~~199~~ 199

B.Sc. Engg. (CEE)/1st Sem. 13 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

THE ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMISTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : **CEE-4103** TIME : 1.5 Hours
COURSE TITLE: **Surveying** FULL MARKS: 100

There are 4 (Four) questions. Answer any 3 (Three) questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate the mark for each question.

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1 (a) Calculate the earthwork for an embankment using the following data: (15)

Change (m)	0	50	100
Ground level (m)	5	7	9.5
Formation level(m)	8	8	8

Formation level width=15 m, side slope= 2 H: 1 V. Ground is level across embankment width.

(b) The lengths and bearings of closed traverse ABCDEA and the latitudes and departures of the known sides are given below. The lengths of the two sides BC and CD could not be measured. Compute the omitted measurements. ($18\frac{1}{3}$)

Line	Length(m)	Reduced bearing
AB	730	S 60°00' E
BC	?	N 62°18'E
CD	?	N37°42' W
DE	940	S55°24'W
EA	575	S02°42'W

2 (a) A square plot ABCD having an area of 400 square meters forms the plane of a pit excavated for road work. Calculate the volume of the excavation in cubic meters from the following data: ($08\frac{1}{3}$)

Point	A	B	C	D
Original Level(m)	55	53	54	52
Final Level(m)	50	50	50	50

(b) List five methods of direct linear measurements and describe them in brief. Write down five considerations of selecting stations in chain surveying. (10+5)

(c) Write short notes on: (10)
(i) Field book (ii) Tie line (iii) Check line (iii) Base line

~~100~~ 200

3 (a) Following information is given for a closed traverse: (23)

The adjusted latitudes and departures of a closed traverse are given below.

Line	Length(m)	R. B.
AB	281.4	S 69°11' E
BC	129.4	N 21°49' E
CD	131	N 19°34' W
DE	144.5	S 46°9' W
EA	168.7	S 74° 24' W

Determine the area of the closed traverse using meridian- distance method.

(b) What is bearing of a line? Define: (i) True Meridian and True Bearing (ii) Magnetic Meridian and magnetic Bearing (iii) Arbitrary Meridian and Arbitrary Bearing ($10\frac{1}{3}$)

4 (a) Write down the differences between plane surveying and geodetic surveying (08)

(b) A chain was tested before starting the survey, and was found to be exactly 20 meters. At the end of the survey, it was tested again and was found to be 19 m. Area of the plan of the field drawn to a scale of 1cm= 6m was 50.4 sq. cm. Find the true area of the field in sq. metres. ($10\frac{1}{3}$)

(c) The following offsets were taken from a chain- line to a hedge. (15)

Distance(m)	0	10	20	40	60	80	100	130
Offset(m)	4	3.7	4.2	3.9	4.1	3.8	3.6	3.8

Calculate the area enclosed between the chain- line, the hedge and the end- offsets by (i) Simpson's rule and (ii) Trapezoidal rule

Equations' Table

1. $l = l'.\left(\frac{L'}{L}\right)$	9.B.B of AB = F.B of BA	17.$\Delta = \frac{O_1+O_2+O_3+\cdots+O_n}{n+1} \times L = \frac{L}{n+1}\sum O$
2. $A = A'.\left(\frac{L'}{L}\right)^2$	10.include angle=(2N-4)× 90^o	18.$\Delta = \left(\frac{O_0+O_n}{2} + O_1 + O_2 + O_3 + \cdots + O_{n-1}\right) d$
3. $V = V'.\left(\frac{L'}{L}\right)^3$	11.exclude angle=(2N+4)× 90^o	19.$\Delta = \frac{d}{3}[(O_0 + O_n) + 4(O_1 + O_3 + \cdots + O_{n-1}) + 2(O_2 + O_4 + \cdots + O_{n-2})]$
4. $C_t = \alpha(T_m - T_o)L$	12.$\sum L = l_1 \cos\theta_1 + l_2 \cos\theta_2 + l_3 \cos\theta_3 + \cdots = 0$	20.V=d$\left[\frac{(A_0+A_n)}{2} + A_1 + A_2 + \cdots + A_{n-1}\right]$
5. $C_p = \frac{(P-P_o)L}{AE}$	13.$\sum D = l_1 \sin\theta_1 + l_2 sin\theta_2 + l_3 \sin\theta_3 + \cdots = 0$	21.V=$\frac{d}{3}[(A_0 + A_n) + 4(A_1 + A_3 + \cdots + A_{n-1}) + 2(A_2 + A_4 + \cdots + A_{n-2})]$
6. $C_s = nC_{s1} = \frac{nl_1(wl_1)^2}{24P^2}$	14.A = $\sqrt{s(s-a)(s-b)(s-c)}$	22.A=h(nh+b)
7. $P_n = \frac{0.204w_1\sqrt{AE}}{\sqrt{P_n - P_o}}$	15.A=$\lvert\sum M_i L_i\rvert$	23. $C_p = V_T - V_P$
8.Back Bearing = Fore Bearing ±180^o	16. $M_i = M_{i-1} + \frac{D_{i-1}+D_i}{2}$	

201

B.Sc. Engg. (CEE)/Ist Sem. 19 March, 2018. (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : Math-4153 TIME : 1.5 Hours
COURSE TITLE: Differential calculus and Integral calculus, Matrix FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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

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

$$\lim_{x\to -1} \frac{\tan(x+1)}{(x+1)}$$

Hence verify your answer analytically.

(b) Let

$$f(x) = \begin{cases} 1/(x+2), & x < -2 \\ x^2, & -2 < x \le 3 \\ \sqrt{x+13}, & x > 3 \end{cases} \quad (15)$$

Find (i) $\lim_{x\to -2} f(x)$ (ii) $\lim_{x\to 0} f(x)$(iii) $\lim_{x\to 3} f(x)$

2.(a)Find a value of the constant k, if possible, that will make the function (10)

$$f(x) = \begin{cases} 9-x^2, & x \ge -3 \\ k/x^2, & x < -3 \end{cases}$$

continuous everywhere.

(b) Find

$\lim_{x\to -\infty} \frac{4x^2-x}{2x^3-5}$. Also find the horizontal asymptote, if any. (8)

(c) Discuss the continuity of the function

$f(x) = \begin{cases} x\sin\frac{1}{x} & if \quad x \neq 0 \\ 0 & if\ x = 0. \end{cases}$ at $x = 0$. (7)

3.(a) Discuss the continuity and differentiability of the function (15)

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

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

(b) Find $\frac{d^2y}{dx^2}$ when $y = x \tan \frac{1}{x}$. (10)

4.(a)Find all values in the interval $[-2\pi, +2\pi]$ at which the graph of (15)

$$f(x) = x - \cos x$$

have horizontal and vertical tangent lines, if any.

(b) Find an equation of for the tangent line to the Folium of Descartes (10)

$$x^3 + y^3 = 3xy$$

at the point $\left(\frac{3}{2}, \frac{3}{2}\right)$. At what point(s) in the first quadrant is the tangent line to the Folium of Descartes horizontal?

203

B.Sc. Engg. (CEE)/ 3rd Sem. 13 March, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER : 2017-2018
COURSE NO. : CEE 4311 TIME : 1.5 Hours
COURSE TITLE : **Mechanics of Solids I** FULL MARKS : 75

There are 4 (Four) questions. Answer any 3 (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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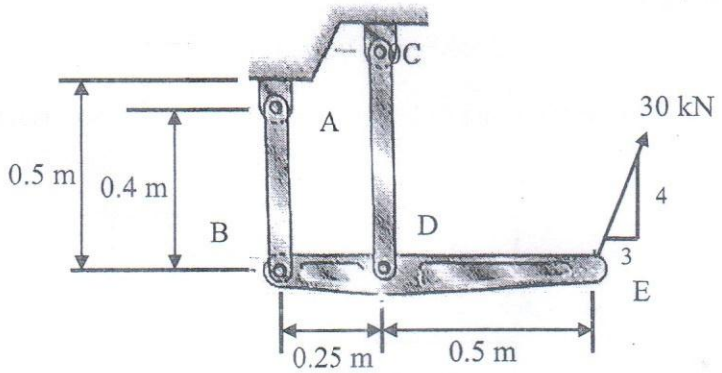
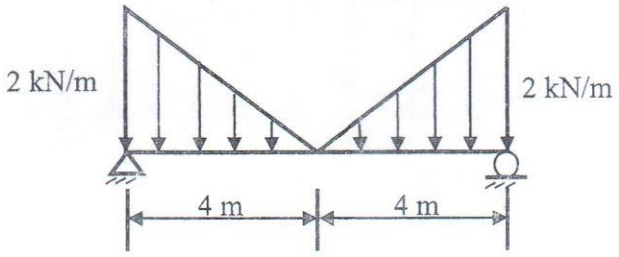
1. a) The rigid bar BDE is supported by two links AB and CD. Link AB is made of Aluminum (E =70 GPa) and has a cross-sectional area of 500 mm^2. Link CD is made of steel (E = 200 GPa) and has a cross-sectional area of 600 mm^2. For the UDL shown below, determine the deflection of 20
   i. B,
   ii. D, and
   iii. E.



   b) Explain creep and relaxation with proper graphical illustration. 05

2. a) Draw SFD, and BMD of the following beam: (***use integral method***) 08



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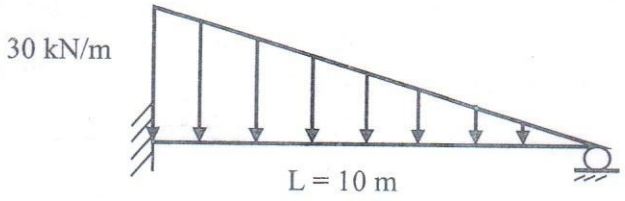
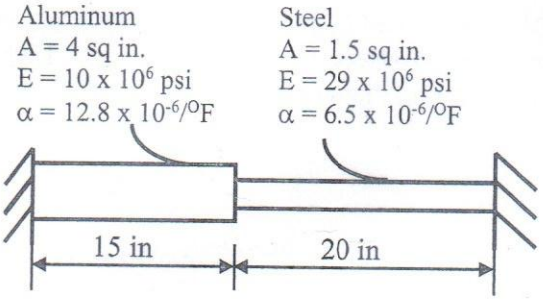
b) Draw SFD, and BMD of the following beam: (***use integral method***) 17



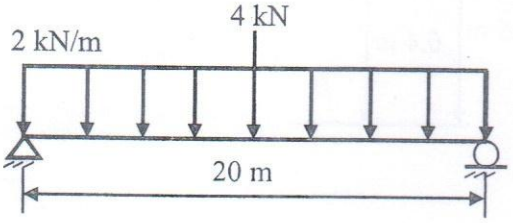
3. a) Derive the followings: 06
   i. $dV/dx = W$
   ii. $dM/dx = V$

b) Calculate the increase in stress for each segment of the compound bar shown in the figure if the temperature increases by $100^{O}F$. Assume that the supports are unyielding and that the bar is suitably braced against buckling. 15

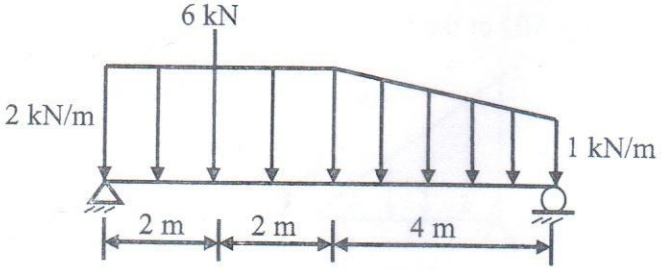


c) Define toughness and resilience. Draw the constitutive curves for mild steel and concrete. 04

4. a) Draw SFD, BMD of the following beam: (***use cut-section method***) 08



b) Draw SFD, BMD of the following beam: (***use integral method***) 17



205

B.Sc. Engg. (CEE)/ 3rd Sem. 20th March, 2018 (Morning)

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

Semester: Mid Semester Examination **Winter Semester: 2017-2018**
Course No.: CEE 4361 **Full Marks: 75**
Course Title: Fluid Mechanics **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 questions paper. The symbols have their usual meaning.

1(a) What is viscosity of fluid? Derive the Newton's equation of viscosity of fluid. (08)

(b) Define absolute pressure and gauge pressure. How are they interrelated? (04)

(c) Assuming a velocity distribution as shown in Figure 1, which is a parabola having its vertex 12 inch from the boundary, calculate the velocity gradient for y = 0,3,6,9, and 12 inch. Also calculate the shear stress in lb/ft^2 at these points if the fluids absolute viscosity is 600 cP. (10)

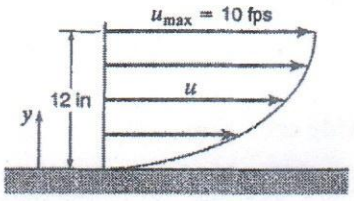


Figure 1

(d) A capillary tube having an inside diameter of 6 mm is dipped into water at 20^0 C. Determine the height of capillary rise. Assume that the contact angle is 30^0 and the surface tension force is 0.073 N/m. (03)

2(a) Show that pressure at a point in a static fluid is independent of orientation, and has the same value in all directions. (07)

(b) A block of wood 5 m long, 3 m wide and 1 m deep is floating horizontally in water. If the density of wood is 700 kg/m^3, find the volume of water displaced and the position of the center of buoyancy. (06)

(c) Figure 2 shows a gate which is a quadrant of a circular cylinder of radius 2 m. Determine the following: (12)

i. The total force acting on the gate per meter length.
ii. The angle at which the force acts to the horizontal.
iii. Prove that the resultant force passes through the hinge C.

~~EE~~ 206

iv. Give the reason why the resultant passes through the hinge C.

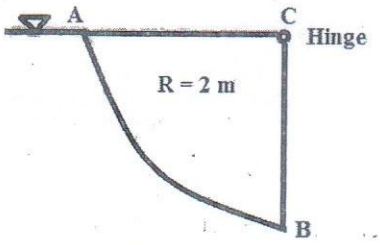


Figure 2

3 (a) Define the following : (08)

i. Newtonian fluid.
ii. Center of Pressure.
iii. Path line.
iv. Ideal fluid.

(b) Derive the equation of a stream line. (05)

(c) A flat plate 2 ft × 3 ft slides on oil (μ = 0.024 lb.ft/sec$^{2)}$ over a large plane surface. What force F is required to drag the plate at a velocity of 4 fps, if the thickness of the separating oil film is 0.025 inch. (05)

(d) A rectangular gate which is 5 m wide and 2.5 m high is in a vertical plane. (07)

i. If the water surface coincides with the top of the gate, find the force exerted by the water on the gate and the position of center of pressure.
ii. If the same area is immersed vertically downwards, the top side being at a depth of 4 m below the free surface find the force exerted by the water on the gate and the position of the center of pressure.

4 (a) Show that stream function and potential function is orthogonal. (08)

(b) Explain the following : (06)

i. As the temperature increases, the viscosities of all liquids decreases but the viscosity of gas increases.
ii. Center of pressure is always situated below the center of gravity.

(c) The velocity components at a point in a flow in the x, y and z directions are respectively u = a + by –cz, v = d – bx- ez, w = f + cx –ey, where a, b, c, d, e and f are arbitrary constants. Does it represent rotational flow? If so, determine the rotation. (06)

(d) A flow net diagram shows that the distance between two consecutive stream lines at two successive sections are 15 mm and 8 mm, respectively. If the velocity at the first section is 2 m/s, find the velocity at the other section. Also, find discharge between the two stream lines. (05)

B.Sc. Engg. (CEE)/ 3rd Sem. 207 14th March, 2018 (Morning)

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

Semester: Mid Semester Examination **Winter Semester: 2017-2018**
Course No.: GS 4351 **Full Marks: 75**
Course Title: Engineering Geology and Geomorphology **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 questions paper. The symbols have their usual meaning

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1(a) Why is knowledge of Geomorphology important for civil Engineers of Bangladesh? (08)

(b) Draw a schematic hydrograph showing the effects of urbanization on runoff and name the changes brought by it on hydrogeological environment. As a civil engineer, how can you solve the urban runoff problem? (12)

(c) Draw a schematic diagram showing the components of total flow. (05)

2(a) The axial length of a drainage basin of area 65,000 m^2 is 600 m. Determine the form factor and comment on the shape of the basin. (05)

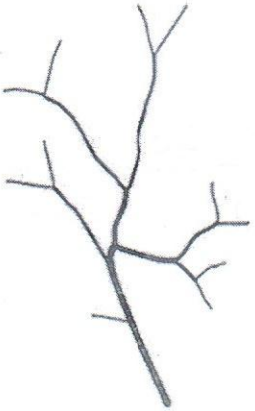
(b) A project is to be built in southwest of Dhaka. The following information was determined from field measurement and proposed design data: (08)

Total Drainage Area = 50 acres
Time of Concentration = 30 minutes

Type of Land Use	Percentage of Total Area
Rooftops	40%
Streets (Drive and Walks)	20%
Average lawns on sandy soil	30%
Parks	10%

Using rational method, find the peak discharge of the area for 2-year frequency storm.
[Use Table 1 and Figure 1 for required data]

(c) For the following stream network, do the stream ranking by both Horton's System and Strahler's system. For the stream ordering by Horton's Method, calculate the Bifurcation Ratio and comment on the result. (12)



3 (a) Write short notes on (i) Rectangular, (ii) Trellis, (iii) Radial types of drainage patterns with diagrams. (12)

(b) Describe different landforms of alluvial river floodplain with neat sketch. (13)

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

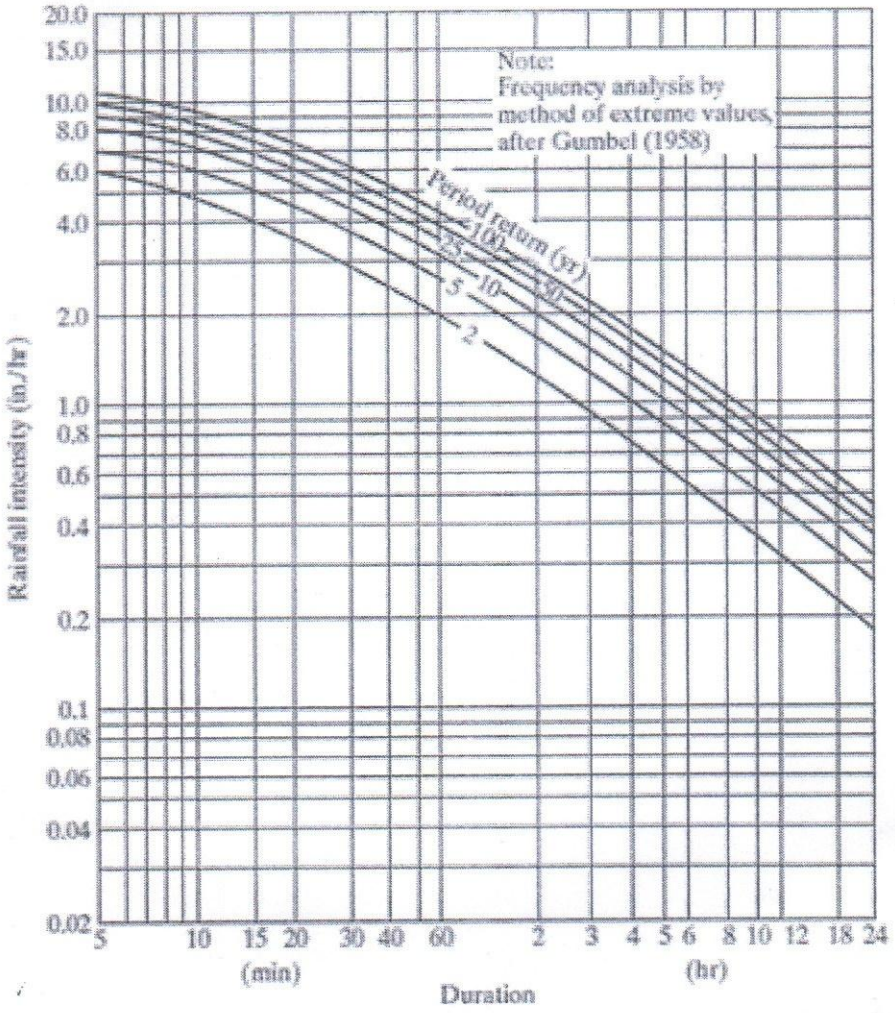
(b) What is river transportation? What are the factors affecting the transportation power of a river? How the knowledge of river transportation can help in determining (i) suitable size and (ii) adequate volume of blocks, in flood protection embankment design? (08)

(c) What is longitudinal bed profile of a steam? What information does it give? Derive the equation of longitudinal bed profile of a stream. (07)

Table 1: Runoff Coefficient values for different land uses

Land Use	C Value
Business:	
Downtown Areas	0.95
Suburban Areas	0.75
Residential lots (lot area only):	
Single-family	
2.5 acres or larger	0.12
0.75 – 2.5 acres	0.20
0.25 – 0.75 acres	0.30
0.25 acres or less	0.45
Apartments	0.75
Industrial:	
Light areas	0.80
Heavy areas	0.90
Parks, cemeteries	0.10
Playgrounds	0.25
Schools	0.55
Railroad yard areas	0.50
Streets:	
Paved	0.90
Gravel (packed)	0.40
Drive and walks	0.90
Roofs	0.90
Lawns	
Lawns, sandy soil	0.20
Lawns, clayey soil	0.20

Figure 1: IDF curve



210

B.Sc. Engg. (CEE)/ 3rd Sem. March 15, 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : GS 4353 TIME : 1.5 Hours
COURSE TITLE: Numerical Analysis and Computer Programming FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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) Briefly explain the reasons why Civil Engineers need to learn numerical methods. Mention some applications regarding Civil Engineering. (6)

   (b) What are the problems with bracketing methods for determining roots of equation? Briefly discuss pitfalls of Newton-Raphson method. (5)

   (c) Use Newton-Raphson method to estimate a root of $f'(x) = 2x^3 - 2.5x - 5$; employing an initial guess of x = 2. $[\varepsilon_s = 10^{-4}\%]$ (6)

   (d) Find eigenvectors of $A = \begin{bmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ 6 & -6 & 4 \end{bmatrix}$ and corresponding eigenvalues. (8)

2. (a) Briefly discuss characteristics of numerical computing. Also explain "Total Numerical Error" and "Other Errors". (8)

   (b) Data regarding compressive strength of concrete (psi) with the change of water-cement ratio have been provided below. (12)

   Fit a base-e exponential model ($y = \alpha e^{\beta x}$) and predict strength when w/c ratio is 0.31, using the model:

w/c ratio	0.4	0.46	0.57	0.78	0.95	1.10
strength (psi)	5145	3457	1895	966	278	111

   (c) The Maclaurin series expansion for $\sin x$ is (5)

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!} - \cdots$$

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

~~271~~ 211

3. (a) Describe the following terms in case of Gauss Elimination: (6)
Forward Elimination, Back Substitution.

(b) Briefly discuss hazards of higher order polynomials with proper graphical illustrations. (5)

(c) Use Gauss Elimination to solve the following system of linear equations: (9)

$$\begin{aligned} 5x &+ 6y &- 8z &= 11 \\ -7x &- 9y &+ 17z &= 21 \\ 12x &- 5y &+ 3z &= -1 \end{aligned}$$

(d) 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 $f(x) = \ln(x)$ and $h = 0.15$, then find
i) the approximated value of $f'(2)$
ii) true value of $f'(2)$
iii) true error of (i) and also relative true error.

4. (a) Derive general expression of Newton's interpolating polynomials for equally spaced data sorted in ascending order. (10)

(b) Deflection $(inch)$ of a loaded beam along with horizontal distances (ft) from the leftmost point have been provided below: (15)

Distance(ft)	0	1	2	3	4
Deflection $(inch)$	0	-0.00196	-0.00233	-0.00315	-0.00268

Predict deflection at a distance of 3.3 ft, using:
i) Graphical method
ii) Linear interpolation
iii) Parabolic interpolation of second order
iv) Newton's interpolating polynomial of maximum possible order

Choose appropriate sets of data in each case to predict more accurate results.

B.Sc. Engg. (CEE)/ 3rd Sem. 16 March, 2018. (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

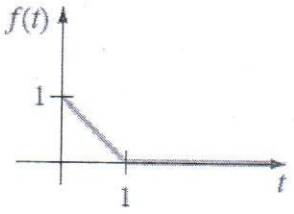
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : Math-4353 TIME : 1.5 Hours
COURSE TITLE: Laplace Transforms, Series Sol. Fourier Series and PDE; FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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 used have their usual meaning

1. a) Find the Laplace Transform of the following function $f(t)$ as in figure (10)



b) Evaluate $L^{-1}\left\{\dfrac{s}{(s+2)(s^2+4)}\right\}$ (15)

2. a) Prove that (10)

$$L\{f''(t)\} = s^2F(s) - sf(0) - f'(0).$$

b) Solve the following differential equation by using Laplace Transform (15)

$$y'' + y = \sqrt{2}\sin 2t, \quad y(0) = 10, \quad y'(0) = 0$$

3. a) Prove that (10)

$$L\{e^{at}f(t)\} = F(s-a) \quad \text{where } a \text{ is any real number.}$$

b) Define unit function with graph. Show that (15)

$$L\{U(t-a)\} = \frac{e^{-as}}{s}.$$

4. a) Determine the singular points of the following differential equation as regular or irregular. Justify your answer. (10)

$$(x^2-9)^2 y'' + (x+3)y' + 2y = 0$$

$$(x^3+4x)y'' - 2xy' + 6y = 0$$

b) Solve the following differential equation by the method of Frobenius about $x = 0$: (15)

$$2xy'' + 5y' + xy = 0$$

~~273~~ 213

B.Sc. Engg. (CEE)/ 5th Sem. 16 March, 2018 (Afternoon)

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

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : CEE 4511 TIME : 1.5 Hours
COURSE TITLE: Design of Concrete Structures I FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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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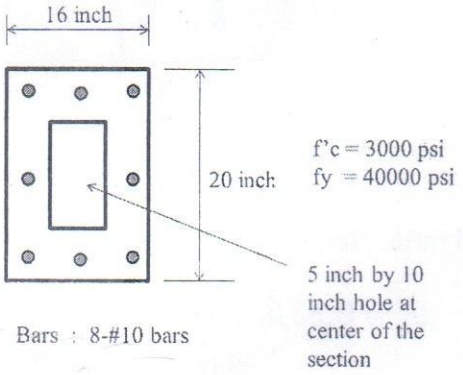
1 (a) Refer to the following 16 inch by 20 inch column section. Stress-strain curves of steel and concrete are attached. Compute the followings: (19)

(i) Transformed sectional area of the column,
(ii) Applied compressive load in column at strain level of 0.0005 (working load),
(iii) Compressive load in column at strain level of 0.001,
(iv) Ultimate load (in compression),
(v) Make comments on results (ii), (iii) and (iv)
(vi) Cracking load of the column under tension,
(vii) Ultimate load of the column under tension.

Assume fast rate of loading in calculation.



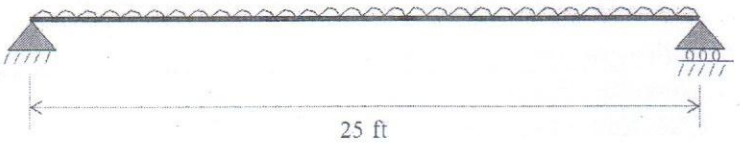
(b) For a bridge construction project the specified design strength was 4000 psi. From a nearby RMC plant, data were collected for similar strength of concrete produced by using the similar materials specified for the project. The compressive strength data (units are in psi) are summarized below: (6)

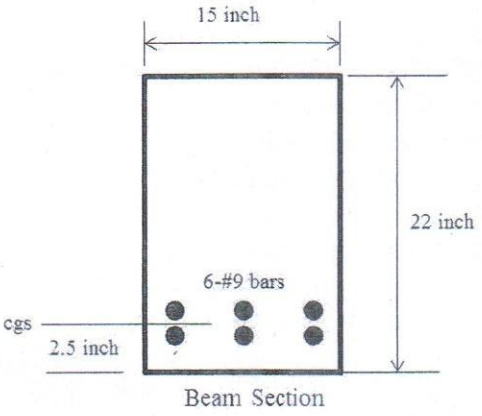
4500, 4600, 4000, 5000, 3900, 4700, 4600, 4400, 4000, 4100
4400, 4000, 4300, 3900, 4500, 4200, 3900, 4400, 4500, 4600
4100, 4300, 4000, 4000, 4700, 4300, 4200, 4100, 4200, 4400

(i) Determine the average required strength of concrete, and
(ii) If only 10 data were available, what will be the average required strength?
(iii) Make a brief discussion on the results.

2(a) Compare WSD and USD. (5)

(b) Refer to the following simply supported RC beam. Calculate the minimum amount of imposed load (excluding self-weight) that will cause cracking at the mid-section of the beam. Also, draw the stress and strain distributions in the beam section for a moment of 40 k-ft. Show the stress and strain over steel also. Given: $f'_c = 4000$ psi, $f_y = 60{,}000$ psi, and $f_t = 350$ psi. (20)





Beam Section

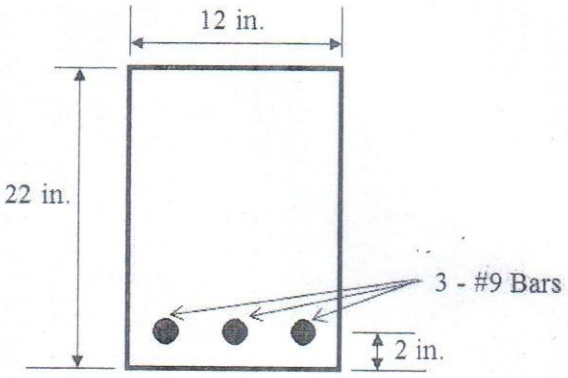
3(a) Define balanced steel ratio. Derive the following equation: (6)

$$\rho_b = 0.85\beta_1 \frac{0.003}{0.003 + \frac{f_y}{E_s}} \frac{f'_c}{f_y}$$

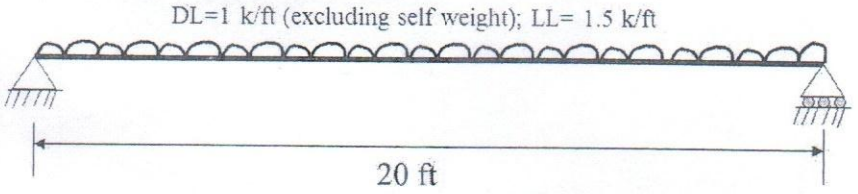
(b) Refer to the following beam section. Calculate the nominal moment capacity (ultimate moment capacity) of the beam section using (i) general non-linear stress distribution in compression zone of concrete, and (ii) Whitney's rectangular stress distribution in compression zone of concrete. Make comments on the results. (19)

~~175~~ 265

Use f'_c = 5000 psi, f_y=60,000 psi, E_s = 29,000,000 psi.



4 Design the following simply supported beam by WSD and USD. Make a brief discussion on the results. (25)



Width of the beam = *10 inch* (architectural requirement)
f_y = *60,000 psi*
f_s = *24,000 psi*
f'_c = *4000 psi*

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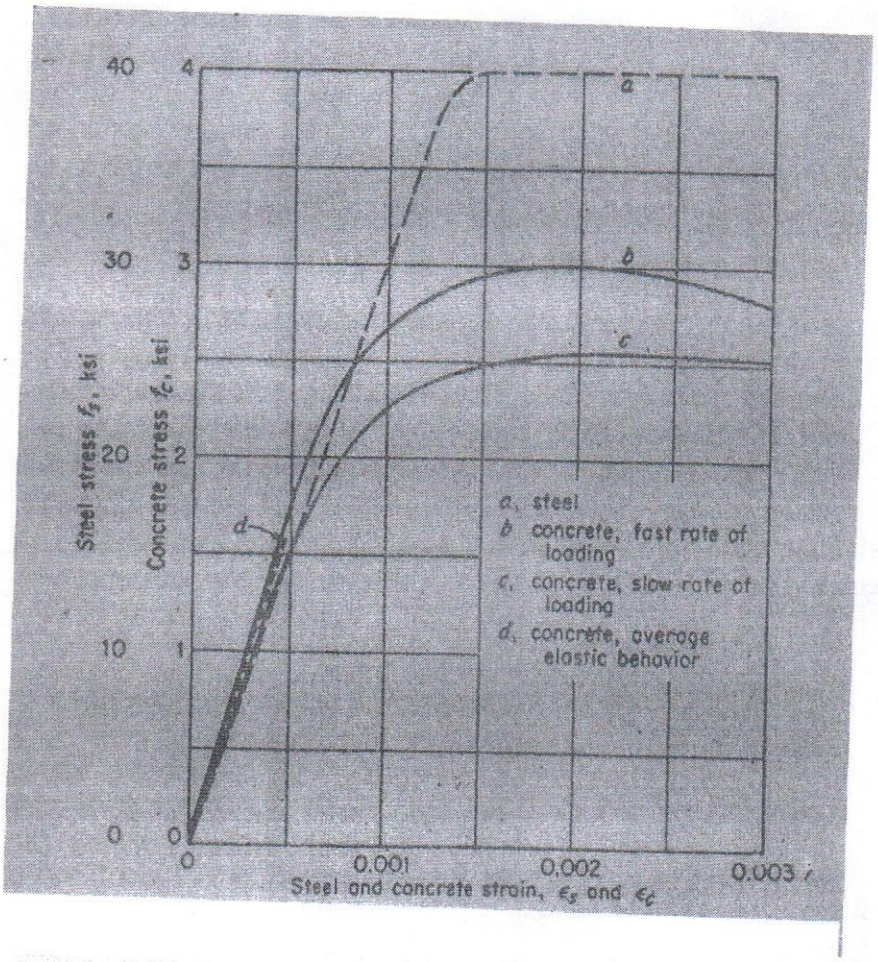
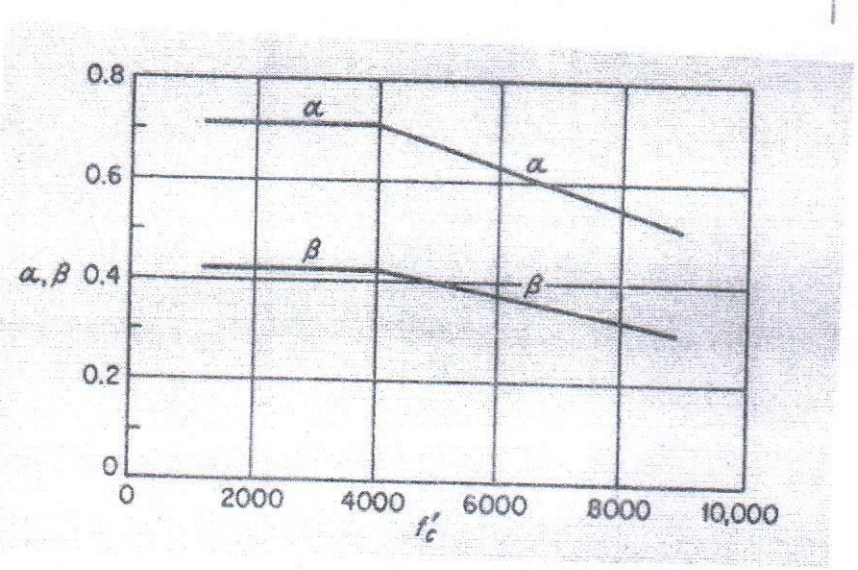

40
30
20
10
0
4
3
2
1
0
Steel stress f_s, ksi
Concrete stress f_c, ksi
a
b
c
d
a, steel
b concrete, fast rate of loading
c, concrete, slow rate of loading
d, concrete, average elastic behavior
0
0.001
0.002
0.003
Steel and concrete strain, ϵ_s and ϵ_c


0.8
0.6
0.4
0.2
0
α, β
α
β
a
β
0
2000
4000
6000
8000
10,000
f'_c

~~177~~ 217

B.Sc. Engg. (CEE)/5th Sem. 13 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : CEE 4513 TIME : 1.5 Hours
COURSE TITLE: Structural Analysis and Design I FULL MARKS: 100

There are 4 (Four) questions. Answer any 3 (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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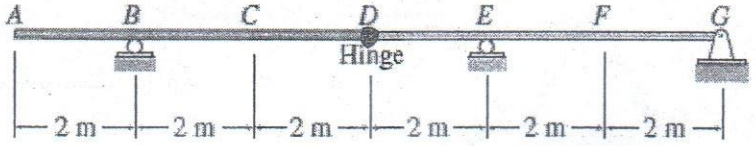
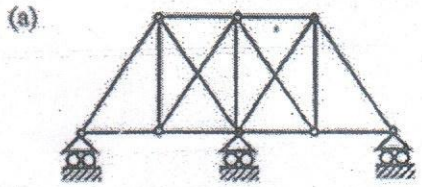
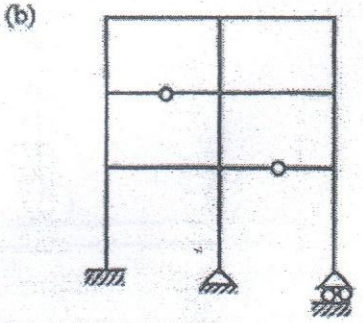
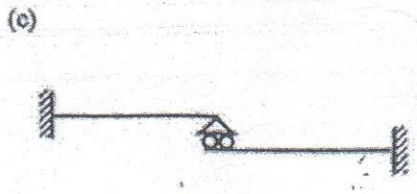
1. Draw the influence lines for the vertical reactions at supports B, E, and G of the beam shown below. Also draw the influence lines for the shear and bending moment at point C and at point F. $(33\frac{1}{3})$



2(a) Determine whether the following structures are statically and geometrically stable or unstable, statically determinate or statically indeterminate. If statically indeterminate, report the number of degrees of indeterminacy. (10)







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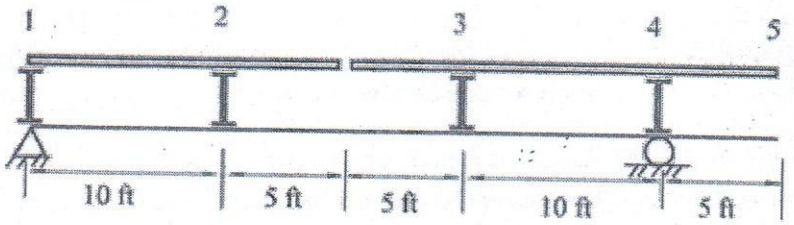
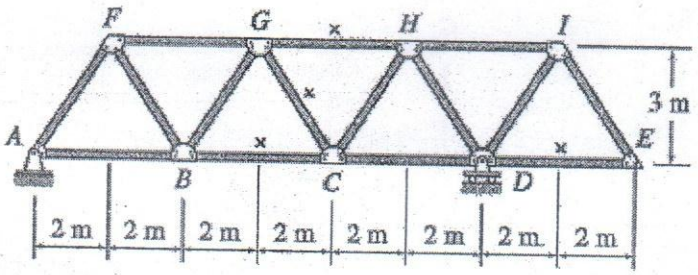
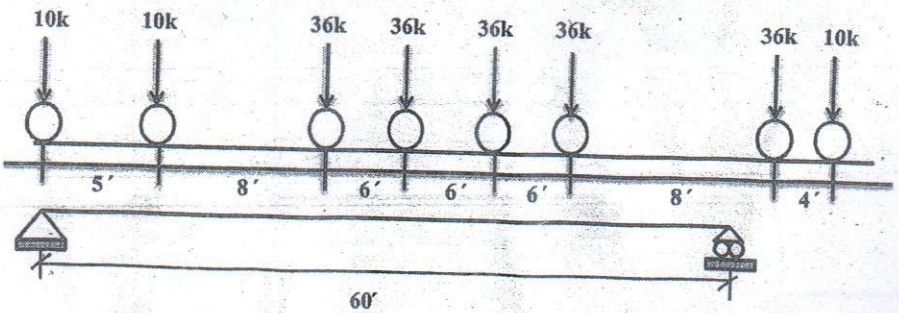
(b) Draw influence line for: Bending Moment at panel points 2 and 3, and Shear force in panel 2-3 and panel 3-4 of the girder with floor beams in the figure shown below: $(23\frac{1}{3})$



3. Draw the influence lines for the forces in the members identified by an "X" of the trusses shown in the figure below. Live load are transmitted to the bottom chords of the trusses. If a moving uniform load of 5 kips per ft combined with a moving concentrated load of 50 kips acting on the truss, calculate the maximum force in bars GC and DE. $(33\frac{1}{3})$



4. Calculate the maximum reaction at left support A of a simply supported beam of span 60 ft due to the axle loads of a heavy freight locomotive shown below. $(33\frac{1}{3})$



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B. Sc. Engg. (CEE)/ 5th Sem. 14 March, 2018 (Afternoon)

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

Mid Semester Examination **Summer Semester: 2017-2018**
Course No.: CEE 4543 **Full Marks: 75**
Course Title: Foundation 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 figures in the right margin indicate full marks. The Symbols have their usual meaning.

1(a) Briefly describe the types of shear failure in footing. (6)

(b) Derive the equation of ultimate bearing capacity for footing by upper and lower bound theories for the ground with clayey soil (cohesion, c_u) where $\phi = 0$, and $\gamma = 0$. Use Mohr – Coulomb failure criteria for the ground. (15)

(c) Briefly describe how water table influences on the bearing capacity of the footing. (4)

2(a) Calculate the ultimate and allowable bearing capacities for a rectangular footing (3.2m X 4.8m) placed at a depth of 2.20 m (Fig.1) for the following two conditions. Use, FS=2.5. Use, Meyerhof equations for bearing capacity factors, shape factors and depth factors. (15)

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

(i) c=80.0kN/m^2, ϕ=30°.
(ii) c=80.0kN/m^2, ϕ=0°.

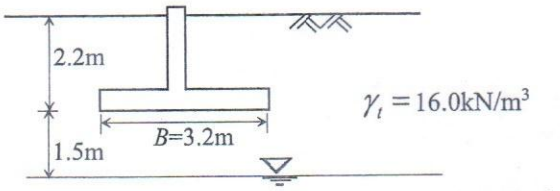


Fig.1

(b) Compute the dimensions of a trapezoidal combined footing (B_1, B_2 and L) for supporting two columns (in column 1, Q_1= 20.0 MN, in column 2, Q_2=28.0 MN) placed at a distance of 6.0 m. The first column is located at 2.0 m from the property line. The net allowable bearing capacity of the ground is 500 kPa. (10)

3 (a) Briefly explain the types of mat foundation with sketches. (7)

(b) Compute the foundation depth (D_f) for a partially compensated mat foundation (50m X 60m) in fully saturated soils (ϕ = 10°, c = 55.0 kN/m^2, γ_{sat} =19.8kN/m^3). Consider factor of safety, FS=3.0; dead load, DL=500 MN; live load, LL=400 MN. Use, Meyerhof shape and depth factors. Use, γ_w =9.8kN/m^3. (18)

~~201~~ 220

4(a) Briefly explain the purposes of pile as a foundation of a structure. Write down the classifications of pile based on foundation of pile with sketches. (8)

(b) Find the allowable bearing capacity of a reinforced concrete pile (diameter = 0.8 m) with a total length of 25.0m driven in medium dense sand. The K and δ values are found to be 1.20 and 0.90ϕ, respectively. The soil profile is shown in Fig. 2. The angle of internal friction of soil, $\phi = 28°$. Use, factor of safety FS=3.0. (17)

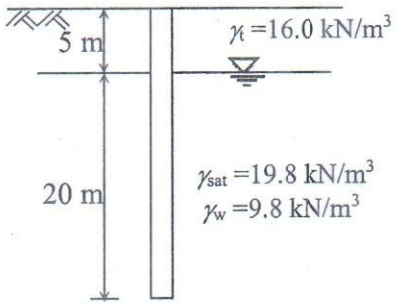


Fig.2

~~102~~ 221

B.Sc. Engg. (CEE)/ 3rd Sem. 16 March, 2018. (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

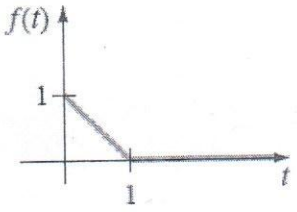
TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018

COURSE NO. : Math-4353 TIME : 1.5 Hours

COURSE TITLE: Laplace Transforms, Series Sol. Fourier Series and PDE; FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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 used have their usual meaning

1. a) Find the Laplace Transform of the following function $f(t)$ as in figure (10)



b) Evaluate $L^{-1}\left\{\dfrac{s}{(s+2)(s^2+4)}\right\}$ (15)

2. a) Prove that (10)

$$L\{f''(t)\} = s^2F(s) - sf(0) - f'(0).$$

b) Solve the following differential equation by using Laplace Transform (15)

$$y'' + y = \sqrt{2}\sin 2t, \quad y(0) = 10, \quad y'(0) = 0$$

3. a) Prove that (10)

$$L\{e^{at}f(t)\} = F(s-a) \quad \text{where } a \text{ is any real number.}$$

b) Define unit function with graph. Show that (15)

$$L\{U(t-a)\} = \frac{e^{-as}}{s}.$$

4. a) Determine the singular points of the following differential equation as regular or irregular. Justify your answer. (10)

$$(x^2-9)^2 y'' + (x+3)y' + 2y = 0$$

$$(x^3+4x)y'' - 2xy' + 6y = 0$$

b) Solve the following differential equation by the method of Frobenius about $x = 0$: (15)

$$2xy'' + 5y' + xy = 0$$

222

~~183~~

B.Sc. Engg. (CEE)/ 5th Sem. 19 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-18
COURSE NO. : CEE 4565 TIME : 1.5 Hours
COURSE TITLE: **Open Channel Flow** FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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) State whether the following open channel flows are steady or unsteady and gradually varied or rapidly varied or spatially varied: (04)
   (i) Flood flow
   (ii) Flow upstream of a dam
   (iii) Flow downstream of a sluice gate
   (iv) Overland flow.

(b) Define best hydraulic channel section. Show that for a trapezoidal channel of a given area of flow, the condition of maximum flow requires that hydraulic mean depth is equal to one-half of the depth of flow. (07)

(c) A trapezoidal channel with z = 1.25, n = 0.023 and S_0 = 0.0003 is to carry 25.5 m^3/sec at a normal depth of 1.85 m. Compute the bottom width of the channel and the velocity of flow. (06)

(d) The velocity distribution in a rectangular channel is represented by (08)

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

If v is the velocity at y, V_{max} = 2 m/sec, y_0 = 2 m, find α and β for the channel.

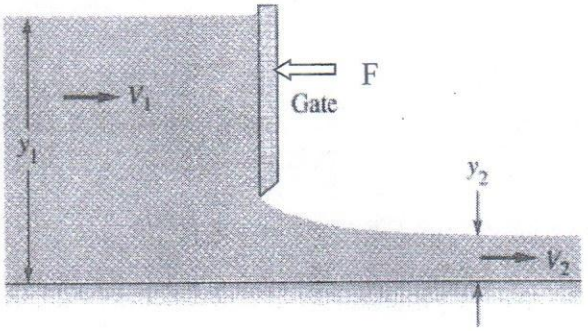
2(a) A rectangular channel laid on a bottom slope of 0.0064 is carrying a discharge of 20.0 m^3/sec of water. Determine width of the channel, when the depth of flow is at critical condition. Assume n = 0.015. (06)

(b) The flow depth at a section in a long rectangular channel changes from 4 ft to 5 ft. Determine the percent change in the rate of discharge. (04)

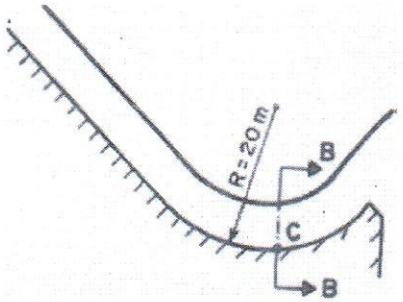
(c) Water is flowing through a sluice gate as shown below. Assuming hydrostatic pressure distribution and neglecting the frictional force on the bed, show that the force F acting on the sluice gate is given by (10)

$$F = \frac{1}{2}\gamma \frac{(y_1 - y_2)^3}{(y_1 + y_2)}$$

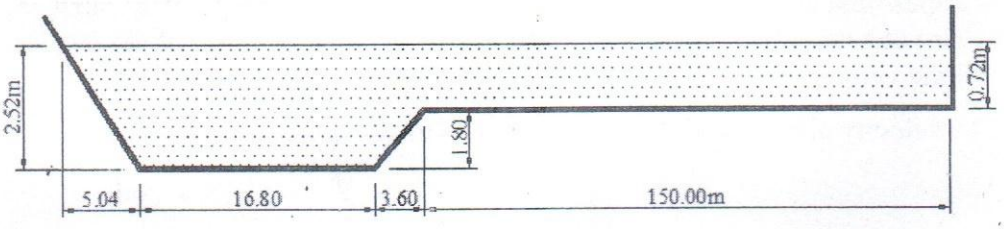
~~184~~ 223



(d) A spillway flip bucket has a radius of 20 m as shown below. If the flow velocity at section BB is 20 m/s and the flow depth is 5.0 m, compute the pressure intensity at point C. (05)



3 (a) The open channel as shown, assume a bed slope of 0.69 in 1584, find the flow rate through the channel section using Chezy equation, take C=35. (07)



(b) Deduce the general expression for hydraulic exponent (M) for critical flow computation. Calculate the value of M for a triangular channel section and for a trapezoidal channel (2H:1V) of 6.0 m bottom width and 2.0m of flow depth. (08)

(c) Supercritical flow occurs at Froude number ($F_r = 2$) at a depth of y = 0.63 m in a rectangular channel. Find the critical depth y_c. (04)

(d) A rectangular channel with a discharge 25 m^3/s, bottom width of 6.25 m, depth y = 2 m is contracted to 5.75 m. (i) Find the depth at contraction (ii) when the depth at contraction is critical, what will be the width at contraction? (06)

4 (a) What are the factors affecting Manning's roughness coefficient? (06)
A rectangular channel 3.6m wide had a widely damaged surfaces and had a Manning's n = 0.03. As a first phase of repair with concrete for which n = 0.013, what percentage increase in discharge as a result of this repair?

(b) 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. (05)

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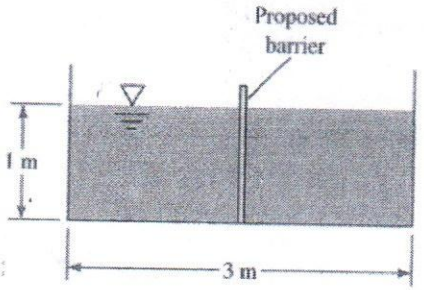

(c) A most efficient trapezoidal section having side slope 1:1 is required to give a maximum discharge of 21.5 m^3/sec of water. The slope of the channel bottom is 1 in 2500. Taking C = 70 $m^{1/2}$/sec in Chezy's equation, determine the dimensions of the channel. Also determine the value of Manning's n for the channel. (07)

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

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

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

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

~~186~~ 225

14

B.Sc. Engg. (CEE)/ 7th Sem. ~~21st~~ March, 2018 (Afternoon)

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

Semester: Mid Semester Examination **Winter Semester: 2017-2018**
Course No.: CEE 4701 **Full Marks: 50**
Course Title: Professional Practice and Communications **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 questions paper. The symbols have their usual meaning

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1(a) "Only skill cannot define profession"- What are the other credentials required to be a professional person? (08)

(b) "Managing project life cycle is complex" – explain with an example. (04)

(c) "A virtual organization is a business without walls"- explain with an example. $(4\frac{2}{3})$

2 The Onuronon's Green access project involved the construction of a new access road and junction adjoining the B71 road in City A. The 800m long access road will provide access to a future mixed-use development, which will form an integral part of the area's future growth strategy. This development will incorporate 1,100 homes and 70,000 square meters of business floor space with mixed-use community facilities, access routes, landscaping and public open space. The creation of the access road involved the construction of two precast concrete beam bridges over the River C, in addition to the construction of multiple flood culverts and an underpass. The interim junction at the B71 was developed under an agreement with the Highways Agency and involved the construction of new road alignments, footpaths and traffic signals and the formation of a parallel embankment. The total budget for this project is 200 million BDT and inauguration is expected at June 2020. Now answer the following questions:

(a) Perform SWOT analysis for this project. (05)

(b) Write down the scope of work (SOW) for this project. (05)

(c) Write a request for proposal (RFP) for feasibility study of this project. (05)

(d) Who will be the key participants for this project? $(1\frac{2}{3})$

3(a) Prepare a notice inviting an Expression of interest (EoI) for selection of an overseas consultant for the following work: (6)

"Design and supervision of an airport construction project for handling wide body aircraft."

~~187~~ 226

(b) Mr. X, the owner of Y cement industry keeps track of customer complaints. For each delivery, there are three possible types of complaint: a late delivery, a poorly handled delivery, or an incorrect delivery. Each week, Mr. X calculates the rate of delivery "defects" for all deliveries, and then uses this information to determine his company's six sigma quality level. During the past week, the company made 620 deliveries. The drivers received 16 late delivery complaints, 19 poorly handled delivery complaints, and 5 incorrect delivery complaints. Calculate the defects per million opportunities (DPMO) and the six sigma level of Y cement industry. $(10\frac{2}{3})$

4(a) What is the difference between a purchase order and an invoice? (02)

(b) Prepare a BOQ for 2400 cu ft of concreting work using following information: $(14\frac{2}{3})$

For 1 cu.m of concrete work: cement=380kg; Fine Aggregate=785 kg; Coarse Aggregate= 1000kg; Water=152 kg; Super Plasticizer=3.04 litre.

Current local rate for cement= 480 BDT/bag; Fine aggregate= 1598 BDT/cu.m; Coarse aggregate= 5900 BDT/cu.m; Super Plasticizer= 140 BDT/litre.

*Assume 3.5% labor cost for each item.
** Assume transportation cost for a 5000kg truck for carrying cement bags= 4000BDT.
*** Assume water is readily available at the site.

~~188~~ 227

Sigma Level Conversion Table

Defects per 1,000,000	Success rate	Sigma Level	Defects per 1,000,000	Success rate	Sigma Level
933,000	7%	0.0	54,800	94.52%	3.1
919,000	8%	0.1	44,600	95.54%	3.2
903,000	10%	0.2	35,900	96.41%	3.3
885,000	12%	0.3	28,700	97.13%	3.4
864,000	14%	0.4	22,800	97.72%	3.5
841,000	16%	0.5	17,900	98.21%	3.6
816,000	18%	0.6	13,900	98.61%	3.7
788,000	21%	0.7	10,700	98.93%	3.8
758,000	24%	0.8	8,200	99.18%	3.9
726,000	27%	0.9	6,210	99.379%	4.0
691,000	31%	1.0	4,660	99.534%	4.1
655,000	34%	1.1	3,470	99.653%	4.2
618,000	38%	1.2	2,560	99.744%	4.3
579,000	42%	1.3	1,870	99.813%	4.4
540,000	46%	1.4	1,350	99.865%	4.5
500,000	50%	1.5	968	99.903%	4.6
460,000	54.0%	1.6	687	99.931%	4.7
421,000	57.9%	1.7	483	99.952%	4.8
382,000	61.8%	1.8	337	99.966%	4.9
345,000	65.5%	1.9	233	99.9767%	5.0
309,000	69.1%	2.0	159	99.9841%	5.1
274,000	72.6%	2.1	108	99.9892%	5.2
242,000	75.8%	2.2	72	99.9928%	5.3
212,000	78.8%	2.3	48	99.9952%	5.4
184,000	81.6%	2.4	32	99.9968%	5.5
159,000	84.1%	2.5	21	99.9979%	5.6
136,000	86.4%	2.6	13	99.9987%	5.7
115,000	88.5%	2.7	9	99.9991%	5.8
96,800	90.32%	2.8	5	99.9995%	5.9
80,800	91.92%	2.9	3.4	99.99966%	6.0
66,800	93.32%	3.0			

B. Sc. Engg. (CEE)/ 7th Sem. ~~189~~ 229 13 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid Semester Examination — **Winter Semester: 2017-2018**
Course No.: CEE 4711 — **Full Marks: 75**
Course Title: Structural Analysis and Design II — **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 figures in the right margin indicate full marks. The Symbols have their usual meaning.

1 Using moment distribution method determine all the reactions at supports for the beam shown in Fig.1. Also draw the shear force and bending moment diagrams. *EI* is constant. (25)

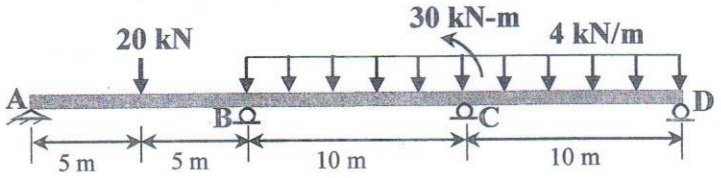


Fig. 1

2 Determine the moments acting at the ends of each member of the frame shown in Fig,2 using moment distribution method. Supports A and D are fixed. The moment of inertia of each member is indicated in the figure. *E* is 200 GPa for all members. (25)

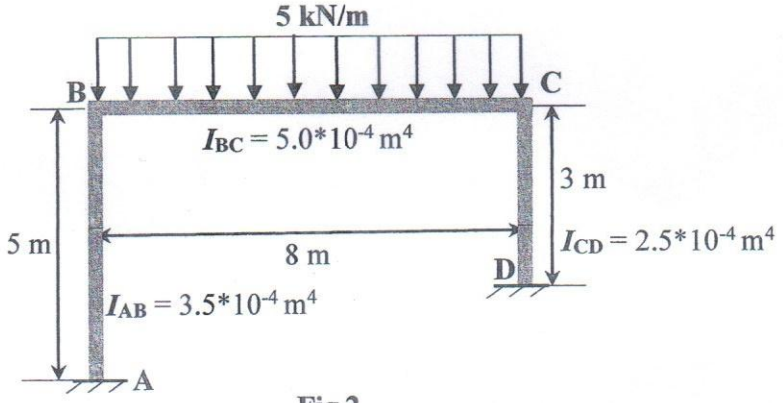


Fig.2

3 Using flexibility method determine the reactions at the supports of the beam shown in Fig.3. Also draw the shear force and moment diagrams. *EI* is constant. (25)

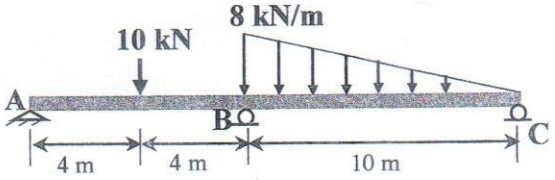


Fig.3

4 Using flexibility method determine the reactions of the supports for the frame shown in Fig.4. Also draw the bending moment diagram of each member of the frame. Support A is fixed, and C is roller. *EI* is constant. (25)

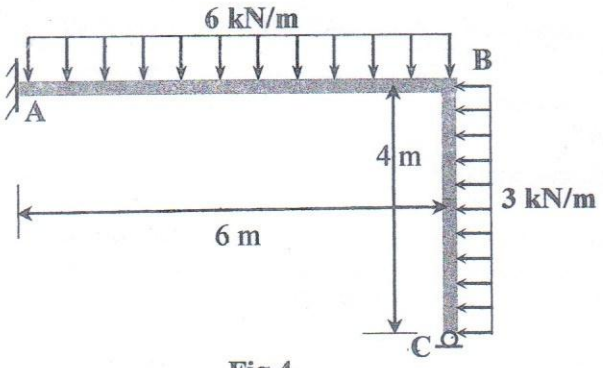
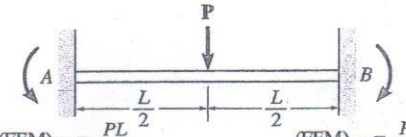
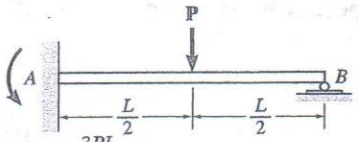


Fig.4

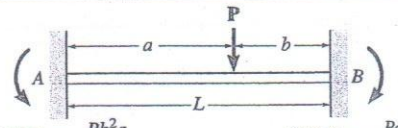
Fixed End Moments



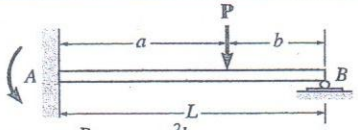
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



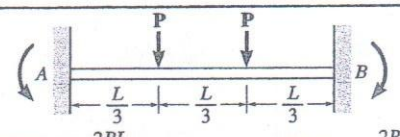
$(FEM)'_{AB} = \frac{3PL}{16}$



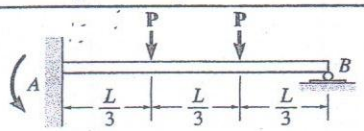
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



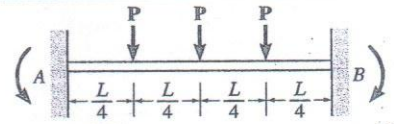
$(FEM)'_{AB} = (\frac{P}{L^2})(b^2a + \frac{a^2b}{2})$



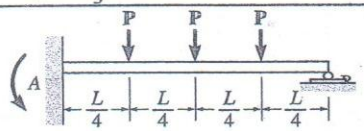
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



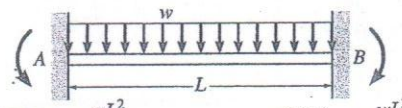
$(FEM)'_{AB} = \frac{PL}{3}$



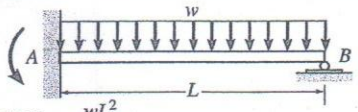
$(FEM)_{AB} = \frac{5PL}{16}$ $(FEM)_{BA} = \frac{5PL}{16}$



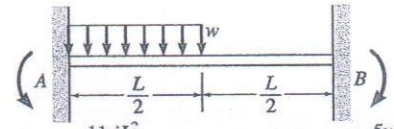
$(FEM)'_{AB} = \frac{45PL}{96}$



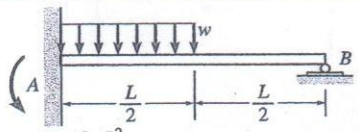
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



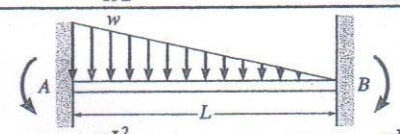
$(FEM)'_{AB} = \frac{wL^2}{8}$



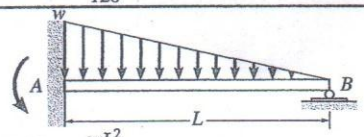
$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



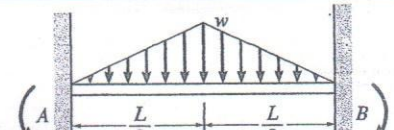
$(FEM)'_{AB} = \frac{9wL^2}{128}$



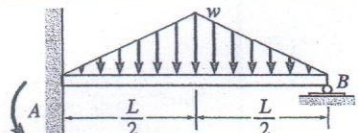
$(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$



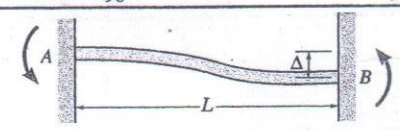
$(FEM)'_{AB} = \frac{wL^2}{15}$



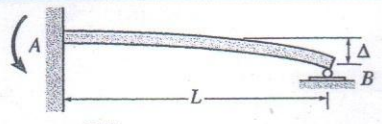
$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$



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

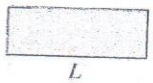
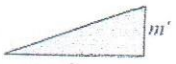
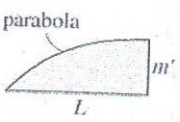
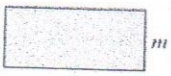
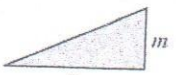
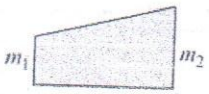
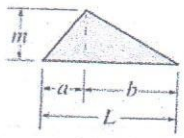
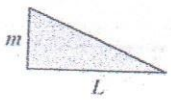


$(FEM)_{AB} = \frac{6EI\Delta}{L^2}$ $(FEM)_{BA} = \frac{6EI\Delta}{L^2}$

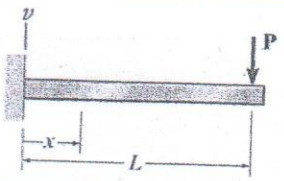
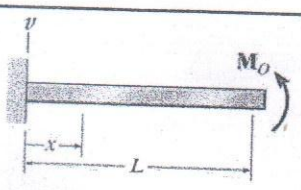


$(FEM)'_{AB} = \frac{3EI\Delta}{L^2}$

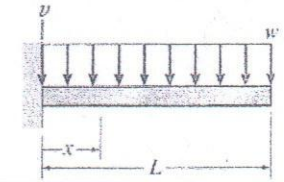
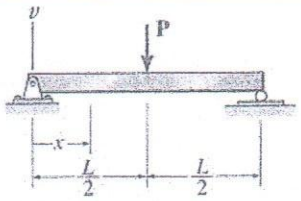
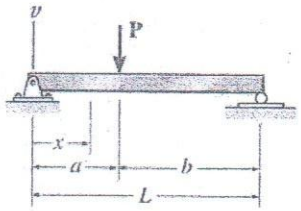
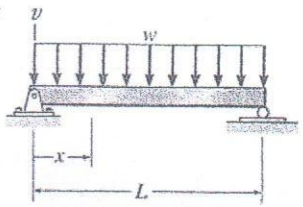
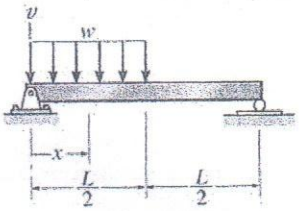
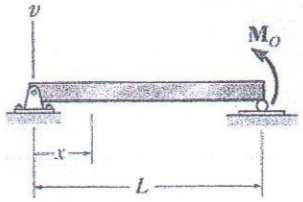
Table for Evaluating $\int_0^L m\,m'\,dx$

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

Beam Deflections and Slopes

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

Beam Deflections and Slopes (continued)

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

~~1044~~ 234

B.Sc. Engg. (CE)/ 7th Sem. 15 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

MID TERM EXAMINATION — WINTER SEMESTER: 2017-2018

COURSE NO. : CEE 4731 — TIME: 1.5 Hours

COURSE TITLE: Environmental Pollution and Its Control — FULL MARKS: 75

There are 4(Four) questions. Answer any 3 (Three). Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. Page 2 of this question paper contains necessary figures. Use where necessary. The Symbols have their usual meaning.

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1. (a) Describe the cycle of an integrated air quality management system. [8]
   (b) What do you understand by primary standard and secondary standard for air quality? Also mention the goals of Clean Air Act 1970. [5]
   (c) Name the criteria air pollutants. Mention their source and corresponding health effects. [6]
   (d) Explain the diurnal variation of NO, NO_2 and O_3 in the atmosphere with figure. [6]

2. (a) What is particulate matter? What are the categories of particulates according to US EPA.? [4]
   (b) Explain the modes of formation of particulates. [6]
   (c) An air stream with a flow rate of 7 m^3/s is passed through a cyclone of standard proportions. The diameter of the cyclone is 200 cm, and the air temperature is 77^0 C. [15]
   (i) Determine the removal efficiency for a particle with a density of 1.5 g/cm^3 and a diameter of 10 μm.
   (ii) Determine the collection efficiency based on the above if a bank of 64 cyclones with diameters of 24 cm are used instead of the single large unit.
   Assume, number of effective turns within the cyclone is 6.

3. (a) Define lapse rate and adiabatic lapse rate. Explain different plume patterns with sketch showing velocity and adiabatic lapse rate profile for each pattern. [12]
   (b) What are the design considerations for stack design? Determine the effective height of stack, given the following data: [7]

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

   (c) What are the effects of SO_2 based on the concentration and exposure on human health? [3]
   (d) What are the health effects of COHb at various levels in the blood? [3]

4. (a) What is control strategy? What are the main steps in developing a control strategy for air pollution? Explain them in short. [6]
   (b) Prepare a comparison chart by listing the minimum collectable particles size, efficiency, advantages and disadvantages of different control devices for particulate matter. [9]
   (c) It is desired to construct a settling chamber to remove particles from an airstream of 180 m^3/min. The temperature of the air is 50^0 C, and the specific gravity of the particle is 2.5. The dimensions of the settling chamber are: 10 ft wide, 20 ft high and 35 ft long. [10]
   Determine the minimum particle size that can be collected or removed in this chamber with 100% efficiency. Also determine the required length to remove 100% of the particles those are larger than 15 microns. Assume reasonable value for missing data if any.

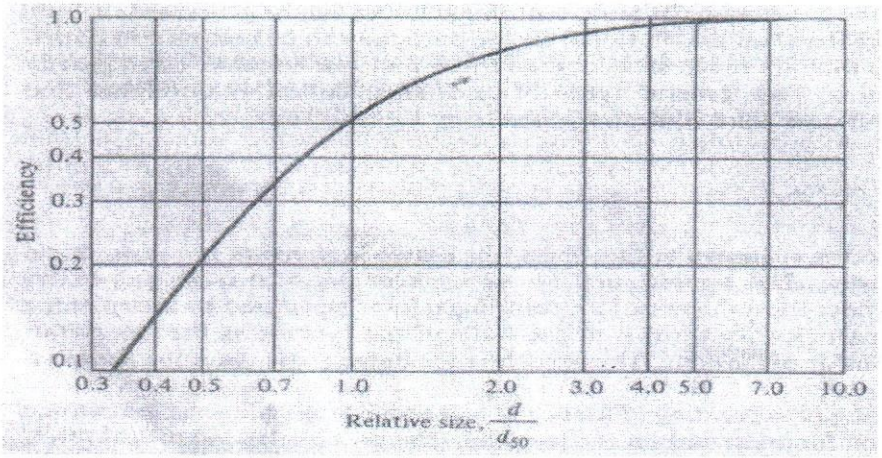

Figure 1: Empirical efficiency for standard dimension cyclone collector as a function of relative particle size.

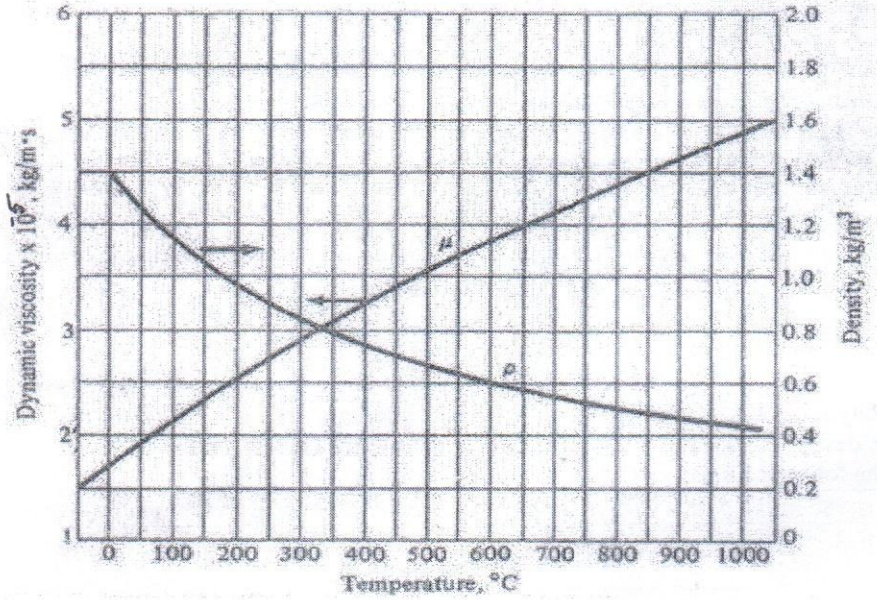

Figure 2: Density and dynamic viscosity of pure air at 1.0 atm pressure as a function of temperature

236

~~196~~

B.Sc. Engg. (CEE)/ 7th Sem. 19 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-18
COURSE NO. : CEE 4737 TIME : 1.5 Hours
COURSE TITLE: **Industrial Wastewater Treatment** FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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.

1(a) A local industry food processing industry has a grit chamber, primary and secondary clarifier and a sludge thickening facility for the influent treatment. What types of settling would occur in these units? (04)

(b) Apex garment has decided to set up a rectangular primary sedimentation tank to treat the effluent from their plant. Analysis of the flow data indicates that the average and peak effluent flow of the plant is 5,000 m^3/day and 15,000 m^3/day, respectively. The plant effluent BOD_5 is 350 mg/L and TSS is 200 mg/L. Design the rectangular primary sedimentation basin, assuming a surface loading rate (SLR) of 40 m^3/m^2-day and width: length ratio of 1:5. Calculate also the BOD_5 and TSS of the effluent from this sedimentation tank for average and peak flow conditions. (12)

(c) What are the purposes of equalization basin? Table below provides the effluent flow rates from a tannery industry located at Hazaribagh area, Dhaka. Calculate the volume of an equalization basin for the industry. (09)

Time interval	Flow rate (m^3/hr)
6AM-10AM	330
10AM-2PM	150
2PM-6PM	400
6PM-10PM	80
10PM-2AM	90
2AM-6AM	150

2(a) What is the difference between an anaerobic process and an anoxic process? What are the final end products in aerobic and anaerobic processes of wastewater treatment? (05)

(b) What are the objectives of biological treatment of industrial wastewater? (06)
Calculate the ThOD of a wastewater represented by $C_6N_2H_4O$. Assume N will be converted to NH_3 in the first step and then NH_3 to NO_3.

(c) 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: (09)
Optimum A/S ratio = 0.08 mL/mg
Temperature of water = 20°C
Air solubility = 18.7 mL/L
Recycle-system pressure = 275 kPa
Fraction of saturation = 0.55

~~197~~ 237

Surface loading rate = 8 L/m^2-min
Sludge flow rate = 400 m^3/day.

(d) A rectangular settling tank has an overflow rate of 30 m^3/m^2-day and dimensions of 2.75 m deep by 6 m wide by 15 m long. Determine whether or not particles with a diameter of 0.1 mm and specific gravity of 2.5 will be scoured from the bottom. Use $f = 0.03$ and $k = 0.04$. (05)

3(a) It is desired to design a secondary settling tank to produce an underflow concentration of 15,000 mg/L from a mixed liquor solids content of 3750 mg/L in the influent. Wastewater flow rate is 2.0 Mgal/day. Calculate the area required for clarification and thickening. Data below are obtained in a laboratory column test of the slurry. (1 ft^3 =7.48 gal). (15)

Time (min)	Interface height, H (mL)
0	1000
2	920
4	840
6	760
8	690
10	600
15	400
20	300
25	280
30	270

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

(c) What are the significance of BOD/COD ratio in selecting treatment process of industrial wastewater? Mention the BOD/COD ratio for various wastewater. (05)

4(a) What are the factors to be considered in selecting a particular treatment unit/process? What are the objectives of preliminary treatment of industrial wastewater? (04)

(b) What are the limitations of BOD test? Mention the uses of toxicity test of wastewater. (04)

(c) A processing industry disposes off its effluent into a river. Characteristics of the effluent and the river are shown below: (13)

	Industry	**River**
Flow, m^3/sec	0.2	5.0
Dissolved oxygen, mg/L	1.0	8.0
Temperature, ^{O}C	15	20.2
BOD5 at 20^{O}C, mg/L	100	2.0
k_1 at 20^{O}C, day-1	0.20	-
k_2 at 20^{O}C, day-1	-	0.3

(i) What will be the DO and BOD_5 after the mixing?
(ii) What will be the DO concentration in the stream after 2.0 days?
(iii) What will be the lowest DO concentration as a result of the waste disposal?

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

238

B.Sc. Engg. (CEE)/ 7th Sem. ~~198~~ 19 March, 2018 (Morning)

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

TERM : MID SEMESTER EXAMINATION
COURSE NO. : CEE 4741
COURSE TITLE: Earth Retaining Structures

SUMMER SEMESTER: 2017-2018
TIME : 1.5 Hours
FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (Three) 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.

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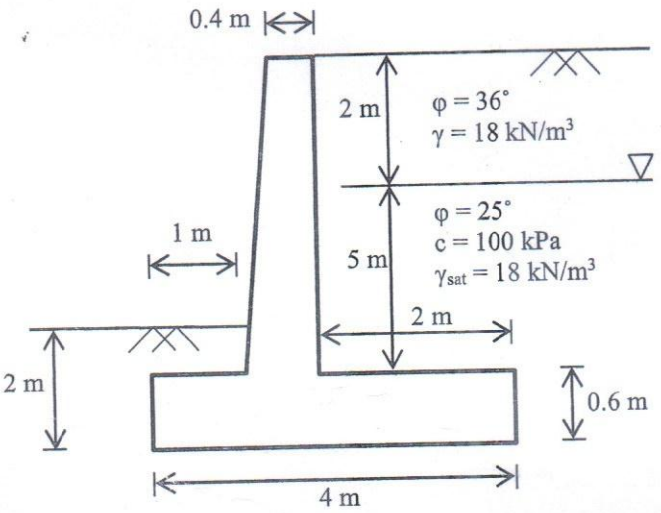
1 (a) What kind of failures occur in retaining wall? Write down the names with schematic diagrams. (8)

(b) What is the difference between Counterfort and Buttressed retaining wall? Explain with schematic diagrams. (8)

(c) When is cofferdam applicable? Write down the loads affect the design of a cofferdam. (5)

(d) Why are earth pressures not same for active and passive conditions? (4)

2 Find the safety against sliding and overturning moment of the cantilever retaining wall shown below. Ignore the passive resistance in front of wall. (25)

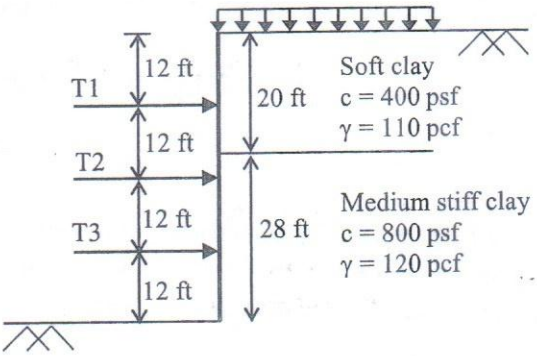


3 (a) Show that earth pressure on braced cofferdam in clay can be expressed by the following equation. (5)

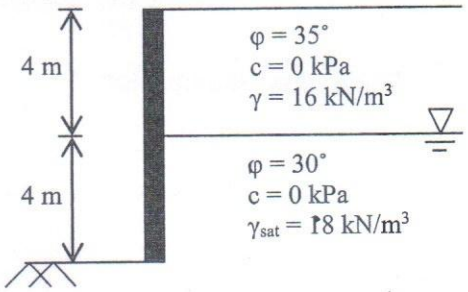
$$P_b = \frac{1}{1.55}(\gamma H - 2q_u)$$

~~199~~ 239

(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 48 ft. Horizontal spacing of the strut is 16 ft each way. (20)



4 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. (25)



~~240~~ 240

M.Sc. Engg. (CEE) 13 March, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID-SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : CEE-6107 TIME : 1.5 Hours
COURSE TITLE: **Advanced Design of Concrete Structures** FULL MARKS: 75

There are 4 (Four) questions. Answer any 3 (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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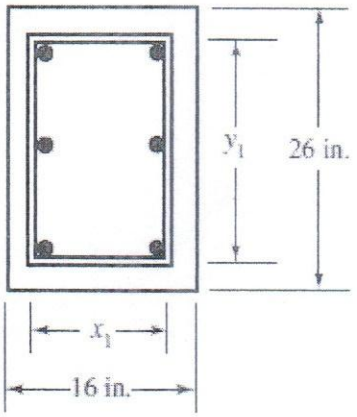
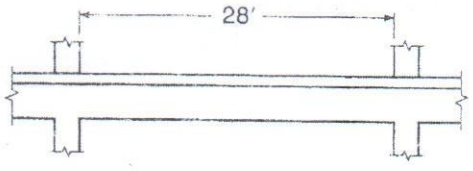
1. (a) Define primary torsion and secondary torsion with examples. (5)

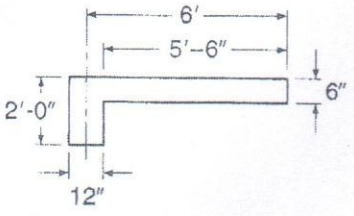
(b) Design the torsional reinforcing needed for the beam shown in the following figure if $f_c' = 4000$ psi, $f_y = 60{,}000$ psi, $T_u = 30$ ft-k, and $V_u = 60$ k. Assume 1.5-in. clear cover, #4 stirrups, and a required A_s for M_u of 3.52 in^2. Select #8 bars for flexural reinforcing. Normal-weight concrete is specified. (20)



2. 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 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. (25)



Longitudinal Section



Cross Section

241

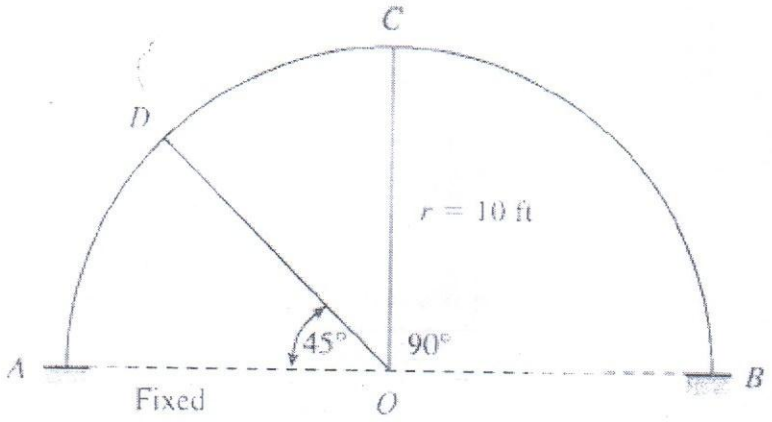
3. Design a circular beam supported on eight equally spaced columns. The center line of the columns lies on a 40-ft diameter circle. The beam carries a uniform dead load of 6 k/ft and live load of 5 k/ft. Use normal weight concrete with $f_c' = 4$ ksi, $f_y = 60$ ksi and b = 14 in. (25)

4. (a) A circular beam is supported on columns placed at equal distances along the circumference of the beam and subjected to uniformly distributed normal loads. Derive the expression of moment at any point N as: (15)

$$M_N = w_u r^2[\theta \sin\alpha + (\theta \cot\theta \cos\alpha) - 1]$$

Where the symbols indicate their usual meanings.

(b) Determine the factored bending and torsional moments in sections C and D of the 10-ft-radius semicircular beam ADCB shown in the following figure. The beam is part of a floor slab that carries a uniform factored load of 304 psf (including self-weight). (10)



Given Equations and Table (CEE-6107)

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

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

$$\frac{A_t}{s} \ge \frac{25 b_w}{f_{yt}}$$

$$M_N = wr^3\left[\frac{\pi}{8}\sin\theta-\frac{1}{6}\{1+(\cos\theta)^2\}-0.11\sin\theta\right]$$

$$T_N = wr^3\left[\frac{\pi}{8}(\cos\theta-1)+\frac{\theta}{4}+\frac{1}{24}\sin 2\theta-0.11\cos\theta\right]$$

Table 21.1 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

M. Sc. Engg. (CEE) 16 March, 2018 (Afternoon)

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

TERM : MID SEMESTER EXAMINATION WINTER SEMESTER: 2017-2018
COURSE NO. : CEE 6109 TIME : 1.5 Hours
COURSE TITLE: Advance Concrete Technology FULL MARKS: 75

There are 4 (Four) 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 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	100
#8	70
#12	60
#16	30
#30	0
#40	0
#50	0
#100	30
#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 the attached table.

2(a) "W/C is a key factor related to compressive strength, permeability and durability of concrete" – Justify. (5)

(b) "Cement industries are polluting our environment significantly" – Justify. (5)

(c) Define hydration of cement. Explain hydration reactions of cement. (5)

3 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, and
(ii) Gel-to-space ratio.

Make a brief discussion on the results.

4 A mixture proportion of mortar is to be prepared based on the following data: (20)

Sand to cement ratio (weight ratio) = 2.6,
W/C=0.50,
Specific gravity of cement = 3.0,
Specific gravity of sand = 2.6,
Air content = 2%.

(i) Calculate the unit contents of sand, cement, and water,
(ii) Calculate the unit weight of mortar,
(iii) Calculate the volumetric ratio of the mortar (consider the unit weight of cement with void is 1350 kg/m^3, and the unit weight of sand with void is 1400 kg/m^3),
(iv) How do you adjust the mixing water and volume of sand if wet sand is used during mixing?

Table 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

M.Sc. Engg. (CEE) 246 19 March, 2018 (Afternoon).

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

Mid Semester Examination — **Summer Semester: 2017-2018**
Course No.: CEE 6505 — **Full Marks: 75**
Course Title: Transportation Planning — **Time: 1.5 hours**

There are 2 (Two) Questions. Answer both 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. (18)

(b) Design the questionnaires for a household survey. (15)

(c) What is the difference between longitudinal and panel data? What are the merits and demerits of panel data in case of travel demand forecasting? (4)

(d) Why do we need volume count data in 4-step travel demand forecasting model? Explain. (4)

(e) Why do we at times build trip generation regression models or trip distribution O-D matrixes separately for various purposes (e.g., NHB, HBW, HBO, etc.)? (4)

(f) What are the typical units of a generalized cost function? Which unit is the best? Explain. (4)

(g) Why singly constrained trip distribution models are normally origin specific? (4)

(h) What are the objectives of collecting screen line and external cordon line O-D survey data? Explain graphically as well. (4)

(i) Normally in which situations you are allowed to use growth factor method for trip generation and distribution? Discuss a scenario where it is essential to use gravity model. (4)

(j) The accuracy of a synthetic model is highly dependent on the accuracy of the cost function. How will you check if your derived cost function is accurate? Explain with a diagram. (4)

2. Consider the following modal-split model between two zones i and j (but we omit the zone indices to alleviate notation): (10)

$$P_1(\Delta t/\theta) = \frac{\exp(-\theta t_1)}{\exp(-\theta t_1) + \exp(-\theta t_2)} = \frac{1}{1 + \exp -\theta(t_2 - t_1)} = \frac{1}{1 + \exp(-\theta\,\Delta t)}$$

$$P_2(\Delta t/\theta) = 1 - P_1 = \frac{\exp(-\theta\,\Delta t)}{1 + \exp(-\theta\,\Delta t)}$$

Where t_k is the total travel time in mode k, and θ a parameter to be estimated.
During the development of a study, travel times were calculated as average of seven measurements (observations) for each mode, at a cost of \$0.5 per observation, and the following values were obtained:
t_1=12±1 min, t_2=17±2 min
If the estimated value for θ is 0.1, compute a confidence interval for P_1.