Semester Examination — **Winter Semester: 2021 - 2022**

Course No.: Math 4153 — **Full Marks: 75**

Course Title: Differential Calculus, Integral Calculus & Matrix — **Time: 1.5 Hours**

There are 4 (Four) questions. Question 4 is compulsory. Answer any two from Questions 1 – 3. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO. The Symbols have their usual meaning.

1. (a) What do you mean by continuity and differentiability of a function. $f(x)$. Test the continuity and the differentiability at $x = \pi/2$ where (8) (CO1, PO1)

$$f(x) = 1; \quad x < 0$$
$$= 1 + \sin x; \quad 0 \le x < \frac{\pi}{2}$$
$$= 2 + \left(x - \frac{\pi}{2}\right)^2; \quad x \ge \frac{\pi}{2}$$

(b) If $y = e^{m\sin^{-1}x}$ then show that $(1-x^2)\, y_{n+2} - (2n+1)\, xy_{n+1} - (n^2+m^2)\, y_n = 0$ (8) (CO1, PO1)

(c) State and prove Euler's theorem. (9) (CO2, PO2)

2. (a) Write down the statement of the Mean Value Theorem. Verify the Mean Value Theorem for the function $f(x) = \dfrac{-2x+3}{5x-2}$ in the interval (1,4) (8) (CO1, PO1)

(b) Write down the Taylor's series of two variables. Expand $e^x \cos y$ near the point $\left(1, \dfrac{\pi}{4}\right)$ by Taylor's Theorem. (8) (CO1, PO1)

(c) Obtain the pedal equation of the curve $r^m = a^m \cos m\theta$ (9) (CO2, PO2)

3. (a) Prove that the curve $\left(\dfrac{x}{a}\right)^n + \left(\dfrac{y}{b}\right)^n = 2$ touches the straight line $\dfrac{x}{a} + \dfrac{y}{b} = 2$ at the point (a, b), whatever the value of n. (9) (CO2, PO2)

(b) An orange grower finds that an orange tree produces on average, 400 oranges per year, if no more than 16 trees are planted in a Unit area. For each additional tree planted per unit area, the grower finds that the yield decreases by 20 oranges per tree. How many frees should the grower plant per unit area so as to set the maximum yield? (8) (CO1, PO1)

(c) If ρ is the radius of curvature at any point P on the parabola $y^2 = 4ax$ and S is the focus of the parabola, then show that ρ^2 varies as $(SP)^3$ (8) (CO1, PO1)

4. Perform the following.

(a) $\int \frac{dx}{\cos 3x - \cos x}$ (7) (CO3, PO2)

(b) $\int \frac{(3x-2)dx}{\sqrt{3+2x-4x^2}}$ (8) (CO3, PO2)

(c) $\int \sin^{-1}\sqrt{\frac{x}{x+a}}\, dx$ (10) (CO3, PO2)

(197)

Program: BSc CE 1st Semester
Semester: Winter semester

Date: October 03, 2022 (Monday)
Time: 10:30 am to 12:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

Exam: Mid Semester Examination
Course Number: Hum 4157
Course Title: Islamiat

Academic Year: 2021 - 2022
Full Marks: 75
Duration: 90 minutes

There are **4 (four)** questions. Answer **3 (three)** questions. The symbols have their usual meaning.

1.	a)	Explain the three basic topics which have been discussed in the Holly Quran as the main teachings of Islam as a whole.	**15**	**CO1**
	b)	Relate the concept of global peace with human surrender towards the supreme Lord emanating the meaning of root word for Islam.	**10**	**CO4**
2.	a)	State the two methods for preservation of the Quran till today.	**10**	**CO3**
	b)	Narrate how the Quran was preserved in written form in the reign of Hazrat Abu Bakar (R) and Hazrat Uthman (R).	**15**	
3.	a)	What are the sources of shariah as Islamic code of life?	**15**	**CO1**
	b)	What is the difference between a Rasul and an Avatar?	**10**	
4.	a)	How Islam has restored the status of women as it was given by ALLAH subhanahu wa taala.	**10**	**CO4**
	b)	How Islam has given the highest dignity for human being in every sphere of life.	**15**	

(198)

B. Sc. Engg. (CEE)/3rd Semester — 28th September 2022/Afternoon

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

Mid-term Examination — **Winter Semester: 2021–2022**
Course Number: CEE 4311 — **Full Marks: 75**
Course Title: Solid Mechanics I — **Time: 1.5 Hours**

There are **4 (four)** questions. Answer **3 (three)** of them. Question *1* and *2* are ***compulsory***. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

---

1. The beam ABCD shown in Fig. 1 has overhangs that extend in both directions for 4.2 m from the supports at B and C, which are 1.2 m apart. Draw the shear-force and bending-moment diagrams for this overhanging beam. — CO2, PO2: [25]

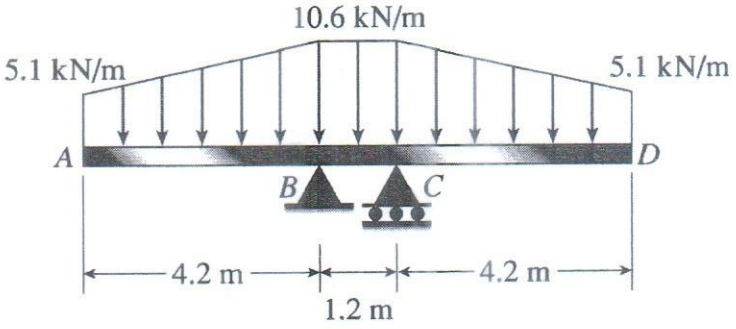


Fig. 1 for Question No. 1

2. Draw the axial force, shear-force and bending-moment diagrams for the beam shown in Fig. 2. — CO2, PO2: [25]

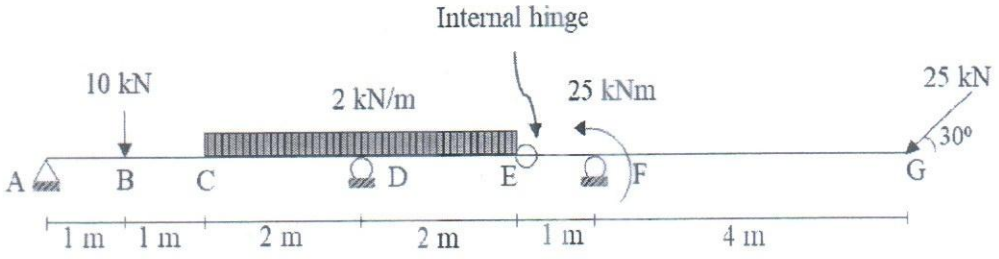


Fig. 2 for Question No. 2

3. A horizontal beam AB with cross-sectional dimensions (b = 0.75 in.) × (h = 8.0 in.) is supported by an inclined strut CD and carries a load P = 2700 lb at joint B [see Fig. 3(a)]. The strut, which consists of two bars each of thickness 5b/8, is connected to the beam by a bolt passing through the three bars meeting at joint C [see Fig. 3(b)]. — CO1, PO2: [25]

(a) If the allowable shear stress in the bolt is 13,000 psi, what is the minimum required diameter d_{min} of the bolt at C?

(b) If the allowable bearing stress in the bolt is 19,000 psi, what is the minimum required diameter d_{min} of the bolt at C?

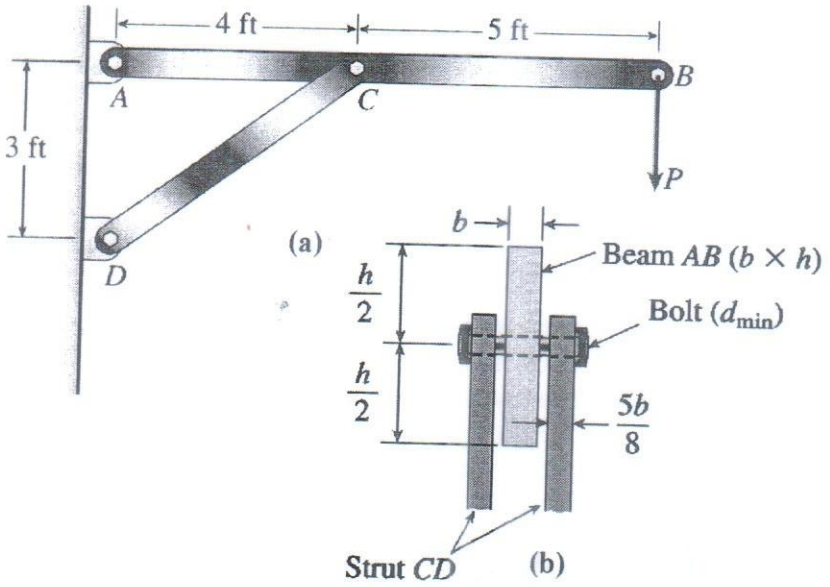


Fig. 3 for Question No. 3

4. Segments AB and CD of the assembly are solid circular rods, and segment BC is a tube. If the assembly is made of 6061-T6 aluminum, determine the displacement of end D with respect to end A. CO1, PO2: [25]

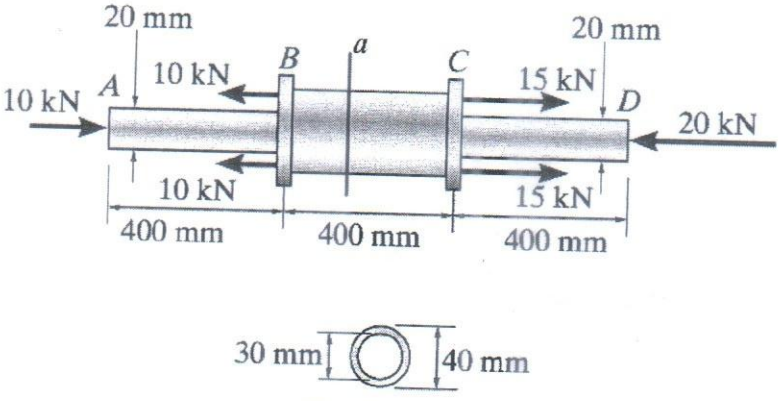


Fig. 4 for Question No. 4

200

B.Sc. Engg. (CEE)/ 3rd Sem. 29th September, 2022 (Afternoon)

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

Semester: Mid Semester Examination **Winter Semester: 2021-2022**
Course No.: GS 4351 **Full Marks: 75**
Course Title: Geology and Geomorphology **Time: 1.5 hours**

There are **4 (Four)** Questions. **Question 1 is compulsory. Answer any 2 (Two) of the remaining 3 (Three)** questions. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume reasonable values for any missing information.

1(a) What is the driving force behind plate tectonics? Explain the mechanism of plate movement. **(6)** [CO1 PO1]

(b) Define types of Tectonic Plate Boundary with neat sketch of movement directions and resulting plate deformations. Also, provide at least one example of each type of boundary. **(10)** [CO1 PO1]

(c) What do you understand by Pacific Ring of Fire? Explain the associated phenomena in light of plate tectonics. **(10)** [CO1 PO1]

(d) What are (i)strike, (ii) dip, (iii) hanging wall, and (iv) dip-slip fault? Explain with sketch. Also sketch a general eroded soil profile of a syncline distinguishing exposed older and younger rock leyers. **(10+4)** [CO1 PO1]

2(a) Write down the Mohs hardness scale and at least one mineral associated to each hardness number. **(8)** [CO2 PO1]

(b) Discuss the properties of Shale, including process of formation and charecteristics as well as concerns from Civil Engineering point of view. **(9.5)** [CO2 PO1]

3(a) What you understand by (i) Streak, (ii) cleavage, (iii) clastic rock, (iv) eolian deposit. **(6)** [CO2 PO1]

(b) Write down the Bowens reaction series. If a magma is rich in Ferro-Magnesium, which direction the reaction series will follow primarily and what minerals may be created? **(11.5)** [CO2 PO1]

4(a) What is meant by 'foliations'? Discuss low and high grade of metamorphism with examples. **(7.5)** [CO2 PO1]

4(b) You are asked to identfy possible geologic and geomorphic history of the site shown (see next page: Figure 1). Please discuss your answer along with your reasoning as well as doubts and concerns. **(10)** [CO2 PO1]

Tips:

- Observe the composition and size variation of exposed rocks.
- Try to find what may have caused the exposure of the steep sloped exposed surface.

201

Figure 1 Site image (rotated) (Question: 4b)

(202)

B.Sc. in Civil Engineering **Date: 04 October, 2022**

3rd Semester **Time: 2.30 pm–04:00 pm**

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

Semester: Mid Semester Examination **Winter Semester: 2021-2022**
Course No.: MATH 4353 **Full Marks: 75**
Course Title: Laplace Transformation, Series, PDE **Time: 1.5 hours**

There are **3 (three)** sets of questions. Answer **all** of them. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume reasonable data if needed. Marks are mentioned in the right side of the question along with CO and PO.

			Full Marks	CO	PO
1.	a)	Define Laplace Transform. Obtain the Laplace transform of $f(t) = \begin{cases} cost, & 0 < t < 2\pi \\ 0, & t > 2\pi \end{cases}$ by using the definition of Laplace transform.	(5)	CO1	PO1
	b)	Use $\mathcal{L}\{f'(t)\} = s\bar{f}(s) - f(0)$ to find $\mathcal{L}\left\{\frac{cos\sqrt{t}}{\sqrt{t}}\right\}$.	(5)	CO1	PO1
	c)	State formula for Laplace transform of a periodic function. Hence find the Laplace transform of the function f (t) shown in Figure 1:	(5)	CO1	PO1

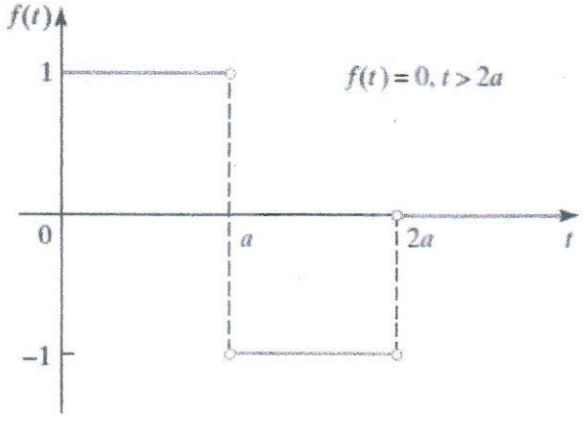


Figure 1: Function f (t)

	d)	Apply $\mathcal{L}\left(\frac{f(t)}{t}\right) = \int_s^\infty F(s)\,ds$ to find $\int_0^\infty \frac{e^{-t} - e^{-3t}}{t}$	(5)	CO1	PO1

2. a) State Convolution theorem for Laplace transform. Hence apply the theorem to find $\mathcal{L}^{-1}\left\{\frac{1}{s^2(s+1)^2}\right\}$. (10) CO1 PO1

b) Use Heaviside expansion formula to obtain $\mathcal{L}^{-1}\left\{\frac{3s+1}{(s-1)(s^2+1)}\right\}$. (10) CO1 PO1

c) Apply Laplace transform to solve the following: (10) CO1 PO1

$(i)\ (D^2+3D+2)y = exp(-t); where\ y(0)=4, y'(0)=1$

$(ii)\ \left.\begin{matrix}\frac{dX}{dt}=2X-3Y\\ \frac{dY}{dt}=Y-2X\end{matrix}\right\}; where\ X(0)=8, Y(0)=3$

3. a) Find the Fourier series expansion of (13) CO2 PO2

$f(x)=\begin{cases}-\pi; & -\pi<x<0\\ x; & 0<x<\pi\end{cases}$. Hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\cdots=\frac{\pi^2}{8}$.

b) Expand $f(x)=\pi x-x^2$ as a Sine series valid in $0\le x\le\pi$. (12) CO2 PO2

204

5th October, 2022 (Afternoon)

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

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

Semester: Mid Semester Examination **Winter Semester: 2021-2022**

Course No.: GS 4353 **Full Marks: 75**

Course Title: Numerical Methods and Computer Programming **Time: 1.5 hours**

There are **4 (four)** questions. Answer **3 (three)** questions, where **Questions 1 and 2 are COMPULSORY** and answer either **Question 3 or 4**. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO. Symbols convey their usual meanings. Assume reasonable values for any missing data/info.

			Marks	CO	PO
1.	(a)	Define 'Numerical Methods'. Why is it essential for the civil engineers to learn numerical analysis?	5	CO1	PO1
	(b)	What is the general description of eigenvalues and eigenvectors of a square matrix? Mention several real-life applications of the concept of eigen vector.	5	CO1	PO1
	(c)	For the given function $f(x) = 2x^4 + 0.5x^3 + 3x^2 + x + 2$ Use Taylor's series to approximate x_{i+1} from 0^{th} to 3^{rd} order when $h = 1$ and $x_i = 0$	10	CO2	PO2
	(d)	Compute the eigenvalues and eigenvectors of the given square matrix- $\begin{bmatrix} -5 & 2 \\ -7 & 4 \end{bmatrix}$	5	CO3	PO1
2.	(a)	State the names of Open methods and Bracketing methods used to determine the roots of equation. How is the Open method different from the Bracketing method? Explain with diagrams..	5	CO1	PO1
	(b)	The given data represents Household Size vs Number of Trips per day. Fit a base-e exponential model ($y = \alpha e^{\beta x}$) and predict the number of trips for a household size of 3 persons.	7	CO3	PO1

HH Size	1	1	2	2	3	3	4	4
Trips/ day	1	2	2	4	4	4	3	5

	(c)	Use a suitable interpolation method to predict 10 days compressive strength of a concrete specimen from the given data.	8	CO3	PO1

Days	1	3	7	14	28
Compressive Strength (Psi)	640	1600	2600	3600	4000

(d) How many bisection iterations would it take to achieve an absolute error of 0.001 if the initial bracket was [0,1]. 5 CO2 PO2

3. (a) Use Newton-Raphson method to solve the root of the given polynomial equation- 10 CO3 PO1

$$f(x) = 4x^3 - 8x^2 + 15x - 48$$

Start from initial guess 0 and complete four iterations.

(b) Experimentally observed value of deflection of a beam are shown in the figure 1. Estimate the bending moment at points: -2, -1, 0, +1, +2. Given, $E = 29 \times 10^6\ psi$, $I = 1000\ inch^4$ 8 CO3 PO1

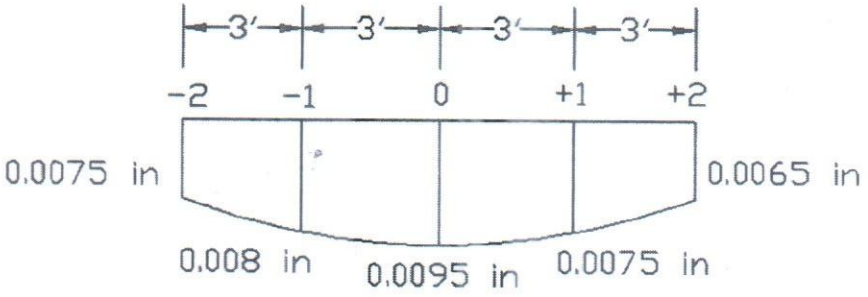


Figure: 1

(c) Using trapezoidal rule, integrate the given term numerically by diving the interval into 4 areas. Compare the result with the analytical solution. 7 CO3 PO1

$$\int_4^{5.2} \ln(x)dx$$

4. (a) Use classical fourth order Runge-Kutta method to integrate the given function from x = 0 to 2. 8 CO3 PO1

$$y' = 2x^2 - y$$

Use, h = 1 and y(0) = −1

(b) A simply supported beam is loaded such as the value of shear force (kip) at a distance x from the starting point of beam is, 10 CO3 PO1

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

L = length of the beam = 5 ft
w = maximum triangular load = 2 kip/ft
Here, bending moment at the mid-span of the beam is $M = \int_0^{L/2} V(x)dx$. Use 4 areas for both trapezoidal and Simpson's rule to evaluate the bending moment at mid-span of the beam and compare the results. Also find the exact value of bending moment. (Given, at x = 0, bending moment M = 0)

(c) Using trapezoidal rule, integrate the given term numerically by dividing the interval into 3 strips. Compare the result with the analytical solution. 7 CO3 PO1

$$\int_0^{\pi/4} \sin(x)\,dx$$

206

B. Sc. Engg. (CEE)/3rd Semester — 30 September 2022 (Afternoon)

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

Mid Examination — **Winter Semester: 2021–2022**
Course Number: CEE 4361 — **Full Marks: 75**
Course Title: Fluid Mechanics — **Time: 1.5 Hours**

There are **4 (four)** questions. Answer any **3 (three)** of them. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

---

1. (a) Explain the following flows with example: [(CO1, PO1) 2.5]
- I. Steady Non-uniform Flow
- II. Unsteady Uniform Flow

(b) Represent the viscous behavior of fluids in a graphical manner. Provide an example each of the followings:- [(CO1, PO1) 6]
- i. Ideal fluid
- ii. Newtonian fluid
- iii. Non-Newtonian fluid
- iv. Laminar flow
- v. Turbulent flow

(c) A velocity distribution of a channel is shown in the **Fig. 1** which is a parabola having vertex **10 cm** from the boundary. Consider a dynamic viscosity of 0.5 poise. Answer the followings- [(CO3, PO2) 16.5]
- **i.** Calculate velocity gradient and shear stress for **y= 0, 4, 8** and **10 cm.**
- ii. Show all the results in a table.
- iii. Draw the velocity gradient vs shear stress profile on a plain paper.
- iv. Comment on the profile you have drawn.

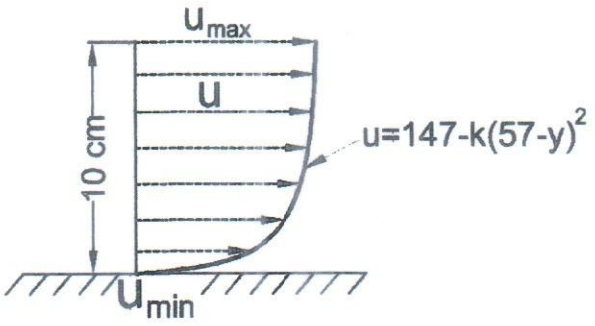


Fig. 1 for Question No. 1 (c)

2. (a) State and derive Pascal's law of fluid pressure. [(CO1, PO1) 8.5]

(b) A rectangular gate is hinged at its base shown in **Fig. 2**. Neglecting the weight of the gate, find the depth of liquid "**h**" so that the gate begins to rotate in counter clockwise direction. The gate is **3 m** wide. [(CO3, PO2) 13.5]

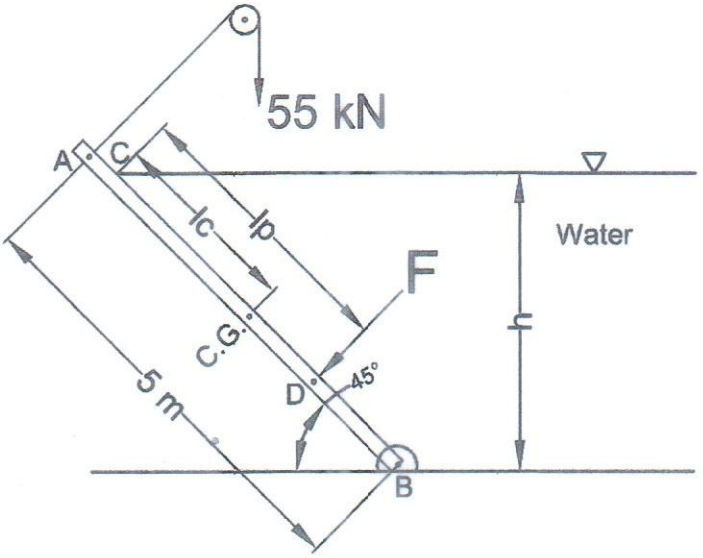


Fig. 2 for Question No. 2 (b)

(c) Pressure in the pipes A and B are **280 kPa** and **140 kPa** respectively. Find the deflection of the mercury in the differential manometer shown in the **Fig. 3** given below. [(CO3, PO2) 3.0]

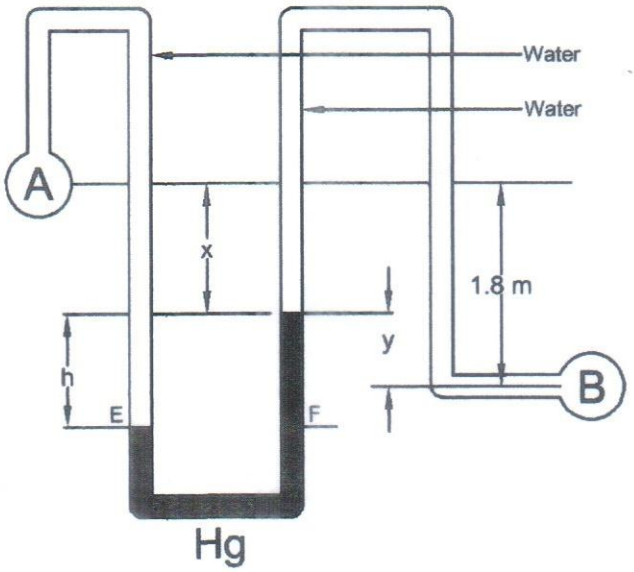


Fig. 3 for Question No. 2 (c)

3. (a) State and derive Bernoulli's theorem of total energy of fluid flow. [(CO1, PO1) 8.5]

(b) A pump is used to collect water from a stream and fill up a tank. The pump's one end is connected to a pipe of diameter **230 mm** and the other end is connected to a pipe of diameter **180mm** and the whole layout of pipe is in accordance with the **Fig. 4** given below. Water is flowing at a rate of **0.15 m^3/s** through the pumping system. There is a differential manometer connected to the pipe layout at two point to measure the [(CO3, PO2) 16.5]

pressure difference and the deflection of the manometer is **3 m**. Find the power of the pump required to do the job.

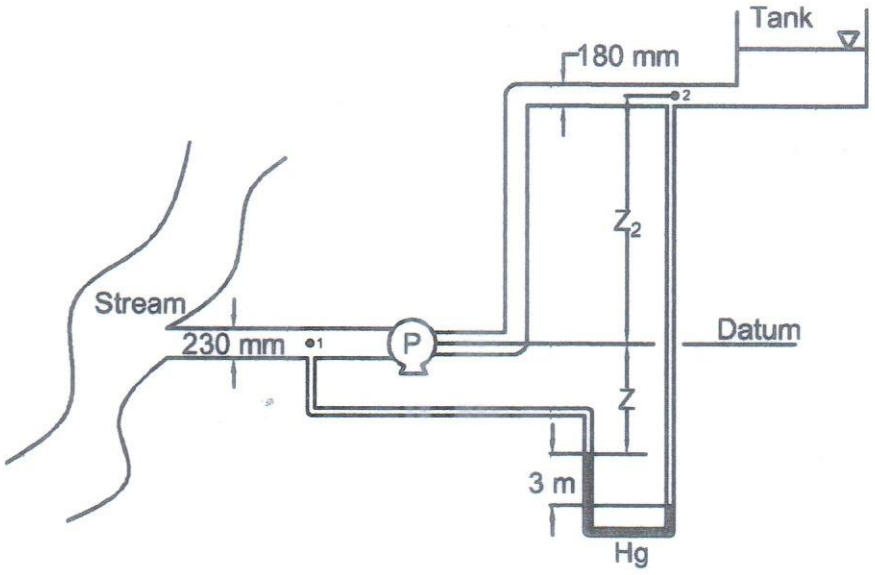


Fig. 4 for Question No. 3 (b)

4. (a) Write short notes with mathematical expression on the following non-dimensional numbers: [(CO1, PO1) 4]

I. Weber Number
II. Mach Number

(b) Explain dimensional homogeneity using an example. What are the use of this principle? [(CO1, PO2) 4.5]

(c) The pressure drop Δp in a pipe for a laminar flow depends on the pipe length L, pipe diameter D, mean velocity V and the water viscosity μ. Show with the help of Rayleigh's method the relation between Δp and other variables is given by [(CO3, PO2) 9.5]

$$\Delta p = \frac{V\mu}{L} f\left(\frac{D}{L}\right)$$

(d) A **1:60** model of a ship experiences a drag force of **50 N** when tested in a wind tunnel at a velocity of **45 m/s**. Calculate the drag force on the prototype if it moves at a velocity of **6 m/s** in sea water. Density of air and water **1.2 kg/m^3** and **1030 kg/m^3** respectively. [(CO3, PO2) 7.0]

209

B. Sc. Engg. (CEE)/ 5th Sem.

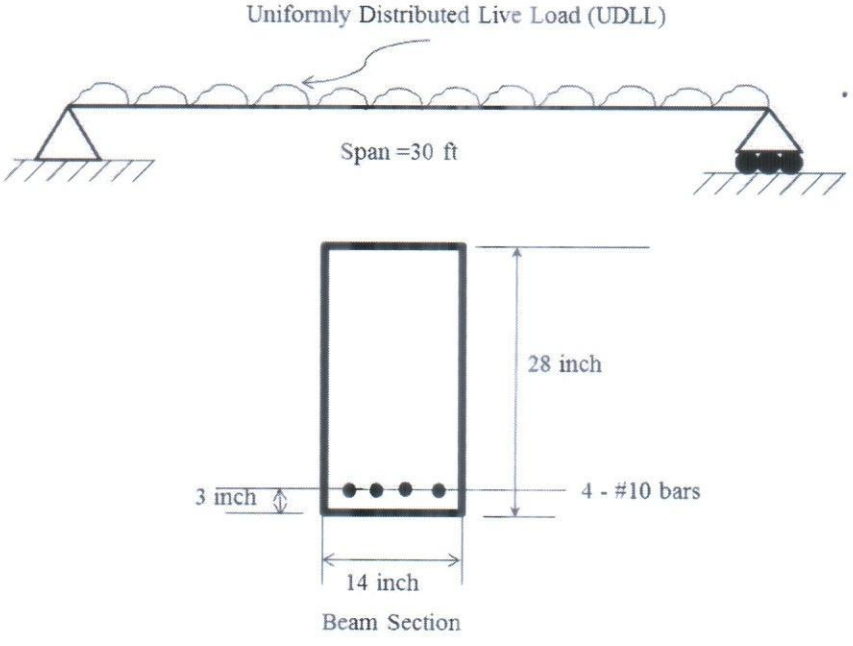
30 September, 2022
2:30 pm – 4:00 pm

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

Mid-Semester Examination — **Winter Semester : 2020 - 2021**
Course No. CEE 4511 — **Full Marks: 75**
Course Title: Design of Concrete Structures I — **Time : 1.5 Hours**

There are **3 (THREE)** questions. Answer all questions. The symbols have their usual meaning.

1(a)	Explain the factors related to compression stress block ($\alpha, \beta, and\ \gamma$) of concrete in the case of USD.	**CO1 PO1**	**5**
1(b)	"A minimum amount of tension steel (ρ_{lim}) is necessary for yielding of compression steel of doubly reinforced concrete beam" – Explain with figures.	**CO1 PO1**	**5**
1(c)	Compare singly reinforced concrete beam and doubly reinforced concrete beam.	**CO1 PO1**	**5**
2	Refer to the following simply supported RC beam.	**CO2 PO2**	**30**



f_c'= 4000 psi, f_y=60,000 psi, f_s = 24000 psi, γ=150 lb/ft^3, $f_t = 6\sqrt{f_c'}$

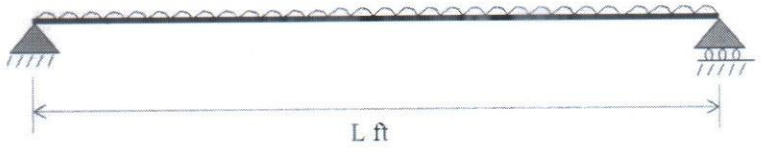
Calculate the following:

(i) Cracking moment,

(ii) Minimum amount of UDLL to produce crack in beam,

(iii) For a moment of 50 k-ft, draw stress and strain distribution across the section,
(iv) Calculate working moment of the section,
(v) Draw stress and strain distributions for working moment condition,
(vi) Calculate ultimate moment capacity of the section,
(vii) Draw stress and strain distributions for ultimate moment condition,
(viii) Make a brief discussion on the results ((i) to (vii)).

3 Design the following simply-supported RC beam for moment by **WSD** and **USD.** Given: UDL (LL) = 1 *k/ft*, UDL (DL) = 1 *k/ft* (**excluding self-weight**). Assume, L=20 ft, f'_c=5000 psi, f_s=20000 psi, f_y=60,000 psi, width of the beam = 14 in. **CO3 PO3** **30**



Make a brief discussion on the results highlighting the cost and sustainability of construction materials.

If you change the supports at the both ends to "fixed supports" instead of "hinge/pin support", what changes in design will occur? Briefly explain using texts and figures *without any calculations*.

(211)

B.Sc. Eng. (CEE), 5th Sem | 29th September 2022 (Afternoon)

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

Mid-Semester Examination | **Winter Semester: 2021 - 2022**
Course Number: CEE 4513 | **Full Marks: 100**
Course Title: Structural Analysis and Design-I | **Time: 1.5 Hours**

There are **4 (four)** questions. Answer **all** questions. Marks of each question and corresponding CO and PO are written in brackets.

---

1 a) Classify the plane trusses shown in Fig. 1 as unstable, statically determinate, or indeterminate. **(10) (CO1) (PO1)**

b) Determinate the bar forces of the truss as shown in Fig. 1 for bars 72, 811, 311, 911, 23. **(15) (CO3) (PO2)**

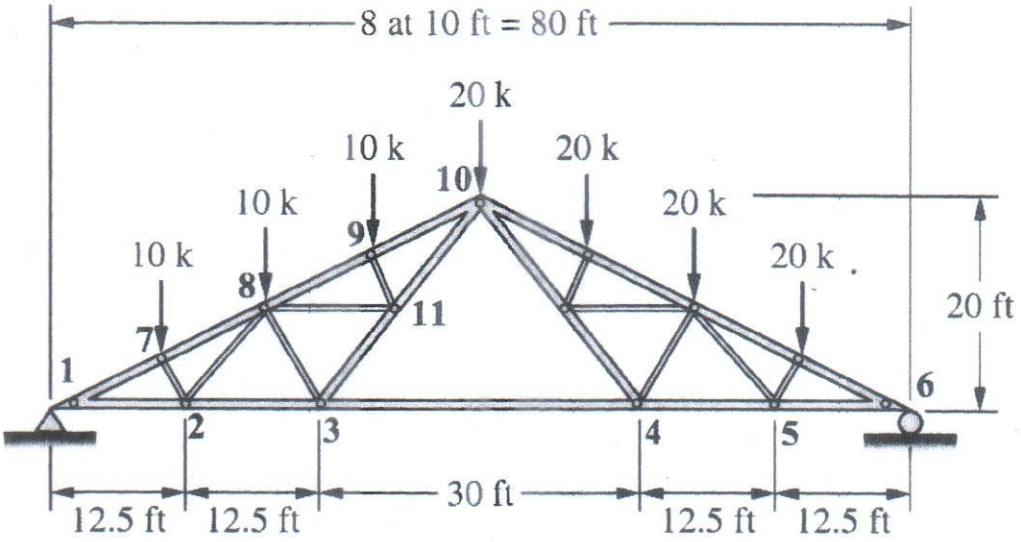


Fig.1 for Question 1

2 a) Determine the reactions at the supports for the structures shown in Fig 2. **(10) (CO1) (PO1)**

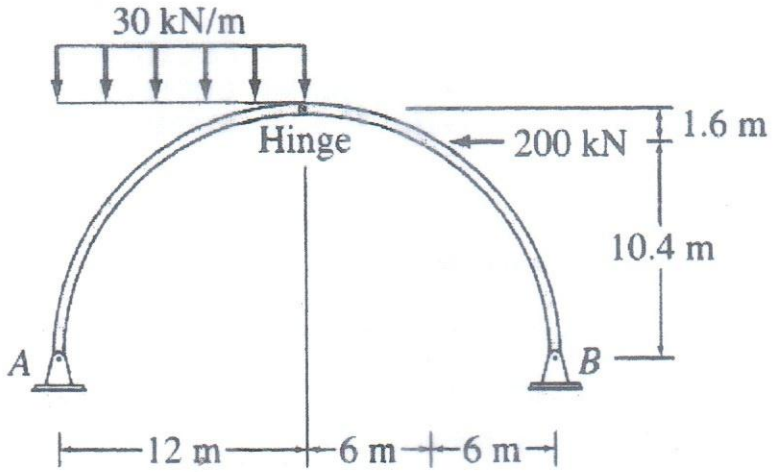


Fig. 2 for Question 2 (a)

b) Draw the SFD and BMD of the girder ABC as shown in Fig. 3. **(15) (CO3) (PO2)**

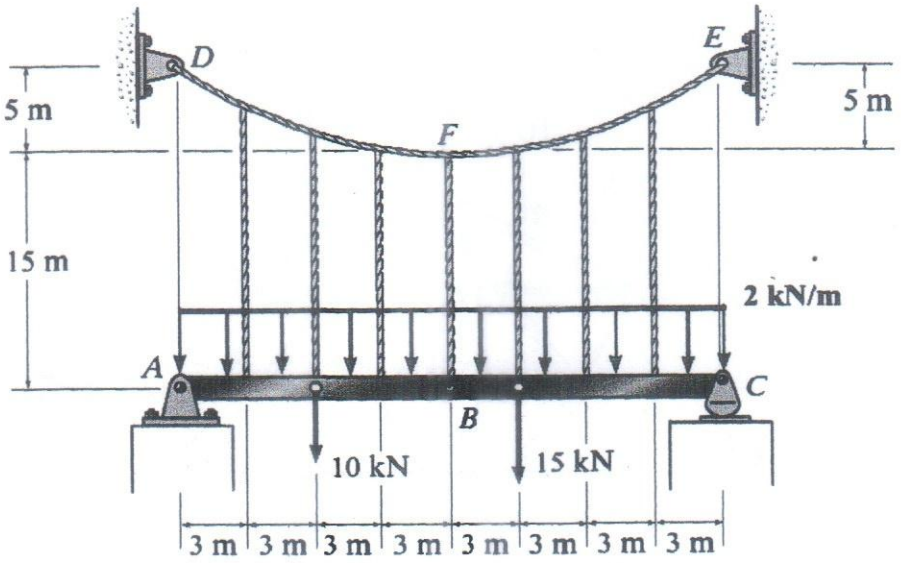


Fig. 3 for Question 2 (b)

213

3 Solve the following frame and draw shear force, normal force, and bending moment diagrams. All values should be clear and comprehensible. Consider frame spacing as 20 ft, and EI is constant. **(25) (CO2) (PO2)**

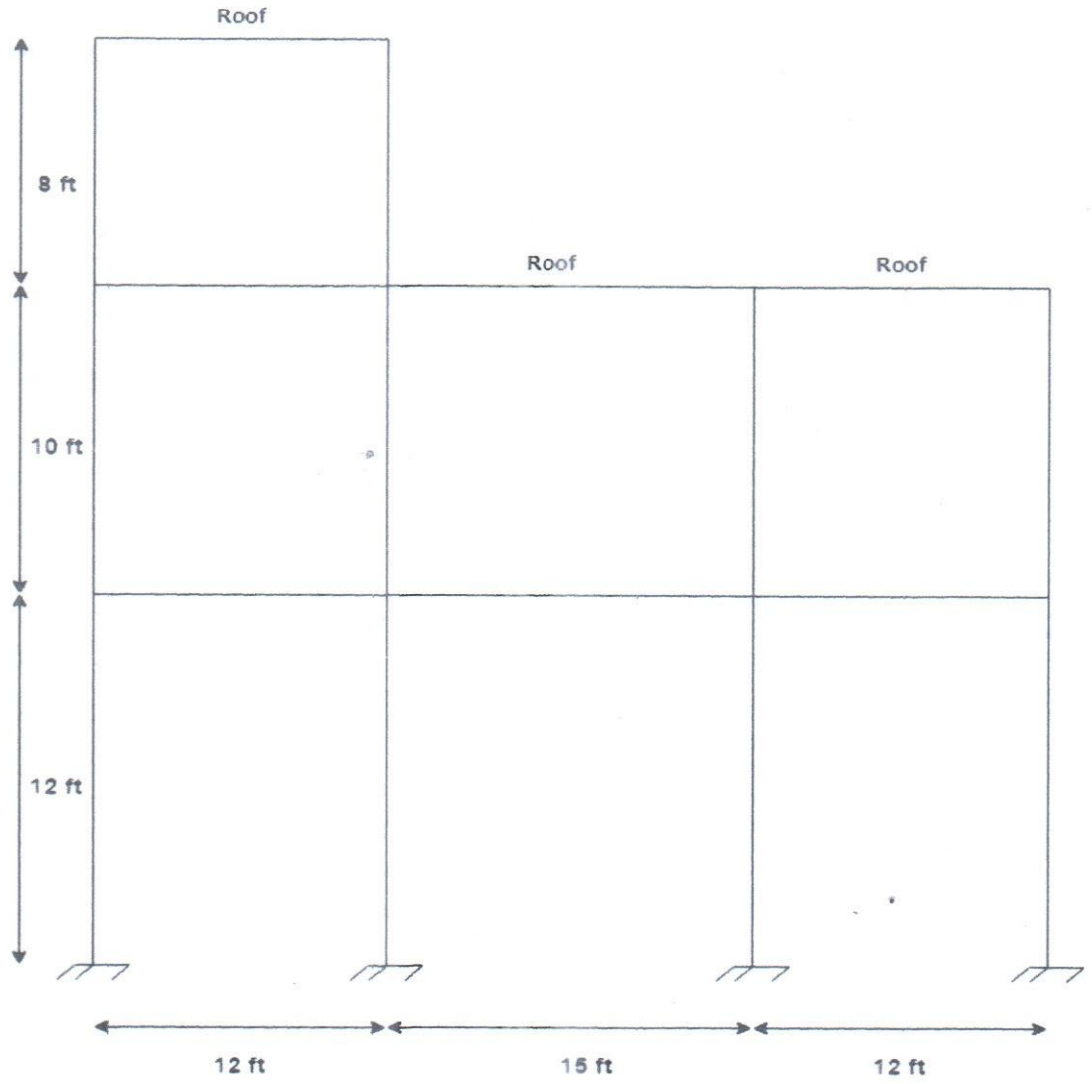


Fig. 4 for Question 3

	Dead Load	Live Load
Roof	30 psf	30 psf
Normal Floor	50 psf	60 psf

4 Solve the frame using both the portal and the cantilever methods. Compare the critical design parameters for both practices and identify the superior method by pointing out the limitations of another method. [NFD, SFD, BMD is not needed] **(25) (CO3) (PO2)**

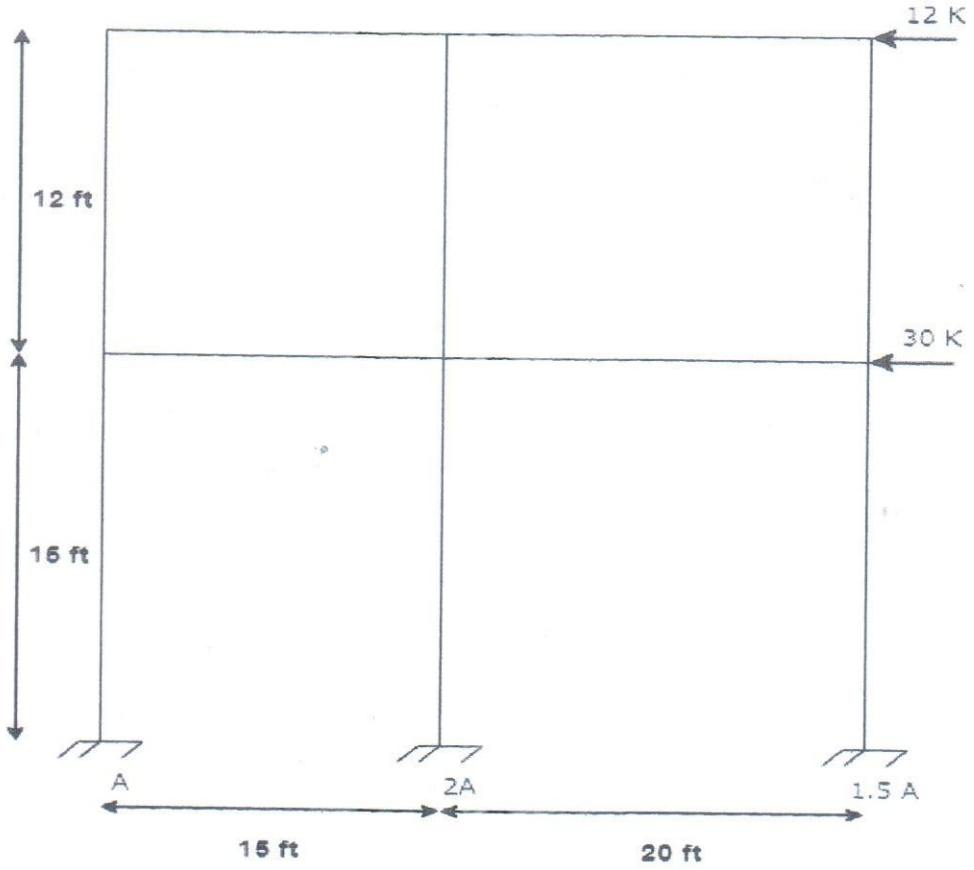


Fig. 5 for Question 4

215

B. Sc. Engg. (CEE)/ 5th Sem. 28 September, 2022

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

Mid Semester Examination **Winter Semester: 2021-2022**
Course No.: CEE 4543 **Full Marks: 75**
Course Title: Foundation Engineering **Time: 1.5 Hours**

There are 4 (Four) questions. Answer 3 (Three) questions. Question 1 is compulsory. Answer 2 questions from question 2, 3 and 4. Programmable calculators are not allowed. The figures in the right margin indicate full marks.

1(a). Define the degree of disturbance for a soil sample. Calculate the degree of disturbance for a Standard Split-spoon Sample. (5) (CO1) (PO1)

1(b). Explain the term N_{60} and $(N_1)_{60}$ with respect to Standard Penetration Test. Write an expression for C_N (Correction factor for overburden pressure). (6) (CO1) (PO1)

1(c). Briefly describe the types of shear failure in footing with depicting soil types for each failure pattern. (6) (CO1) (PO1)

1(d). Derive the equation of ultimate bearing capacity for footing by upper bound theory for the ground with cohesion, c_u = 40 kPa, $\phi = 0$, and $\gamma = 0$, showing all necessary steps of the derivation. Use Mohr – Coulomb failure criteria for the ground. (10) (CO1) (PO1)

2. A footing of 3.0 m X 4.5 m is placed at a depth of 2.5 m from the ground surface. The vertical load of 3.0 MN, bending moments about the shorter direction of 600 kN-m, and bending moment about the longer direction of 450 kN-m are acting on the footing. Estimate the allowable load of the footing. Use Meyerhof equations for bearing capacity factors, shape factors, depth factors, and eccentricity. The ground conditions are shown in **Fig.1**. Use a factor of safety of 2.5. Also, check the foundation size and the maximum stress on the soil. (24) (CO2) (PO3)

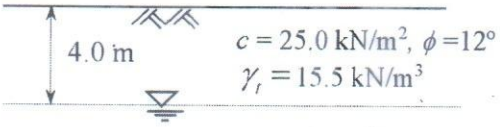


Fig.1

3(a). Compute the dimensions of a trapezoidal combined footing (B_1, B_2 and L) for supporting two columns (in column 1, Q_1= 25.0 MN, in column 2, Q_2=27.0 MN) placed at a distance of 8.0 m. The first column is located at 2.5 m from the property line. The net allowable bearing capacity of the ground is 420 kPa. Use the relation $B_1 = 1.5B_2$. (9) (CO2) (PO3)

3(b). Size of a pile is 400 mm × 400 mm having a length of 20 m, and the top of the pile is at ground level. The soil layers are as follows- (15) (CO2) (PO3)

Soil Layers:

0 – 6 m, sand, unit weight = 18 kN/m^3, soil friction angle = 30^0, δ= 20^0, K= 1.0, and

6 – 30 m, sand, unit weight = 20 kN/m^3, soil friction angle = 35^0, δ= 25^0, K= 1.5, N_q=140.

Use, critical Depth $(L/D)_{cr}$ = 15D

Estimate the ultimate axial capacity of the pile, both end bearing and skin friction when

i) Water table is at 25 meter below ground level

ii) Water table is at ground level. Use, γ_w=9.8 kN/m^3.

4. Estimate the ultimate axial capacity of the pile group for the following conditions- (24) (CO2) (PO3)

Number of piles = 16

Size of the pile = 400 mm × 400 mm

Spacing of the pile, c/c = 1200 mm

Length of the pile = 20 m

Top of the pile is at ground level

Soil Layers:

0 – 6 m, clay, unit weight = 17 kN/m^3,

Unconfined compression strength = 40 kN/m^2, reduction factor = 0.95

6 – 30 m, clay, unit weight = 20 kN/m^3,

Unconfined compression strength = 200 kN/m^2, reduction factor = 0.60

Water table is at 6 m below ground level.

217

Name of the Program: B. Sc. in Civil Engineering | Date: 5th October, 2022

Semester: 5th Semester | Time: 2:30 pm – 4:00 pm

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

Semester: Mid Semester Examination | **Winter Semester: 2021-2022**

Course No.: CEE 4551 | **Full Marks: 75**

Course Title: Transportation and Traffic Engineering | **Time: 1.5 hours**

Answer all the questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO. Symbols convey their usual meanings. Assume reasonable data/values for any missing data/info. The examination is OPEN BOOK and OPEN NOTES.

		Full Marks	CO	PO

1.

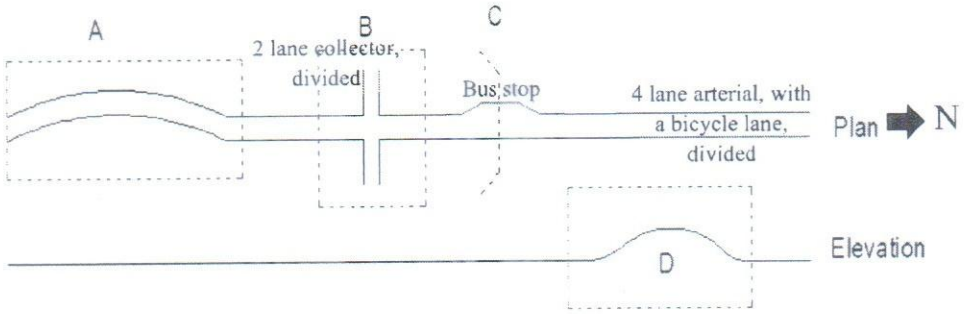


Figure- 1

(a) The arterial has a design speed of 60 miles per hour, and maximum values for super-elevation and co-efficient of side friction are 6% and 0.12 respectively. The two tangent lines of the curve (Section A from the Figure-1) meet at station 1200+20, and the angle of deflection is 14°. Find the length of the curve, the stations for the point of curvature and point of tangency and all other relevant characteristics of the curve (length of the long chord, the middle ordinate, and the external distance). Considering the width of each lane to be 12 ft, design the super-elevation of the curve. Demonstrate the transitions in super-elevation through a figure. — 20 — CO2 — PO3

(b) Section B of the Figure-1 represents a four-legged intersection with significant volume on the arterial. During the morning peak, S-W right turn movements and during the evening peak E-S right turn movements become significant. All legal movements are allowed. Provide a fully at-grade (channelization and/or signalization) design solution. Also, draw conflict diagrams before and after the solution has been implemented. — 20 — CO2 — PO3

(c) Draw the cross-section elements with dimensions at Section-C (From the Figure-1) with a separated contra-flow cycle lane, a bus lane, and a traffic lane. — 5 — CO2 — PO3

	(d)	A vertical curve (Section D from the Figure-1) of 1,000 ft is designed to connect a grade of +5% to a grade of -4%. The V.P.I is located at station 3,300+51 and has a known elevation of 200 ft. Find the following: i) The station of the V.P.C. and the V.P.T. ii) The elevation of the V.P.C. and the V PT. iii) The elevation of points along the vertical curve at 120-ft intervals. iv) The location and elevation of the high point on the curve. v) In order to check if the recommended grades are correct, what are the parameters that you need to check?	15	CO2	PO3
2	(a)	What percentile values should you choose for determining PRT and pedestrian walking speed? Justify your answer.	3	CO1	PO1
	(b)	Propose PCU values for CNG and rickshaw. Explain why you have chosen such values.	3	CO1	PO1
	(c)	Can traffic elements be designed around audio cues? State your reasoning.	3	CO1	PO1
	(d)	Explain under which circumstances you should not use a diamond interchange.	3	CO1	PO1
	(e)	If a person is located closer than the total stopping distance, will there be a certain accident? Defend your response.	3	CO1	PO1

B.Sc. Engg. (CEE)/ 5th Sem.

219

04 October 2022
02:30 P.M to 04:00 P.M

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

Mid-Semester Examination | **Winter Semester: 2021 - 2022**
Course No.: CEE 4563 | **Full Marks: 75**
Course Title: Engineering Hydrology | **Time: 1.5 Hours**

There are 3 **(Three)** questions. Answer all 3 **(Three)** questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO. Symbols convey their usual meanings. Assume reasonable data/values for any missing data/info.

---

1. **(a)** Explain how a well designed parking lot can be a catchment. **(CO1, PO1: 4)**

   (b) Explain how temperature and water quality affect evaporation. **(CO1, PO1: 5)**

   (c) What is pan coefficient and why is it necessary? **(CO1, PO1: 4)**

   (d) Explain why a perennial river can be both influent and effluent. **(CO1, PO1: 4)**

2. The silty clay soil of a catchment has a porosity, suction head and hydraulic conductivity of 42.3%, 29.2 cm and 0.05 cm/hr, respectively. If the initial soil moisture is 12.7% then calculate the cumulative infiltration and infiltration rate at the end of 75 minutes. What is the ponding time and cumulative infiltration at ponding if the rainfall intensity is 12 mm/hr? **(CO3, PO3:15)**

3. **(a)** What is infiltration index? Explain with a figure how the intensity of rainfall affects the infiltration rate. **(CO2, PO2: 6)**

   (b) Explain the formation, types, and forms of precipitation with a proper figure. **(CO2, PO2: 7)**

   (c) The stage–discharge data of a perennial river are shown in the following table. Develop the equation of rating curve and the discharge at a stage of 4.4 m. **(CO2, PO2: 12)**

   (d) In a rectangular area five rain gauges P1, P2, P3, P4 and P5 are located as shown in the given figure 1. The recorded rainfall for June is as follows: Station P1: 75 mm, Station P2: 40 mm, Station P3: 65 mm, Station P4: 32 mm and Station P5: 38 mm. Use the Arithmetic and Thiessen Polygon method to compute the areal rainfall of the given catchment for the month of June. **(CO2, PO2: 8)**

220

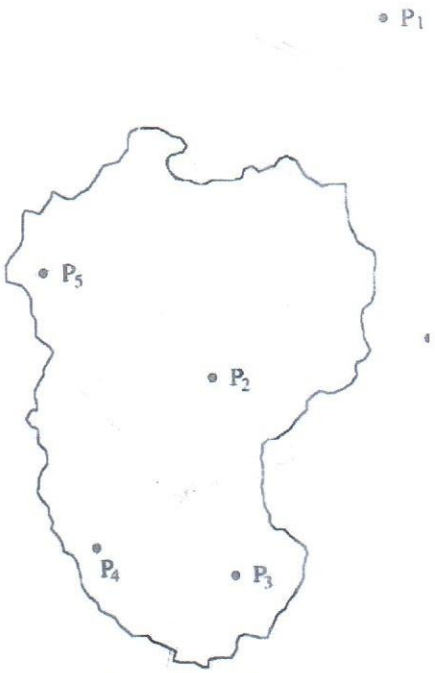


Figure 1

(e) For the rainfall gauging stations A, B, and C, which are all situated in the same climatic region, the annual precipitation data (cm) for ten successive years are given below in table 1. The data of one station are not reliable. Determine this station with the double-mass curve analysis. **(CO2, PO2:10)**

Table 1

Year	A	B	C
1971	90	100	100
1972	60	100	80
1973	70	80	70
1974	80	120	100
1975	50	50	50
1976	50	50	50
1977	100	100	100
1978	50	100	80
1979	120	200	170
1980	60	100	100

(221)

B.Sc. Engg. (CEE)/ 5th Sem. **03 October, 2022 (Monday)**

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

Mid Semester Examination Winter Semester: **AY 2021-2022**
COURSE NO. : **CEE 4565** TIME: **1.5 hrs**
COURSE TITLE: **Open Channel Flow** FULL MARKS: **75**

There are **3 (three) questions. Answer ALL the questions.**
The figures in the right margin indicate CO-PO and also the full marks of the question.

Q.1 (a) Why velocity distribution coefficients are used in open channel flow problems? For the velocity distribution given in Figure 1, calculate the values of α and β. CO1-PO1: **(07)**

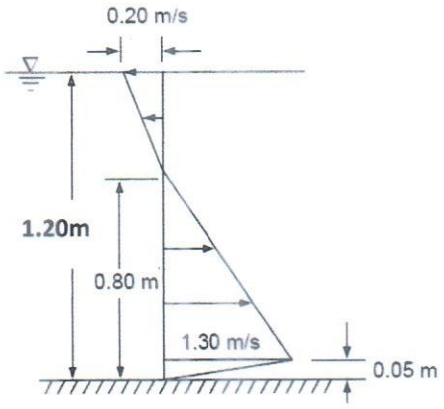


Figure 1.

(b) A sluice gate controls the flow in a channel of width 4.0 m. If the discharge Q is 1.5 m^3/sec and the upstream water depth is 2.5 m, calculate the downstream depth and the force acting on the sluice gate. CO1-PO1: **(08)**

(c) Figure 2 shows a submerged flow over a sharp-crested weir in a rectangular channel. If the discharge is 1.8 m^3/s/m, estimate the energy loss due to weir. What is the force acting on the weir? CO1-PO1: **(06)**

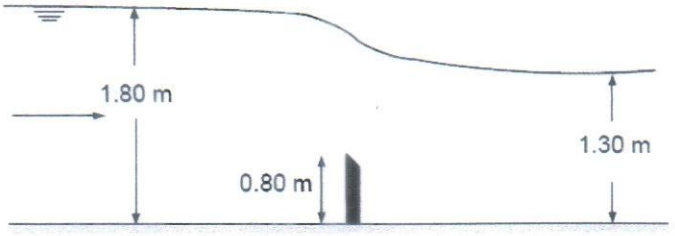


Figure 2.

(d) The velocity distribution in a channel section may be approximated by the following equation: CO1-PO1: **(09)**

$$V = V_o \left(\frac{y}{y_0}\right)^n$$

Where, V is the flow velocity at depth y, V_o is the flow velocity at depth y_o, and n is a constant. Derive expressions for the energy and momentum coefficients.

222

Q.2 (a) Water in an approximately rectangular channel has a velocity head equal to its depth. Is the flow sub-critical, critical, or super-critical? Explain your answer. CO2-PO2: **(04)**

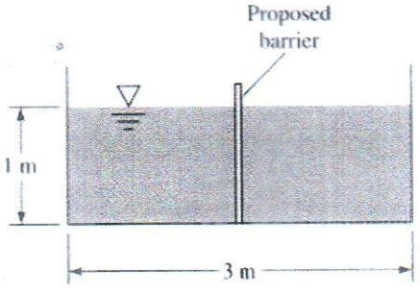
(b) Show that the relation between the alternative depths y_1 and y_2 for a rectangular channel is given by CO2-PO2: **(06)**

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

Where, y_c is the critical depth of flow.

(c) Compute the maximum discharge that may be carries by a channel for a specific energy of 2.0 m, when the channel is (i) rectangular with b = 6.0 m, (ii) trapezoidal with b = 6.0 m and z = 2. CO2-PO2: **(06)**

(d) The channel as shown below is planning to divide into two by placing the proposed barrier at the center. Determine percentage increase or decrease in flow by placing the proposed barrier. CO2-PO2: **(04)**



Q.3 (a) Derive the condition for maximum discharge of an economic circular section with Chezy's equation. CO2-PO2: **(05)**

(b) Using the Newton-Raphson method, compute the normal depth and velocity for a trapezoidal channel with b = 6.2 m, z = 1.5, S_0 = 0.0025 and n = 0.025 and Q = 35 m^3/sec. CO2-PO2: **(05)**

(c) Derive the general expression for hydraulic exponent (N) for uniform flow computation using Manning's equation. Calculate the value of N for a wide rectangular channel and for a triangular channel. CO2-PO2: **(07)**

(d) (i) An irrigation channel of trapezoidal section, having size slope 1.5:1 is to carry a flow of 12 cumec on a longitudinal slope of 1 in 5000. The channel is to be lined with materials for which n = 0.012. Find the dimensions of the most economic section of the channel. CO2-PO2: **(08)**

(ii) A rectangular channel (n = 0.015) has a width of 2.5m and it is desirable to have a Froude number at uniform flow to be equal to or less than 0.4 for all discharges in this channel. Determine the channel slope necessary to achieve this criteria.

223

B. Sc. Engg. (CEE)/ 7th Sem. 28 September, 2022 (Morning)

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

Semester Mid-Semester Examination **Summer Semester: 2021-2022**
Course No.: CEE 4703 **Full Marks: 75**
Course Title: GIS Application in Civil Engineering **Time: 1.5 Hours**

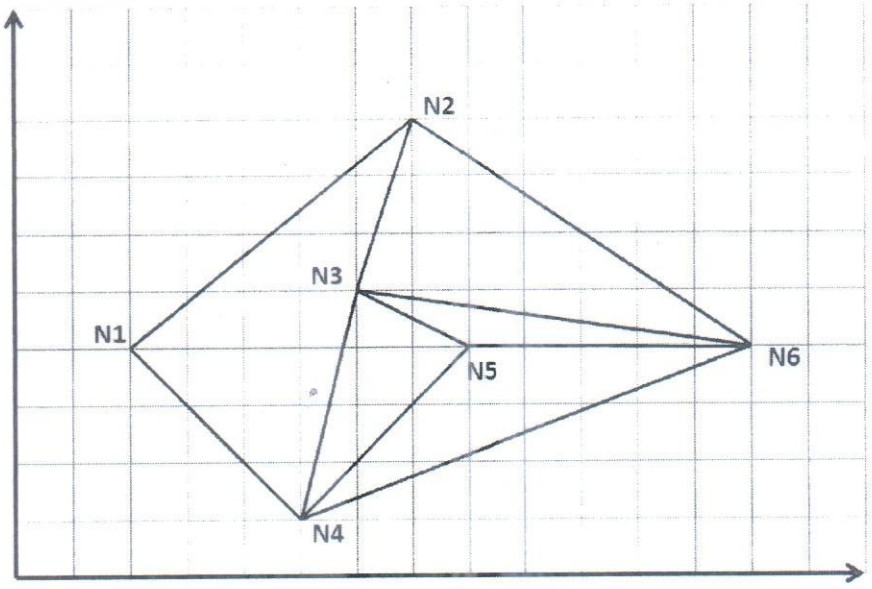
There **are 3 (Three)** questions. Answer all **3 (three)** questions. Programmable calculators are not allowed. Do not write on this question paper. The symbols have their usual meaning. The exam is **OPEN BOOK**. Each student is allowed to carry the course materials in one book. Students may have their own writings inside the book.

1(a)	Draw the polyline having sequentially connected nodes as [(2,9); (3,8); (5,7); (7,8); (8,5); (6,4); (5,5); (2,3); (3,4); (2,1)] in a graph paper and demonstrate step by step how the vector shape can be simplified using Douglas-Peucker algorithm. The tolerance level is one unit.	(10)	CO1 PO1
(b)	Which file format takes less space – ASCII or Binary? Show an example.	(5)	
(c)	When combining lines and polygons together, what features will contain the resulting theme? Will the result be a polygon theme, a line theme, or both? Explain.	(5)	
(d)	How can you evaluate the disaster impact of an earthquake using aerial photography and satellite images?	(5)	
(e)	What is redundancy, and why should you avoid it in a geographical database? Explain with an example	(5)	
2.	The table below represents the coordinates of a vector map kept in simple polygons with the coordinates list method. Arrange them in such a way that there are three polygons on the map (there may be other features present, too). Draw the vector map on graph paper and present the data in topological polygon structure using the Spaghetti model and the Topological model.	(20)	CO2 PO4

ID	X	Y	ID	X	Y
N1	3	8	N6	1	6
N2	5	8	N7	2	3
N3	7	6	N8	4	2
N4	6	6	N9	5	2
N5	2	5	N10	7	3

224

3. Find the shortest route between N1 and N6. Show every step of the calculation. (25) CO2 PO4



225

Name of the Program: B. Sc. in Civil Engineering
7th Semester

Date: 03 October 2022 (Morning)
Time: 10:30 am – 12:00 pm

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

Mid Term Examination
Course Number: CEE 4711
Course Title: Structural Analysis & Design II

Winter Semester: 2021 - 2022
Full Marks: 75
Time: 1.5 Hour

There are **2 (two)** questions. Answer **both the** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

---

1. Determine support moments and reactions for the beam presented in Figure 1. Draw shear force and bending moment diagram. Consider EI = constant. **(37.5) (CO3) (PO2)**

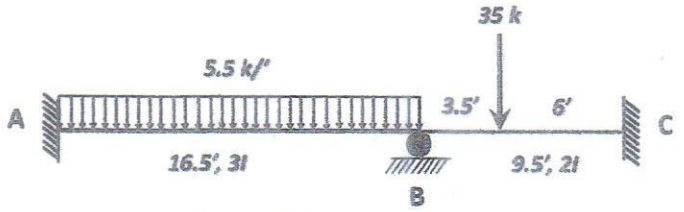


Figure: 1

2. Evaluate the DOKIs due to the loading and support conditions given in Figure 2. Consider EI = constant. **(37.5) (CO3) (PO2)**

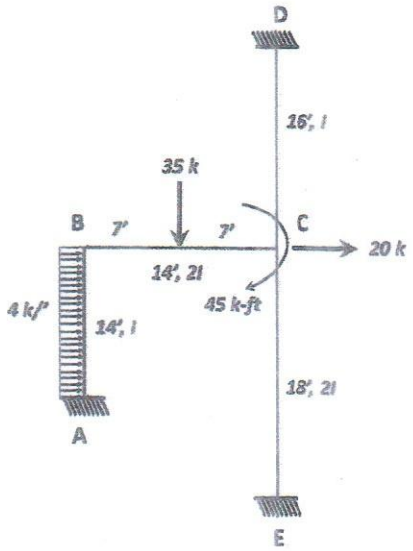


Figure: 2

226

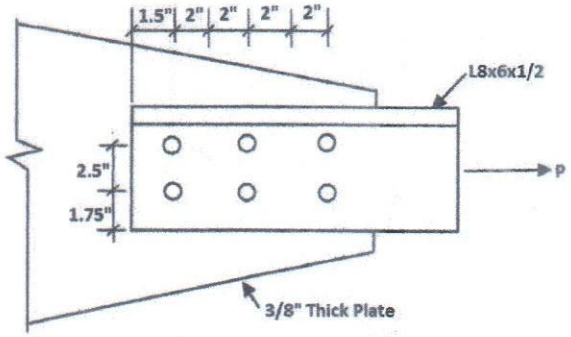
B.Sc. Engg. (CEE), 7th Sem. 28 September 2022 (Morning)

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

Mid Semester Examination **Winter Semester: 2021 - 2022**
Course Number: CEE 4713 **Full Marks: 75**
Course Title: Design of Steel Structures **Time: 1.5 Hours**

There are 4 **(four)** questions. Answer all 4 **(four)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

1. Determine the tension capacity (P) of the angle L8x6x1/2 attached to a 3/8-inch-thick gusset plate with the bolt configuration shown in **Figure 1**. The short leg of the angle is connected to the gusset plate. Consider all limit states and assume uniform tension stress. The material is A36 (F_y= 36 ksi and F_u= 60 ksi) steel and bolts are 1/2 -inch dia. with standard holes. Follow AISC-ASD approach. **(24) (CO2) (PO2)**



Section properties of L8x6x1/2:

A_g (in^2)	$\bar{x}$ (in)	$\bar{y}$ (in)	k (in)
6.80	1.46	2.46	1

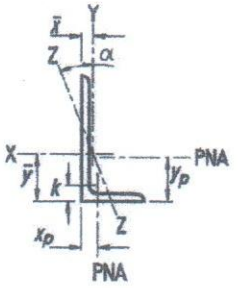


Figure 1

2. A 12 ft long A36 (F_y= 36 ksi and F_u = 58 ksi) steel tension member needs to resist a service dead load of 60 kips and a service live load of 140 kips. Select the lightest channel section from the following table to resist the loads. The tension member is connected to a gusset plate using 5 nos. 7/8 -in bolts with standard holes as shown in **Figure 2**. Neglect block shear failure mode and use AISC-ASD method. Assume that the gusset plate has adequate strength **(25) (CO3) (PO3)**

against tension, and U = 0.75.

Shape	A_g (in^2)	r_x (in)	r_y (in)	t_f (in)	t_w (in)
C15x50	14.7	5.24	0.865	0.650	0.716
C12x25	7.34	4.43	0.779	0.501	0.387
C15x33.9	10.0	5.61	0.901	0.650	0.400
C12x30	8.81	4.29	0.762	0.501	0.510
C15x40	11.8	5.43	0.883	0.650	0.520

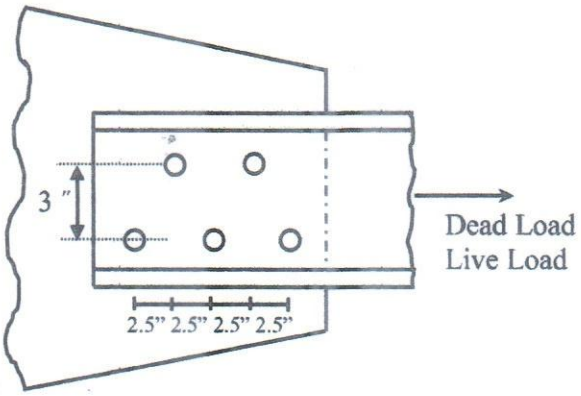


Figure 2

3. Column AB in **Figure 3** is subjected to an axial compressive load of 100 kips dead load and 200 kips live load. Suppose hot-rolled sections of A992 (F_y = 50 ksi) steel shown in the following table are available in market. Select the lightest W section from this table to resist the axial loads. Follow AISC-LRFD method and assume K = 0.8. **(20) (CO3) (PO3)**

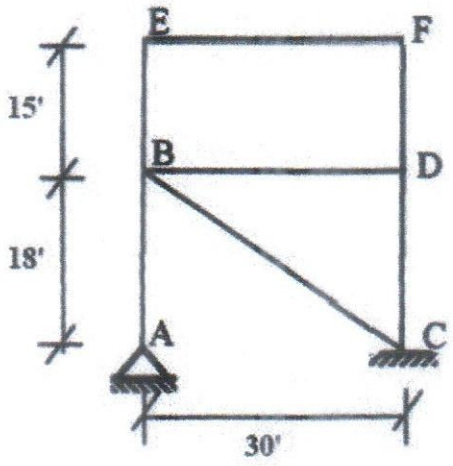


Figure 3

Shape	A_g (in^2)	r_x (in)	r_y (in)	t_f (in)	t_w (in)	b_f (in)	T (in)

W8x40	7.34	3.53	2.04	0.56	0.36	8.07	5.75
W10x45	13.3	4.32	2.01	0.62	0.35	8.02	7.5
W12x45	13.1	5.15	1.95	0.58	0.33	8.05	9.25
W10x68	19.9	4.44	2.59	0.77	0.47	10.1	7.5
W10x77	22.7	4.49	2.60	0.87	0.53	10.2	7.5

4. For a compression steel member, about which axis (between the major and minor axes) buckling is easier and why? Describe a way of increasing the buckling capacity of a compression steel member without changing the steel section. **(3+3) (CO1) (PO1)**

Formula

1. $R_n = 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$
2. $R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt}$
3. $F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right]F_y$
4. $F_{cr} = 0.877F_e$
5. $F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$

229

B.Sc. Engg. (CEE)/7th Sem. October 5, 2022 (Wednesday)

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

TERM: MID SEMESTER EXAMINATION
COURSE NO.: CEE 4733
COURSE TITLE: Industrial Wastewater Engineering

WINTER SEMESTER: 2021-2022
TIME: 1.5 Hours
FULL MARKS: 75

There are **4 (Four)** questions. Answer **3 (Three)** questions, where **Questions 3 and 4 are COMPULSORY** and answer either **Question 1 or 2**. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO in the brackets. Symbols convey their usual meanings. Assume reasonable values for any necessary design data where required.

---

1. **(a)** Differentiate between sanitary, industrial and municipal wastewater. **(3)** (CO1, PO1)

   (b) Sketch a diagram to show the sources of municipal wastewater in relation to collector sewers and treatment. Describe briefly the wastewater sources, treatment, reuse and effluent disposal options. **(8)** (CO1, PO1)

   (c) A meat-processing plant slaughters an average 500,000 kg of live beef per day. The majority is shipped as dressed halves with some production of packaged meats. Blood is recovered for a salable by-product, paunch manure (undigested stomach contents) is removed by screening and hauled to land burial, and process wastewater is settled and skimmed to recover heavy solids and some grease for inedible rendering with other meat trimmings. After this pretreatment, the waste discharged to the municipal sewer is 4500 m^3/d containing 1300 mg/l of BOD_5. Determine the followings: i) BOD_5 value per 1000 kg LWK (live weight kill), ii) hydraulic equivalent population, and iii) BOD_5 equivalent population of the daily wastewater flow. **(12)** (CO2, PO2)

2. **(a)** What is aeration. Why we use aeration? Mention the common types of aerators with a diagram. **(5)** (CO1, PO1)

   (b) Differentiate between paddle wheel, propeller and fountain aeration systems with diagrams. **(6)** (CO1, PO1)

   (c) A fine-bubble aeration system is used to remove BOD_5 and fully nitrify the industrial wastewater. The temperature of the wastewater is 54°F, site elevation is 5000 ft, diffuser depth is 18 ft and there is a 2 mg/l dissolved oxygen residual. Determine the followings: i) oxygen demand, ii) total horsepower (hp) requirement, iii) number of surface aerators if 20 hp for each aerator, and iv) airflow requirement (cfm) using an influent flow of 3.5 mgd, BOD_5 of 140 mg/l in primary effluent and of 15 mg/l in plant effluent, and ammonia of 23 mg/l? Assume that $\alpha = 0.65$, $\beta = 0.95$, F= 0.75, peaking factor = 2, $C_{T,P,de} = 8.8$ mg/l (for the elevation is 5000 ft at 54°F), $C_{20,1,de} = 9.1$ mg/l (at standard conditions) and SOTR ranges from 4 to 7.7 O_2 lb/hp.hr. **(12)** (CO2, PO2)

3. **(a)** Differentiate between disc and tubular diffusers with diagrams. **(5)** (CO1, PO1)

(b) Sketch a diagram of a typical small extended-aeration plant with diffused aeration, air-lift pump in clarifier, equalization tank and effluent chlorination. Describe the operational procedure of this plant. **(8)** (CO1, PO1)

(c) As a Design Engineer, you are assigned to design a small extended-aeration plant for the treatment of industrial wastewater without sludge-wasting facilities at a loading rate of 1 mgd, 10.5 lb BOD_5/1000 cft/day with an aeration period of 24 hr. The measured suspended solids buildup rate in the aeration tank is 68 mg/l/day. What percentage of the raw influent BOD_5 is converted and retained as MLSS? If the MLSS concentration is allowed to increase from 2000 mg/l to 6000 mg/l before wasting solids, how long would this buildup take? **(14)** (CO3, PO3)

Design and sketch the extended-aeration plant with proper dimensions.
Do you think cylindrical design of the extended-aeration plant is better and why?
Select the pollutants in wastewater that can be removed by extended-aeration plant and justify your statement.

4. **(a)** How sludge becomes activated sludge in secondary treatment of municipal wastewater? Explain briefly with a diagram. **(5)** (CO1, PO1)

(b) Design a biotower for a local industry in Tongi area to treat its process wastewater with a plastic modular medium (n = 0.6). The flow rate of the wastewater is 1000 m^3/d with a BOD_5 of 500 mg/l and an average temperature of 18°C. The treatability constant, k, is 0.04/min for the system at 20°C. Depth of the medium is 5.5 m. The desired effluent BOD_5 is 15 mg/l. Determine the followings: (i) the area of biotower required without any recycle, (ii) the organic loading rate of biotower without recycle, (iii) the area of biotower required when direct recirculation ratio is 3:2, and (iv) the organic loading rate of biotower with recycle. **(20)** (CO3) (PO3)

Design and sketch the biotower (with proper dimensions) with and without considering recirculation flow. Which one of the above designs seems better to you and why?
Do you think rectangular design of biotower is suitable and why?

Formulae

$$O_2 \text{ demand} = Q(BOD_i - BOD_e)\cdot 8.34 - (\text{waste TSS})(1.4) + (\text{BOD in recycle and return flows}) + 4.6Q(NO_3)\,8.34$$

$$Cde/C = 1 + 0.01205(\text{diffuser depth})(1 + 5.6\cdot 10 - 7(\text{site elevation}))$$

$$OTR = SOTR\left(\frac{\beta\cdot C_{T,P,de} - C_L}{C_{20,1,de}}\right)(\theta^{T-20})(\alpha F)$$

$$Q_{air} = \frac{Q_{O2}}{OTE\cdot \rho_{air}\cdot f_{O2}\cdot 24\cdot 60} = \frac{Q_{O2}}{QTE\cdot 0.0174\cdot 1400}$$

$$\frac{S_e}{S_o} = e^{-\frac{kD}{q^n}} \qquad S_a = \frac{S_o + RS_e}{1+R} \qquad \frac{S_e}{S_a} = \frac{e^{-\frac{kD}{q^n}}}{(1+R) - Re^{-\frac{kD}{q^n}}}$$

(231)

B. Sc. in Civil Engineering
7th semester

Date: 04 October, 2022
Time: 10:30 am – 12:00 pm

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

Mid Term Examination — **Winter Semester : 2021 - 2022**
Course Number: CEE 4735 — **Full Marks: 75**
Course Title: Environmental Pollution and Its Control — **Time : 1.5 Hours**

There are 03 **(three)** questions. Answer **all** questions. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume reasonable data if needed.

			Marks	CO	PO
1.	(a)	Explain the cycle of an Integrated Air Quality Management System.	(05)	CO1	PO1
	(b)	According to the pollutant concentration given on the following table what AQI and air quality description should be reported for the air pollution on the days given? Write comments based on your results.	(15)	CO2	PO2
	(c)	What is particulate matter? Briefly discuss the advantages and disadvantages of fabric filters.	(05)	CO1	PO1
2.	(a)	What is CBOD and NBOD? Write down the nitrification process. Why BOD_5 test is not affected by nitrification?	(07)	CO1	PO1
	(b)	A consultation between the Department of Civil and Environmental Engineering and a food processing company was established. The BOD of a untreated wastewater is suspected to range from 50 to 200 mg/L. Three dilutions are prepared to cover this range. The procedure is same in each case. The sample is diluted to a 250 ml bottle. The following table shows the test results:	(09)	CO3	PO2

Pollutant	01 October, 2022	02 October, 2022
O_3 (ppm) 1 hour	0.1329	0.1548
$PM_{2.5}$ ($\mu g/m^3$)	131.34	160.18
CO (ppm)	13	11
SO_2 (ppm)	0.2222	0.2281

Waste water (ml)	DO_i	DO_f
7	9.2	6.9
12	9.1	4.4
23	8.9	1.5

i. Determine the average BOD
ii. Determine the ultimate BOD
iii. The BOD rate constant determined in the laboratory for this mixed water is 0.13 per day. What fraction of maximum oxygen consumption will occur in first three days?

(c) On October 1, 2022, Dhaka's air quality index (AQI) was 109, with particulate matter being the responsible pollutant. The city corporation plans to install a settling chamber to lessen pollutants. Making this an economic decision, they take into account the parallel operation of two identical settlement chambers at a total flow rate of 60000 m^3/h. If the flow of flue gas is distributed evenly between the chambers and no mixing occurs in both horizontal and vertical directions, the overall particulate collection efficiency of the system is 86.5%. **(09) CO3 PO2**

i. Calculate the overall particulate collection efficiency if the flue gas is unintentionally distributed unevenly such that one chamber gets 77% of the gas flow and the other receives the rest.
ii. What should be the flow rate for 100% collection efficiency?

3. (a) Write down the steps in developing a control strategy. What is effective control strategy? **(07) CO1 PO1**

(b) Discuss the particle deposition mechanism. **(06) CO1 PO1**

(c) An environmental pollution management strategy for a power plant first considered using a settling chamber to treat a particulate-filled air stream. The volumetric flow is 1.0 m^3/s. Design settling chamber to collect particles 11 μm in diameter having a density of 1600 kg/m3. The chamber is to be 2.5 m in width and 1.5 m in height. **(12) CO4 PO3**

i. How long must the settling chamber be to give theoretical perfect collection efficiency?
ii. Using the length determine the collection efficiency for 5 μm particles with the same density.
iii. Draw the schematic diagram of the settling chamber.

233

Table 1: Breakpoint table for PSI Calculation

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	Good
0.070 - 0.084	-	55 - 154	15.5 - 65.4	4.5 - 9.4	0.035 - 0.144	([2])	51 - 100	Moderate
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	Unhealthy for Sensitive Groups
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	Unhealthy
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	Very unhealthy
([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	Hazardous
([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	

[1] Areas are required to report the PSI based on 8-hour ozone values. However, there are areas where a PSI based on 1-hour ozone values would be more protective. In these cases the index for both the 8-hour and the 1-hour ozone values may be calculated and the maximum PSI reported.

[2] NO_2 has no short-term NAAQS and can generate a PSI only above a PSI value of 200.

[3] 8-hour O_3 values do not define higher PSI values ($\geq$ 301). PSI values of 301 or higher are calculated with 1-hour O_3 concentrations.

[4] The numbers in parentheses are associated 1-hour values to be used in this overlapping category only.

234

Program: B. Sc. in Civil Engineering
Semester: 7th Semester

Date: 30 September 2022
Time: 10:30 am – 12:00 pm

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

Midterm Examination
Course Number: HUM 4753
Course Title: Engineering Economics and Accounting

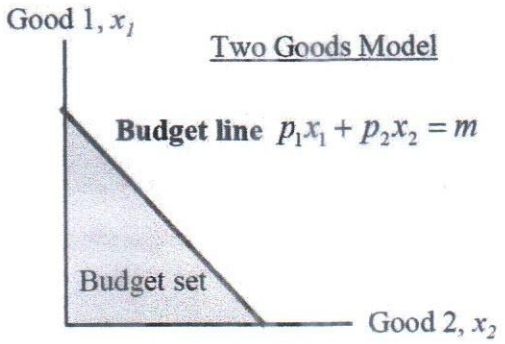
Winter Semester: 2021 - 2022
Full Marks: 75
Time: 90 Minutes

There are **3 (Three)** questions. **Answer all questions**. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are provided in brackets. The examination period is 1.5 hours.

---

1. (a) Exemplify "Time Value of Money". Distinguish between IRR and MARR. Characterize "Risk" and "Return" in terms of engineering economics. **(8) (CO1) (PO1)**

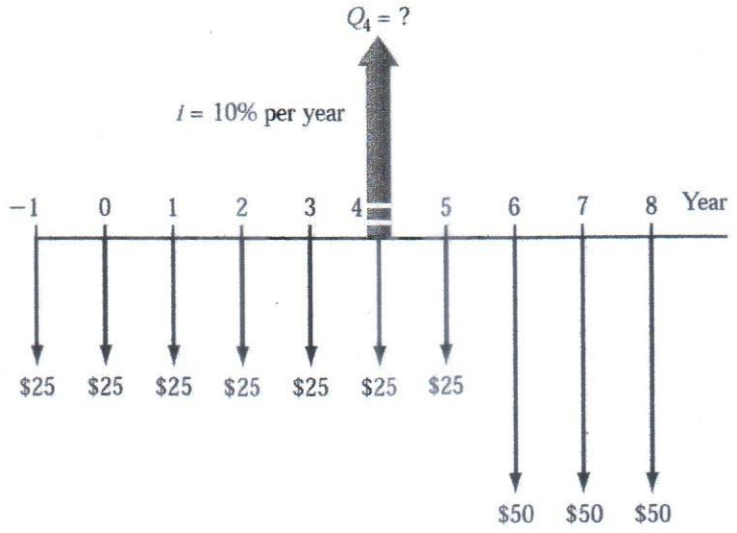
(b) Formulate the opportunity cost for the following Two Goods model. Note that, x_1 represents the composite goods, i.e., all other goods except Good 2 (x_2). **(3.5) (CO2) (PO2)**



(c) The Texas Tomorrow Fund (TTF) is a program started in 1996 in Texas wherein parents could prepay their child's college tuition when the child was young. Actuaries set the price based on costs and investment earnings at that time. Later, the Texas legislature allowed universities to set their own tuition rates; tuition costs jumped dramatically. The cost for entering a newborn in 1996 was $10,500. If the TTF fund grew at a rate of 4% per year, while tuition costs increased at 7% per year, determine the state's shortfall when a newborn enters college 18 years later. **(5) (CO1) (PO1)**

(d) Use the cash flow diagram to find the single amount of money Q_4 in year 4 that is equivalent to all the cash flows shown. Use i = 10% per year. **(8) (CO2) (PO2)**

235

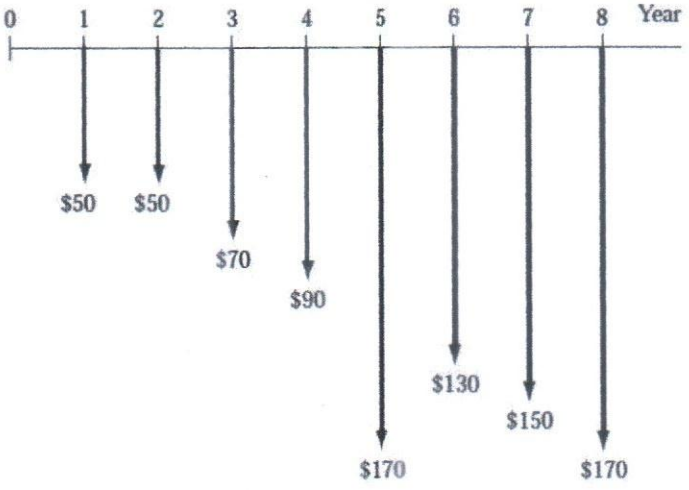


2. (a) What is "Pareto Improvement"? Explain "Marginal Rate of substitution". Differentiate between "Substitutes" and "Complements" in terms of economic goods. **(8) (CO1) (PO1)**

(b) Henry Mueller Supply Co. sells tamperproof, normally open thermostats (i.e., thermostat closes as temperature rises). Annual cash flows are shown in the table below. Determine the future worth of the net cash flows at an interest rate of 10% per year. **(5) (CO1) (PO1)**

Year	1	2	3	4	5	6	7	8
Income, $1000	200	200	200	200	200	200	200	200
Cost, $1000	90	90	90	90	90	90	90	90

(c) Find the present worth in year 0 for the cash flows shown below. Let i = 10% per year. **(8) (CO2) (PO2)**



(d) For the cash flows shown below, obtain the value of G such that the present worth in year 0 equals \$16,000 at an interest rate of 10% per year. **(4) (CO2) (PO2)**

Year	0	1	2	3	4	5
Cash Flow, \$	0	8000	8000	8000−G	8000−2G	8000−3G

3. (a) Clarify "Breakeven Point" and "Shutdown Point" using a schematic AC, AVC, and MC diagram. Add the mathematical explanation accordingly. **(8) (CO1) (PO1)**

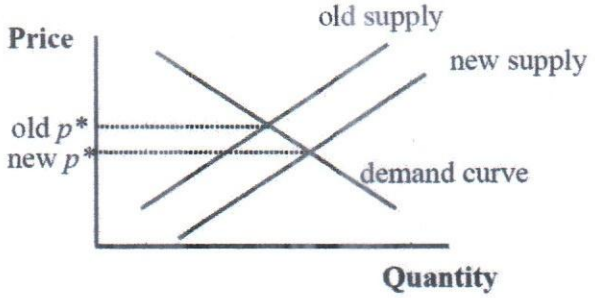
(b) GKX Industries expects sales of its hydraulic seals (in inch and metric sizes) to increase according to the cash flow sequence 70 + 4 k, where k is in years and cash flow is in \$1000. **(6) (CO2) (PO2)**

i. What is the amount of the cash flow in year 3?

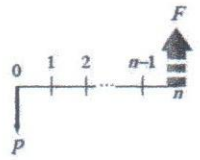
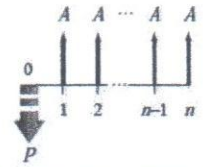
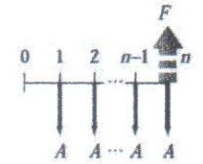
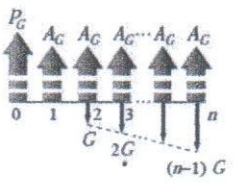
ii. What is the future worth of the entire cash flow series in year 10?
Let, i = 10% per year.

(c) A low-cost noncontact temperature measuring tool may be able to identify railroad car wheels that need repair long before a costly structural failure occurs. If BNF Railroad saves \$100,000 in years 1 through 5, \$110,000 in year 6, and constant amounts increase by \$10,000 each year through year 20, what is the equivalent annual worth over the 20 years of the savings? The interest rate is 10% per year. **(8) (CO2) (PO2)**

(d) What can be derived from the following demand-supply diagram? **(3.5) (CO1) (PO1)**



NOTES

Type	Find/Given	Factor Notation and Formula	Relation	Sample Cash Flow Diagram
Single Amount	F/P Compound amount	$(F/P,i,n) = (1+i)^n$	$F = P(F/P,i,n)$	
	P/F Present worth	$(P/F,i,n) = \frac{1}{(1+i)^n}$	$P = F(P/F,i,n)$	
Uniform Series	P/A Present worth	$(P/A,i,n) = \frac{(1+i)^n - 1}{i(1+i)^n}$	$P = A(P/A,i,n)$	
	A/P Capital recovery	$(A/P,i,n) = \frac{i(1+i)^n}{(1+i)^n - 1}$	$A = P(A/P,i,n)$	
	F/A Compound amount	$(F/A,i,n) = \frac{(1+i)^n - 1}{i}$	$F = A(F/A,i,n)$	
	A/F Sinking fund	$(A/F,i,n) = \frac{i}{(1+i)^n - 1}$	$A = F(A/F,i,n)$	
Arithmetic Gradient	P_G/G Present worth	$(P/G,i,n) = \frac{(1+i)^n - in - 1}{i^2(1+i)^n}$	$P_G = G(P/G,i,n)$	
	A_G/G Uniform series	$(A/G,i,n) = \frac{1}{i} - \frac{n}{(1+i)^n - 1}$ (Gradient only)	$A_G = G(A/G,i,n)$	

238

M. Sc. in Civil Engineering

28 September, 2022 (Wednesday)
Time: 2:30 PM–4:00 PM

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

TERM: MID SEMESTER EXAMINATION
COURSE NO.: CEE 6303
COURSE TITLE: Municipal Wastewater Treatment and Process Design

WINTER SEMESTER: 2021-2022
TIME: 1.5 Hours
FULL MARKS: 75

There are **3 (Three)** 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. Symbols convey their usual meanings. Assume reasonable values for any necessary design data where required.

---

1. **(a)** Describe briefly on wastewater, its type, point and nonpoint sources pollution. **(5)**

   (b) The average daily flow in a small river during the driest month is 100 L/s. If a wastewater treatment plant could consistently produce an effluent with a BOD_5 of 20 mg/L or less, what population could be served if the BOD_5, in the river, after dilution, must not exceed 4 mg/L? Assume that there is no upstream pollution and that the municipal water supply does not come from the river.
   Sketch the material balance in the river. **(7)**

   (c) A municipal WWTP receives 20,000 m^3/day of flow. Two primary clarifiers operating in parallel will handle the flow. The state's regulatory agency's criteria are as follows: average overflow rate = 20 $m^3/(d.m^2)$, and the average detention time = 3.0 hours. Determine: i) Clarifier diameter. ii) Side water depth. iii) Weir loading rate if an inboard peripheral weir is used that is 0.25 m from the edge of the clarifier. **(13)**

   Design and sketch the primary clarifiers with proper dimensions.
   Do you think the freeboard is necessary? Justify your answer.

2. **(a)** Sketch a secondary wastewater treatment plant (WWTP) process and describe briefly. **(7)**

   (b) A completely mixed activated sludge process is designed to treat 20,000 m^3/day of domestic wastewater having a BOD_5 concentration of 250 mg/L following primary treatment. The DoE permit may require that the effluent BOD_5 and TSS concentrations not exceed 20 mg/L on an annual basis. The following biokinetic coefficients are to be used in the design of the process: Y = 0.6 mg VSS/mg BOD_5, k = 5 d^{-1}, Ks = 60 mg/L BOD_5 and k_d = 0.06 d^{-1}. Assume that the MLVSS concentration in the aeration basin will be maintained at 3000 mg/L and the ratio of VSS:TSS is 0.75. Determine the followings: i) Effluent soluble BOD_5 ($SBOD_5$) concentration necessary to meet the total BOD_5 ($TBOD_5$) requirement of 20 mg/L. ii) Mean cell residence time (MCRT) necessary to meet any standards. iii) Volume of the aeration basin in cubic meters. iv) Quantity of waste sludge produced at the MCRT. **(18)**

Design and sketch the aeration basin with proper dimensions.
Justify whether the MCRT meet the standard mixing requirement.

3. **(a)** Sketch a two-stage anerobic digestion and describe briefly. **(7)**

(b) An aerobic digester is to be designed to stabilize 3266 lb of combined primary and waste-activated sludge. The volume of the combined sludge that will be fed to the digester is 1036 cfd. The volatile solids concentration of the combined sludge is 70%, and the minimum design operating temperature is 16°C. The primary sludge contains 940 lb of BOD with an oxygen demand of 1.9 lb of oxygen per lb of BOD, whereas the WAS consists of 865 lb of VSS with an oxygen demand of 2.0 lb of oxygen per lb of VSS destroyed. **(18)**

Determine the followings: i) Design hydraulic detention time or digestion time in days. ii) The aerobic digester volume. iii) The volatile solids loading rate to the aerobic digester. iv) The quantity of oxygen required to stabilize primary BOD in primary sludge. v) The quantity of oxygen required to stabilize VS in secondary sludge (WAS) and in combined sludge (CS). vi) The total quantity of oxygen required to stabilize the combined sludge (by considering BOD and VS). vii) The total air required in cfm if air contains 0.0175 lb of oxygen per cubic foot of air and the diffusers have a transfer efficiency of 5.0%.

Design and sketch the aerobic digester with proper dimensions.
Justify whether the air supplied meet the standard mixing requirement.

Formulae

$$\frac{1}{\theta_c} = Y\frac{(dS/dt)_U}{X} - k_d = Y\frac{(kXS_e)/(K_S + S_e)}{X} - k_d = Y\frac{kS_e}{K_S + S_e} - k_d$$

$$V = \frac{YQ(S_o - S_e)}{1 + k_d\theta_c}\frac{\theta_c}{X}$$

$$P_x = \frac{YQ(S_o - S_e)}{1 + k_d\theta_c}$$

240

M.Sc./M. Engg. (CEE). 30 September, 2022 (Afternoon)

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

Semester: Midterm Examination **Winter Semester: 2021-2022**
Course No.: CEE 6501 **Full Marks: 75**
Course Title: Highway Engineering **Time: 1.5 hours**

There are **4 (Four)** Questions. Answer any **3 (Three)** questions. All questions carry equal marks. Programmable calculators are not allowed. Do not write on this question paper. The symbols have their usual meaning. Assume reasonable values for any missing information. **Students can bring Highway Capacity Manual (excluding Supplements), Highway Safety Manual printouts, and ONE page (both side) handwritten note.**

1(a) What can be the performance measures for estimation of level of service of an urban highway with frequent bus stops? (10)

(b) Write down the steps for computation of LOS for rural two-way highway. Also, describe the standard values (base conditions) for a two-way rural highway that can be used without a modification factor. (15)

2(a) BRT projects places BRT lanes in the middle of an urban highway. What safety measures you may propose to improve pedestrian safety for the BRT passengers? (10)

(b) What are the human factors of design? How age and perception affect overtaking and stopping sight distance? (5)

(c) Write down the importance of shoulders on highway design. How does presence of heavy vehicle change a road performance? (10)

3. A proposal is being offered to convert a 2-lane rural highway to 3-lane rural highway (middle lane for passing only). Find the change of level of service for initial scenario and final scenario. Relevant information is given below: (25)

	Case 1 (Before)	Case 2 (After)
Number of Total Lanes	2	2+1
Lane width	13'	11'
Right lateral clearance	6'	4'
Peak hour traffic (veh/hour)	1800	2000
Directional Split	50/50	50/50
FFS	55 mph	60 mph
Truck traffic	7%	7%
PHF	0.82	0.90
No passing zone	70%	0%
Access points	10	12

No interchange. Rolling terrain with 3% gradient. Facility operates under ideal conditions.

241

4. A 2-lane undevided rural highway has undergone the following treatment (before/after). Predict number of crushes in a given mile that would have happened without treatment and expected crushes after treatment. Show change in crush distribution as well. Use the data given in Question 3 as necessary. (25)

	Before treatment (Case 1)	**After treatment (Case 2)**
Number of Total Lanes	2	2+1(middle lane for passing)
Median	Painted	Rumble strips
Driveway density	6	8
Lighting	No	No
Shoulder	Unpaved	Paved

242

M. Sc. Engg. (CEE) 05 October, 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid Semester Examination **Winter Semester: 2021-2022**
Course No.: CEE 6701 **Full Marks: 75**
Course Title: Advanced Soil Mechanics I **Time: 1.5 Hours**

There are 3 (Three) questions. Answer all questions. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1(a). Briefly explain the procedures of determining soil parameters (cohesion and angle of internal friction) from the Direct Shear test and Triaxial Consolidated Drain test. (7)

(b). Briefly describe the mechanism of Unconfined Compression test. (6)

(c). Derive the finite difference equation for determination of consolidation rate in two-dimensional condition. (12)

2. A clay layer of 10.0 m thick is drained out on its top surface and has a uniform initial excess pore water pressure distribution over the depth is 150 kPa. The coefficient of consolidation of the clay is 0.36 m^2/month. Using the finite difference method determine the degree of consolidation that the layer will have undergone 30 months after the commencement of consolidation. Compare the answer with the theoretical value (use following equation). (25)

For U = 0 to 60%, $T_v = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2$; For U > 60%, $T_v = 1.781 - 0.933\log(100 - U\%)$

3. RHD has planned to build a road of 5 m height at Babur Bari, Rampal, on clayey soil having a thickness of 12 m overlying the sandy layer. Unit weight of the road section is 19.0 kN/m^3. The parameters of the soils are- γ_{sat}=18.81 kN/m^3, γ_w= 9.81 kN/m^3, C_c=0.33, C_s = 0.06, initial void ratio e_0 =1.26, c_v = 0.67 m^2/month, and c_α = 0.008. (25)

(i) Compute the primary consolidation settlement of the clay layer, considering the soil as Normally Consolidated.

(ii) Compute the time required to reach the 90% consolidation where the time factor, T_v=0.848.

(iii) Calculate also total (primary and secondary) settlement after 150 years of applying the surcharge. Use, T_v=1.781 for 100% primary consolidation.

(iv) It is expected that a pavement layer will be placed 12 months after the soil fill is done, and maximum allowable settlement after this is 25 mm. Determine a suitable triangular sand drain system to achieve the requirements. Consider complete primary settlement for designing the sand drain.

$T_v = \frac{c_v t}{H_{dr}^2}$; $T_v = \frac{\pi}{4}\left(\frac{U_v\%}{100}\right)^2$, n=R/r, R=0.525 s, $T_r = \frac{c_h t}{4R^2}$,

$U = 100 - \frac{1}{100}(100 - U_v)(100 - U_r)$

243

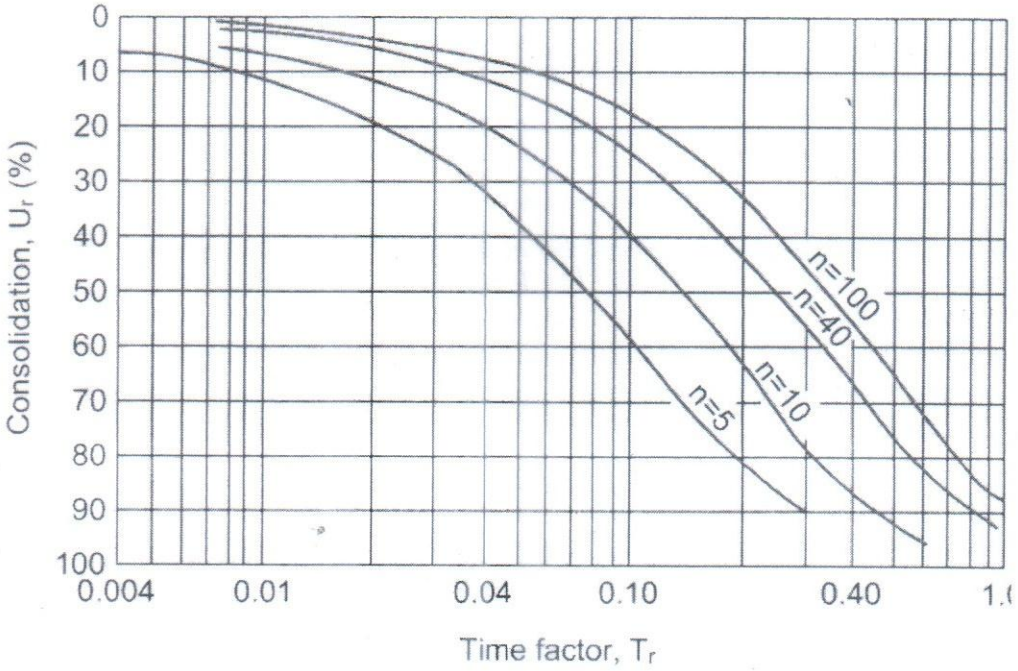


Figure for Q3