

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

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
 COURSE NO. : CEE 4201 TIME : 1.5 Hours
 COURSE TITLE: Analytical Mechanics 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.

- 1.a) Force F of the concurrent force system of Fig. 1 is unknown. It is known that the magnitude of the resultant is 1620 N. However, the direction of the resultant is unknown. Determine the force F . (16)

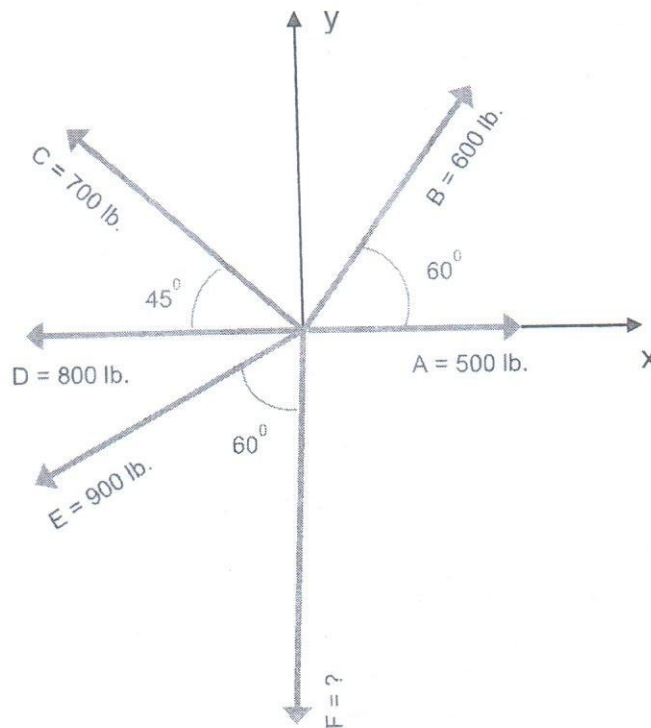


Fig. 1

- b) Two timbers, AB and BC are pinned together at B (Fig. 2). A load $F = 4.5$ kips acts horizontally at C . It $\theta = 60^\circ$, find the reactions at A and C . (17.33)

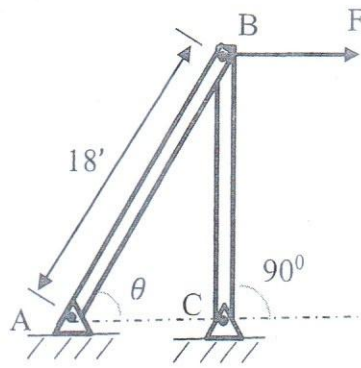


Fig. 2

2. Determine member forces of the truss shown in Fig. 3. (33.33)

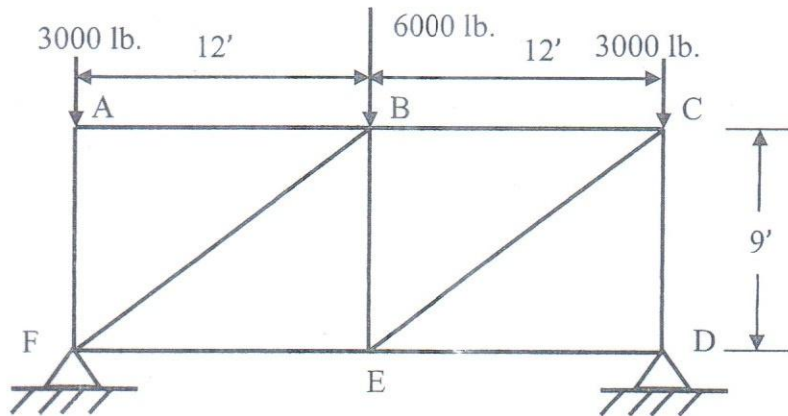


Fig. 3

3.a) What is Varignon's theorem? (8)

b) Reaction of three parallel forces is given as $R = 400$ lb. and its line of action is $r = 10''$ away from C as shown in Fig. 4. $F_3 = 600$ lb. Find out values of F_1 and F_2 . (25.33)

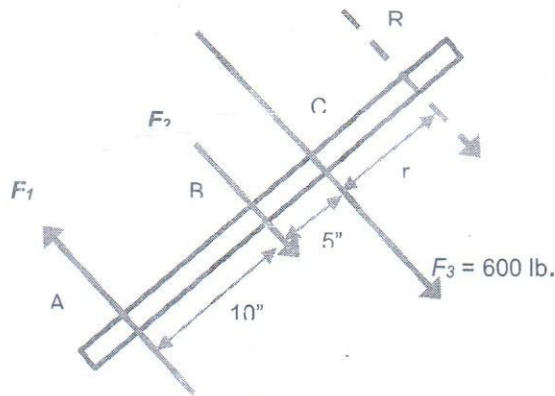


Fig. 4

4. Determine shear force and bending moment at section C of the beam shown in Fig. 5. (33.33)

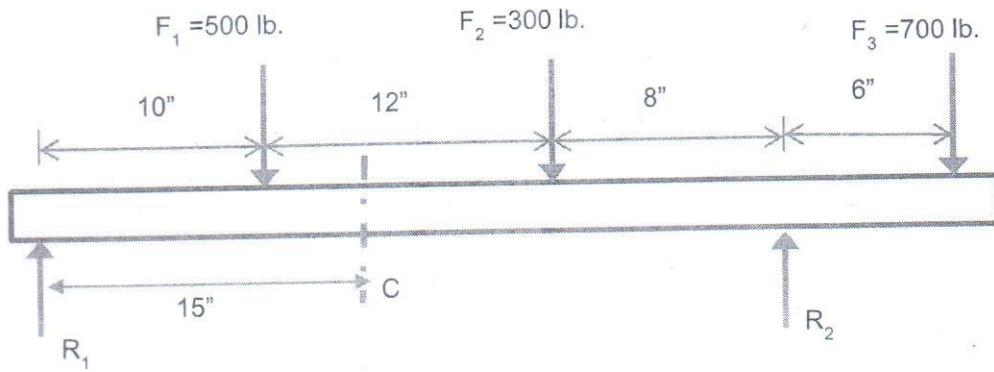


Fig. 5

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DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid Semester Examination

Summer Semester, A.Y. 2017-2018

Course Code: Chem 4253

Time : 1½ hours

Course Title: Chemistry-II

Full Marks : 75

There are 4 (four) Questions. Answer any 3 (three) of them.

Marks in the margin indicate the full marks.

- 1 a) What do you understand by priming and foaming? Describe their effects in a boiler. 10
- b) Write short note on the following: 9
(i) Sedimentation (ii) Coagulation, and (iii) Filtration.
- c) A Zeolite softener was completely exhausted by the treatment of water. It was then regenerated by passing 400 litres of NaCl solution containing 50 g per litre NaCl. Calculate the amount (in litre) of sample water of hardness 500 ppm that can be softened by this softener. 6
- 2 a) What are the different factors that affect the rate of underwater corrosion? Describes any two of them elaborately. 8
- b) Discuss the principle involves to control corrosion by the method modification of metals and modification of environment. 8
- c) Write short notes on the following: 9
(i) Differential aeration corrosion (ii) Cavitation-erosion, and (iii) Cathode sputtering.
- 3 a) Classify polymers based on structure and also, on composition of polymer. 6
- b) What is addition polymerization? Discuss the reaction mechanism of different classes of addition polymerization. 10
- c) Write notes on the following polymers: 9
(i) PVC (ii) Bakelite, and (iii) Nylon 6 6.
- 4 a) What is silica scale? How can it be removed from the boiler feed water? 6
- b) Define paint. Write name of different components of paints. Mention the function of each component of the paint. 10
- c) What is HDPE? Write reaction mechanism for the synthesis of HDPE. Mention the uses of HDPE. 8

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DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION
COURSE NO. : PHY 4253
COURSE TITLE: Physics II

SUMMER SEMESTER: 2017-2018
TIME : 1.5 Hours
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) Explain the statement "electric charge is quantized". What do you understand by the statement that electric charge is conserved? (05)
- (b) (i) An electric dipole is placed in a uniform external electric field E in an angle θ . Find the expression of the net torque τ acting on the dipole and also find the expression of electric potential energy stored in the dipole-field system. (15)
- (ii) Calculate the electric field E at a distance y from a line, which has a linear charge density λ .
- (c) Two similar balls of mass m are hung from the same point by two silk threads of length l and carry similar charges q . Assume the angle θ between threads is so small that $\tan\theta$ can be replaced by its approximate equal, $\sin\theta$. With this approximation, show that $x = \left(\frac{q^2 l}{2\pi\epsilon_0 mg}\right)^{\frac{1}{3}}$, where x is the separation between balls and g is the acceleration due to gravity. (05)
2. (a) What is electric flux? A point charge q is placed at the center of a sphere of radius r . Calculate the electric flux that cuts the whole surface area of the sphere. (05)
- (b) (i) Write down Gauss's law for electricity. Deduce Coulomb's law from Gauss's law. (15)
- (ii) Deduce the expression of electric potential due to a dipole p at a distance r from its center, where r makes an angle θ with the dipole axis.
- (c) Two metal spheres are 3 cm in radius and carry charges of $+1.0 \times 10^{-8}$ C and -3.0×10^{-8} C, respectively, assumed to be uniformly distributed. If their centers are 2m apart, calculate the potential of the point halfway between their centers. (05)
3. (a) What do you understand by electric capacitance and a capacitor? Write down three uses of a capacitor. (06)
- (b) Find the expressions of capacitance for two coaxial (i) cylinders and (ii) spheres of inner diameter a and outer diameter b . Discuss an atomic of dielectrics. (14)
- (c) A potential difference of 300 V is applied to a 2.0- μ f capacitor and an 8- μ f capacitor connected in series. What are the charge and potential difference for each capacitor? (05)
4. (a) Define current density and electron's drift speed? Show that in a conductor the drift speed v_d is related to the current density J by the formula: $v_d = J / ne$, where n is the number of electrons per unit volume and e is the electronic charge. (12)
- (b) Define resistivity of a material. Prove that the electrical conductivity of a conductor is reciprocal to its resistivity. (08)
- (c) An aluminum wire whose diameter is 0.25 cm is welded end to end to a copper wire of diameter 0.16 cm. The composite wire carries a current of 10 A. What is the drift speed for copper wire? Assume that the density of copper is 9.0 g/cm³, atomic weight of copper is 64 and Avogadro's number is 6.0×10^{23} atoms/mole. (05)

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B.Sc. Engg. (CEE)/ 2nd Sem.

August 7, 2018 (Afternoon)

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

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
 COURSE NO. : GS 4253 TIME : 1.5 Hours
 COURSE TITLE: Ecology and Environment 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) The following data were gathered from a 160-meter line transect for X forest in southern Bangladesh. Strip width (w) was limited to 30m to the right side of the main transect line and 35m to the left side of the main transect line whereas the total area of the forest is 12000 m². (18)

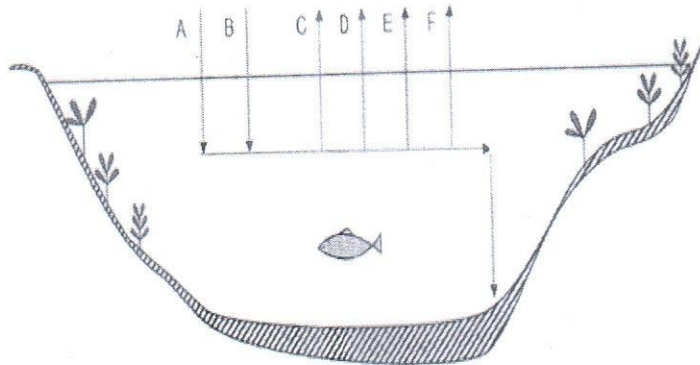
Observation no	Plant type	Position of the sample from the transect line	Perpendicular distance (X _i) m	Sighting angle (degree)
1	Plant type-1	Left	14	12
2	Plant type-2	Right	18	8
3	Plant type-3	Left	17	14
4	Plant type-1	Right	32	32
5	Plant type-4	Right	37	36
6	Plant type-1	Left	40	49
7	Plant type-3	Left	33	77
8	Plant type-2	Left	21	82
9	Plant type-3	Left	25	52
10	Plant type-4	Right	24	42
11	Plant type-3	Right	45	62
12	Plant type-1	Left	36	70
13	Plant type-3	Right	45	60
14	Plant type-3	Left	57	0
15	Plant type-2	Right	8	2
16	Plant type-3	Right	12	36
17	Plant type-1	Left	17	54
18	Plant type-4	Left	19	42
19	Plant type-2	Right	21	62
20	Plant type-1	Right	54	69

Based on the provide data calculate the followings:

- i. Calculate the Hayne estimate of population density for each types of the plants.
 - ii. Calculate the biomass for each types of the plants considering the mass of plant type 1= 20kg Plant type 2 = 5kg plant type 3 =10kg and plant type 4= 2kg.
 - iii. Draw the biomass pyramid of this ecosystem by applying 10% rule for other trophic levels.
- (b) "Autotrophs are self-nourishers but heterotrophs are not"-explain this statement with examples. (4)
- (c) "Biome is greater than ecosystem"-explain with examples. (3)
2. (a) A survey was conducted in Sundarban to measure the current number of Royal Bengal tiger in the forest .The following data was obtained when monitoring the number of tigers in Sundarban :
 Captured and marked = 25 tigers
 Recaptured at a later date = 24 tigers
 Number of marked individuals in recaptured sample = 8 tigers
 5 tigers were found dead of which 2 were marked in the previous survey
 Estimate the size of the tigers population in Sundarban using the Lincoln Index. (8)
- (b) Identify which member of each of the following pairs, in general, has the greatest diversity of species. Defend your answer with proper explanation. (7)
- i. An area of the Black Forest in Germany contains 134 pitch pines, 24 douglas firs, and 53 red pines or A meadow contains 1532 chestnut oaks, 342 black cherry trees, 12 white ash trees, and 1022 yellow birches.
 - ii. A forest with a Simpson's Index of 0.215 or a forest with a Simpson's index of 0.618?
- (c) As you are a studious IUT student, your discussion with your classmate evolves into a conversation about the mean residence time (MRT) of carbon. Your classmate creates a table of various ecosystems and asks you to rank them in order of MRT (1-4, with 1 being the longest and 4 being the shortest). Briefly explain your methodology. (10)

Ecosystem	Area (10^6 km^2)	NPP ($\text{g m}^{-2}\text{yr}^{-1}$)	Biomass (kg m^{-2})	Rank
Young Temperate Forest	5	1300	30	
Ocean Plankton	332	125	0.003	
Tropical Rain Forest	17	2200	45	
Savanna	15	900	4	

3. (a) In an ecosystem, We currently have 125 rabbits and 15 foxes. These species are known to compete for some, but not all, of their resources. We are able to determine that the carrying capacity of rabbit (k_1) is 200 and the Lotka-Volterra model coefficient α is 4. The carrying capacity for foxes (k_2) is 100 and the Lotka-Volterra model coefficient β is 1. Over time, will both species be able to co-exist? If not, which one will be driven to extinction in this area? (15)
- (b) In the aquatic ecosystem pictured below: (A) is the amount of CO₂ reduced to organic carbon by phytoplankton; (B) is the amount of CO₂ reduced to organic carbon by rooted aquatic plants; (C) is the amount of organic carbon respired by phytoplankton; (D) is the amount of organic carbon respired by rooted aquatic plants; (E) is the respiration of the zooplankton, bacteria, and fish in the water; (F) is the respiration of the muddwelling organisms and bacteria. (10)



$A = 200,000 \text{ g C year}^{-1}$; $B = 20,000 \text{ g C year}^{-1}$; $C = 50,000 \text{ g C year}^{-1}$; $D = 50,000 \text{ g C year}^{-1}$; Net Community Production = $2000 \text{ g C year}^{-1}$; and Mean Residence Time = 0.15 years. Find the total biomass of the ecosystem. Show your work and state any assumptions made

4. (a) You are a scientist studying elephant ecology in the X Forest of Uganda. As part of your project you have collected the following data: (10)

Forest	Values (unit)
Net Primary Production	$856 \text{ kcal m}^{-2} \text{ yr}^{-1}$
Total Biomass of Elephants	9.70 kcal m^{-2}
Elephants	
Food Consumed (I)	$67.5 \text{ kcal m}^{-2} \text{ yr}^{-1}$
Fecal material and urine lost (F)	$30.2 \text{ kcal m}^{-2} \text{ yr}^{-1}$
Maintenance metabolism (R)	$36.8 \text{ kcal m}^{-2} \text{ yr}^{-1}$
Growth (P)	$0.50 \text{ kcal m}^{-2} \text{ yr}^{-1}$

Based on the provided data calculate the followings:

- i. What is the exploitation efficiency of the elephants?
 - ii. What is the assimilation efficiency of the elephants?
 - iii. What is the production efficiency of the elephants?
 - iv. What is the ecological efficiency of this ecosystem?
- (b) Write short notes on: (10)
- i. Ecological Niche
 - ii. Ecological Competition
- (c) Draw the energy flow diagram of an ecosystem (5)

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B. Sc. Engg. (CEE)/ 4th Sem.

09 August, 2018 (Morning)

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

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
 COURSE NO. : CEE 4411 TIME : 1.5 Hours
 COURSE TITLE: Engineering Materials FULL MARKS: 100

There are 4 (Four) questions. Answer 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.

1. The sieve analysis data of a sand sample for a bridge construction project are summarized below: 40

ASTM Sieve	Material Retained (g)
3 inch	0
1.5 inch	0
$\frac{3}{4}$ inch	0
$\frac{3}{8}$ inch	0
#4	0
#8	30
#12	130
#16	0
#30	0
#40	100
#50	100
#100	60
#200	10
Pan	70

- (i) Calculate the FM of the sand sample,
- (ii) Draw the grading curve of the sand 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) If the required FM of the sand is 2.6, in what ratio the sand sample is to be mixed with another sand sample of FM = 3.0 to maintain the required FM.

- (vi) If the total sample passes through #100 sieve, what will be fineness modulus of the sample?
- (vii) What is the possible range of fineness modulus?
2. Mixture proportion of mortar is necessary for plastering work of a brick wall of 20 ft long and 10 ft height. The following data are provided: 30
- Sand to cement ratio (weight ratio) = 2.5; W/C=0.50; Specific gravity of cement = 3.0; Specific gravity of sand = 2.65; Air content = 2%; Mortar thickness = 0.75 inch.
- (i) Calculate the unit contents of sand, cement, and water,
- (ii) Calculate the cost of materials for 1 cubic meter of mortar (assume reasonable unit prices),
- (iii) Calculate the unit weight of mortar,
- (iv) Estimate the amount of each ingredients of mortar necessary for the plastering work of the both surfaces of the wall. Assume 10% extra volume of material is necessary due to the loss of mortar during application on the wall,
- (v) If there is 5% (by weight) surplus amount of water (in addition to SSD) in sand, how will it be adjusted with the mixing water of mortar?
- (vi) Explain the effect of compressive strength of mortar with the variation of sand to cement ratio.
- (vii) Explain the effect of compressive strength of mortar with the variation of water to cement ratio.
3. (a) Define hydration of cement. Explain hydration of cement with chemical reactions. 10
- (b) Why is gypsum added in cement? What is false setting? 4
- (c) Define initial setting time and final setting time of cement. Write the ASTM specifications related to the setting time of cement. 5
- (d) Write short notes on CEM Type II A-S, CEM Type II B-S, CEM Type II A-L cement as per BDS EN 197-1:2003. 3
- (e) SSD weight and OD weight an aggregate sample are 1400 kg/m^3 and 1350 kg/m^3 . Specific gravity of the aggregate sample is 2.6. Calculate absorption capacity and the amount of void per cubic meter of sample. 8
4. (a) Write some field tests of brick. 5
- (b) "Cement industries pollute our environment significantly"- Explain. 4

- (c) The load deformation data of a bar of length 100 mm and diameter 25 mm are given below. 21

Load (Kip)	Deformation (mm)
0	0.0
10	4.5
20	9.1
30	13.6
40	18.2
50	22.7
50	45.4
50	68.2

Do/Calculate the following:

- (i) Draw stress (MPa) versus strain curve,
- (ii) Young's Modulus (in N/mm^2 unit),
- (iii) Proportionality limit (in N/mm^2 unit),
- (iv) Yield point (in N/mm^2 unit),
- (v) Permanent deformation after unloading ,
- (vi) Modulus of resilience (in N-mm/mm^3 unit), and
- (vii) Make a brief discussion on the stress-strain curve of the material.

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	3½ in.	3½ in.
75 mm	3	3 in.	3 in.
63 mm	2.5	2½ in.	2½ in.
53 mm	2.12	2 in.	2.12
45 mm	1.75	1¾ in.	1¾ in.
37.5 mm	1.50	1½ in.	1½ in.
31.5 mm	1.25	1¼ in.	1¼ in.
26.5 mm	1.06	1 in.	1.06
22.4 mm	0.875	7/8 in.	7/8 in.
19.0 mm	0.750	3/4 in.	3/4 in.
16.0 mm	0.625	5/8 in.	5/8 in.
13.2 mm	0.530	½ in.	0.530 in.
11.2 mm	0.438	—	7/16 in.
9.5 mm	0.375	3/8 in.	3/8 in.
8.0 mm	0.312	5/16 in.	5/16 in.
6.7 mm	0.265	¼ in.	0.265 in.
5.6 mm	0.223	—	No. 3½
4.75 mm	0.187	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

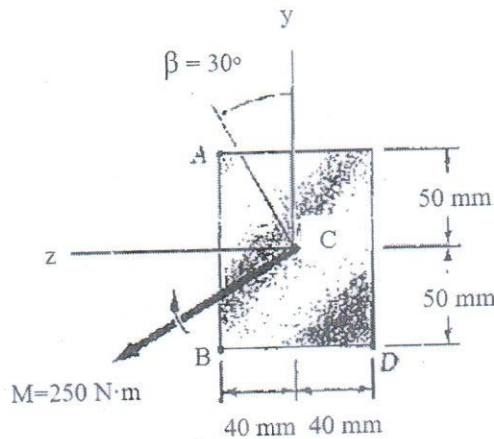
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DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester: Mid Semester Examination
Course No.: CEE 4413
Course Title: Mechanics of Solids II

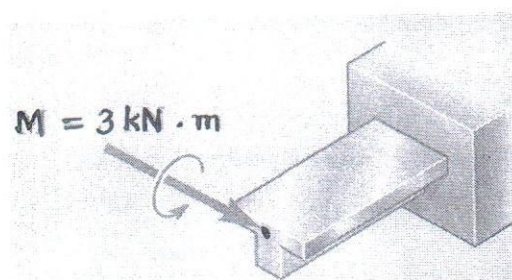
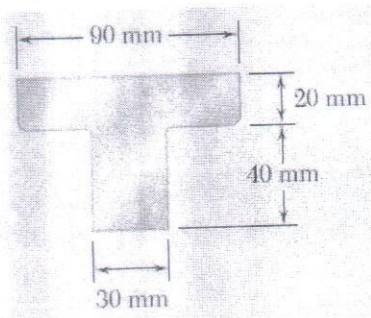
Summer Semester: 2017-2018
Full Marks: 75
Time: 1.5 hours

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) The couple M is applied to a beam of the cross section shown in a plane forming an angle β with the vertical. Determine the stress at (i) point A, (ii) point B, and (iii) point C, (iv) the angle that the neutral axis forms with the horizontal plane. (15)

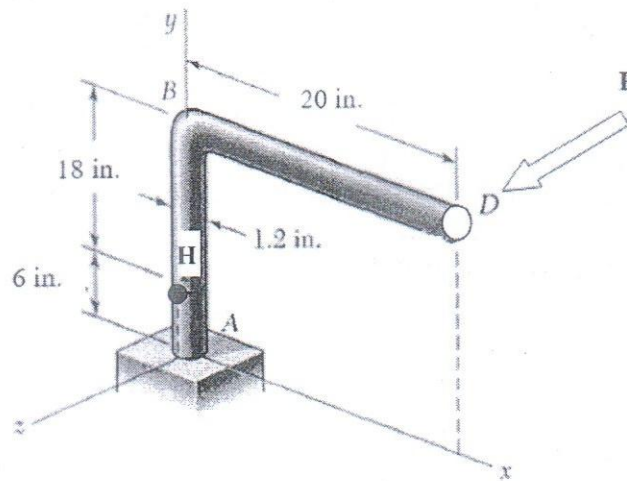


- (b) A cast-iron machine part is acted upon by the $3 \text{ kN}\cdot\text{m}$ couple as shown in the following figure. Determine the maximum tensile and compressive stresses in the casting. (10)

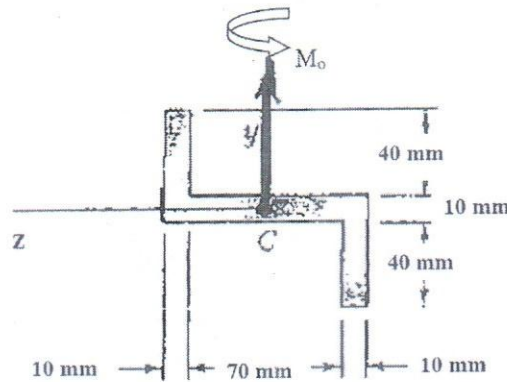


- 2(a) Explain with diagrams the symmetric and unsymmetric bending of beams. (5)
- (b) A single horizontal force P of magnitude 200 lb is applied to end D of lever ABD. Knowing that portion AB of the lever has a diameter of 1.2 in., determine the followings: (20)
- the normal and shearing stresses on an element located at point H and having sides parallel to the x and y axes,
 - the principal planes and the principal stresses at point H.

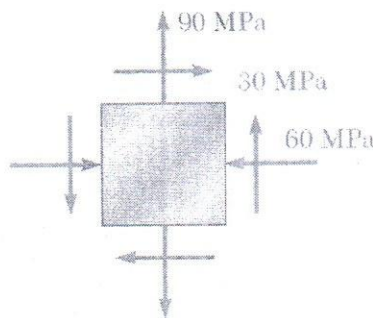
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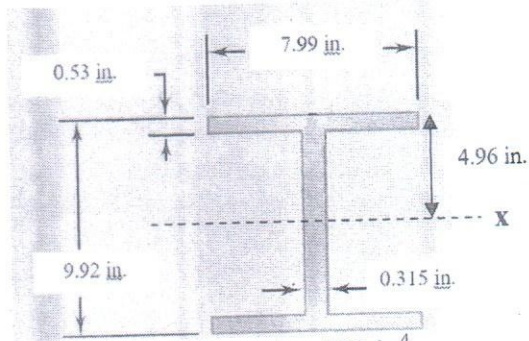
- 3(a) The z section shown is subjected to a couple M_o . Determine the largest permissible value of the moment M_o if the maximum stress is not to exceed 80 MPa. Given $I_{max} = 2.28 \times 10^{-6} \text{ mm}^4$, $I_{min} = 0.23 \times 10^{-6} \text{ mm}^4$, and principal axis makes an angle of 25.7° (clockwise) with the horizontal. (10)



- (b) For the given state of stress, determine the followings: (15)
- the normal and shearing stresses after the element shown has been rotated through 25° clockwise and 10° counterclockwise
 - the principal plane and the principal stresses
 - the maximum shearing stress and corresponding normal stress.

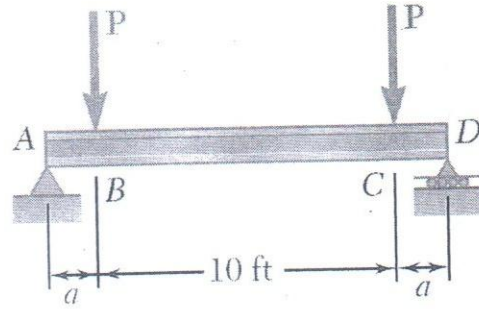


- 4(a) A overhanging rolled-steel beam supports a load P as shown below. Knowing that $P = 90$ kips, (20) 'a' = 10 in., and allowable stress (σ_{all}) = 36 ksi, determine (a) the normal stress at the top surface and at flange-web junction, (b) the maximum value of the principal stress σ_{max} at the junction of the flange and web, (c) whether the specified shape is acceptable as far as these two stresses are concerned.



$$I_x \text{ (moment of inertia)} = 209 \text{ in}^4$$

$$S_x \text{ (elastic section modulus)} = 42.1 \text{ in}^3$$



- (b) Define 'plane stress'. Explain with example where does 'plane stress' occur?

(5)

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

Mid Semester Examination

Summer Semester: 2017-18

Course No.: CEE 4431

Full Marks: 75

Course Title: WATER SUPPLY 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 questions paper. The symbols have their usual meaning.

- 1 (a) In water supply, per capita water demand is very important. How can you calculate the per capita water demand? Explain the hourly variation of water demand with diagram. (06)
- (b) Mention the requirements of an indicator organism in water. If coliforms are detected in a water supply, will the water cause diseases to those who drink it? Explain your answer. (04)
- (c) The population data of an urban area is given below. Using the least square parabolic method; calculate the population in 2020 and 2030. (10)

Year	1950	1960	1970	1980	1990	2000
Population (Thousand)	25	28	32	37	43	52

If the per capita water consumption is 450 lpcd, estimate the design capacity of the treatment plant and the distribution network for water supply in the area.

- (d) What are the basic requirements of drinking water? Mention the quantities of water required for various purposes in rural areas of Bangladesh. (05)
- 2 (a) Distinguish among dissolved substances, suspended solids and colloidal substance based on their size. What are the factors to be considered in selecting a suitable source for water supply? (05)
- (b) A ground water sample has the following chemical analysis at 20°C. (08)

Cations	Conc. (mg/L)	Anions	Conc. (mg/L)
Ca ⁺²	180	HCO ₃ ⁻	300
Mg ⁺²	65	CO ₃ ⁻²	40
Na ⁺	60	SO ₄ ⁻²	60
K ⁺	20	Cl ⁻	348
Fe ⁺²	0.5	NO ₃ ⁻	35

- (i) Check the completeness of the chemical analysis data
- (ii) Calculate the total hardness and non-carbonate hardness and alkalinity of the water in mg/L as CaCO₃.
- (c) What types of impurities should be removed from raw water in order to make water safe for drinking and suitable for domestic uses? What are the treatment methods that could be used for removing those impurities from the water? (06)

- (d) For a town having population of 60,000 estimate the average daily demand of water. Assume industrial use 10%, institutional and commercial use 15 %, public use 5% and livestock 10% of domestic demand. Assume per capita water demand is 50 L/day and leakage to be 5%. (06)
- 3 (a) What are the environmental significance of TDS? Mention the unit treatment processes for the removal of the following from water: (05)
- Color
 - Dissolved substances
 - Living impurities.
- (b) What is effect of Surface Overflow Rate (SOR) on the performance of a Plain Sedimentation Process? Explain with diagram. (06)
- Suppose that the depth of a sedimentation tank is reduced by 60%. Assume discrete particle settling, what is the effect on particle removal efficiency if the flow rate is unchanged (from the original case)? Explain your answer.
- (c) What are the basic elements of a water supply system? (07)
- For a water treatment plant with a design flow of 2.0 million gallon per day (MGD), determine the dimensions (in ft) for a rectangular sedimentation basin with a detention time of 4 hr, an overflow rate of 700 gpd/ft², and length to width ratio of 4 to 1. (Assume 1.0 ft³ = 7.48 gal).
- (d) What are the causes of alkalinity in water? Explain the type of hardness present in water under the following conditions: (07)
- When alkalinity = hardness
 - When alkalinity > hardness and pH < 8.3
 - When alkalinity < hardness.
- 4 (a) An ideal sedimentation tank with a surface area of 100 m² receives an inflow of 25 x 10⁶ L/day of water. Referring to the data for particles types A, B and C, find the percentage of each particle size settle down. (06)
- | Particle Type | Settling velocity (cm/sec) |
|---------------|----------------------------|
| A | 0.49 |
| B | 0.25 |
| C | 0.20 |
- (b) What are the various conventional methods of water treatment? Draw a flow diagram to treat protected surface water and also list the chemicals generally required in the treatment process. (05)
- (c) Distinguish between potable and palatable water. What are the allowable limit of turbidity, nitrate, fluoride, hardness and arsenic in drinking water according to WHO guideline and Bangladesh standard? (06)
- (d) A city of 60,000 residents has an average water demand of 350 lpcd. The institutional and commercial/industrial areas of the city are 200 and 300 hector, respectively and water demand expected is 20 and 23 m³ per hector per day. The public water use and water unaccounted for are 10 and 6 percent of total municipal water demand, respectively. Calculate total municipal demand and each component as percent of total municipal demand. (08)

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

Mid Semester Examination
Course No.: CEE 4441
Course Title: Soil Mechanics

Summer Semester: 2017-2018
Full Marks: 100
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 classification of soil based on origin. (15 $\frac{1}{3}$)
- (b) Classify the soil based on individual particle size for MIT Classification, Unified Soil Classification, USDA Classification, and Japanese Classification systems. (12)
- (c) Classify the soil shown in Table 1 using the U.S. Department of Agriculture textural classification chart (Fig.3)? (6)

Table. 1 Particle-size Soil distribution in percentage

Particle-size Soil distribution (%)	A	B	C
Gravel	0	10	20
Sand	20	30	50
Silt	30	35	20
Clay	50	25	10

- 2(a) (i) Briefly describe the Atterberg limits. (11)
(ii) Describe the cone penetration method for determining the liquid limit.
- (b) Table 2 shows the results of sieve analyses of soil A and soil B. Answer the followings for both soils- (22 $\frac{1}{3}$)
- (i) Plot grain-size distribution curves.
(ii) Determine D_{10} , D_{30} , and D_{60} from the grain-size distribution curve.
(iii) Calculate the uniformity coefficient, C_u .
(iv) Calculate the coefficient of gradation, C_c .

Table 2. Results of sieve analyses

Sieve No.	Sieve Opening (mm)	Mass retained on each sieve (g)	
		Soil A	Soil B
#4	4.75	0	0
#6	3.35	4	5
#10	2.00	10	46
#20	0.85	45	150
#40	0.425	185	4
#60	0.25	132	60
#100	0.15	70	120
#200	0.075	35	110
Pan	-	19	5

- 3(a) The moist density of a soil is 1500 kg/m^3 . Given, $w = 10\%$ and $G_s = 2.60$. (18)
 Determine:
 (i) Dry unit weight
 (ii) Void ratio, Porosity
 (iii) Degree of saturation
 (iv) Mass of water, in kg/m^3 , to be added to reach full saturation
- (b) Describe the benefits of soil compaction. Draw the quantitative ideal curves showing the relation of dry unit weight and water content for (i) 100% saturation, (ii) 80% saturation, and (iii) 60% saturation in a graph paper. (11)
- (c) Define the optimum water content. What do you mean by the dry of optimum and wet of optimum? (4 $\frac{1}{3}$)
- 4(a) An embankment for a highway with the cross-section as shown in Fig.1 is to be constructed, where the length of the embankment will be 2.0 km. The left side slope (vertical : horizontal) is 1:1, and the right side slope is 1:2. The void ratio of the compacted fill is specified as 0.65. Three borrow pits are available as described in Table 3, which lists the respective void ratios of the soil and the cost per cubic meter for moving the soil to the proposed construction site. Make the necessary calculations to select the pit from which the soil should be bought to minimize the cost. Assume $G_s=2.65$ for all pits, and $\gamma_w=9.8 \text{ kN/m}^3$. (20 $\frac{1}{3}$)

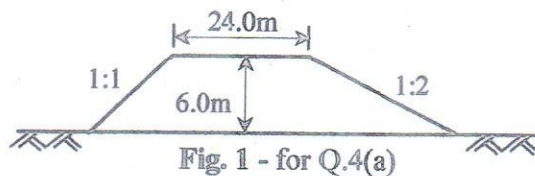
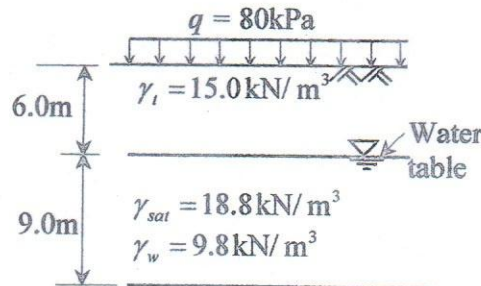


Table 3. Void ratio and unit cost of soil

Borrow pit	Void ratio	Cost (USD/m ³)
A	1.40	4.50
B	0.70	6.00
C	1.05	5.00

- (b) Draw total stress, pore water pressure and effective stress distributions for the ground shown in Fig.2 for (i) immediately after applying surcharge, and (ii) after dissipating excess pore water pressure. (13)



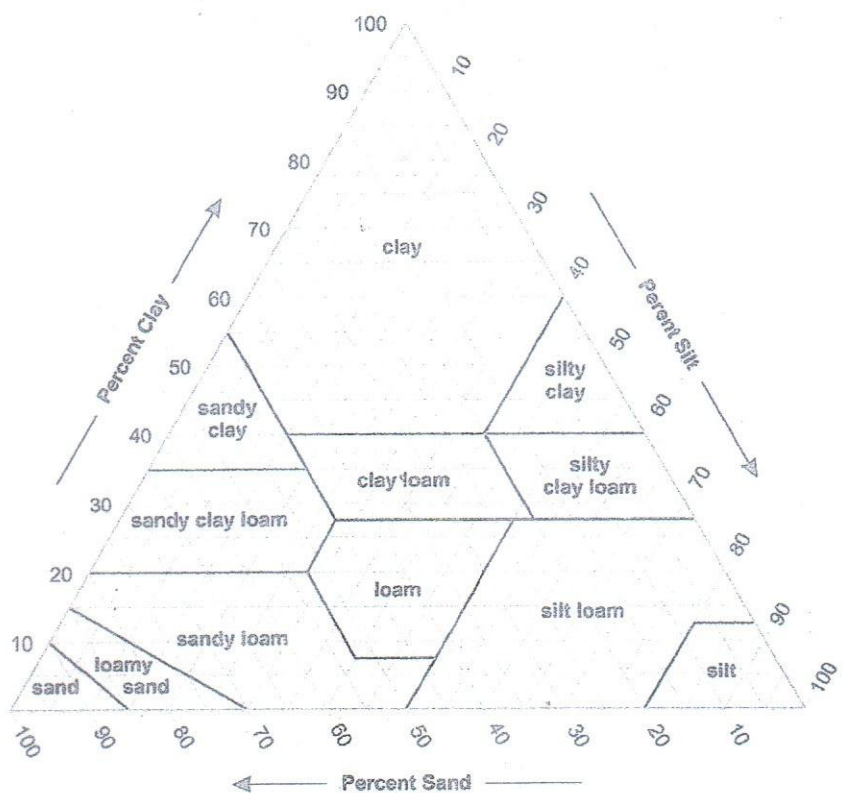


Fig. 3. U.S. Department of Agriculture textural classification chart for Q.1(b)

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

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
 COURSE NO. : Math 4453 TIME : 1.5 Hours
 COURSE TITLE: Probability and Statistics 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 Following table (Table 1) shows a frequency distribution of a weekly wages of 88 employees at the Marks & Spencer Company. (25)

Table 1

Wages (\$)	Number of Employees
250.00 – 259.99	14
260.00 – 269.99	15
270.00 – 279.99	18
280.00 – 289.99	16
290.00 – 299.99	15
310.00 – 319.99	10

- (i) Construct a Histogram for the frequency distribution shown in Table 1.
- (ii) Construct (i) a cumulative frequency distribution, (ii) a percentage cumulative distribution, (iii) an ogive, and (iv) a percentage ogive from the frequency distribution shown in Table 1.
- 2 Compute the Mean, Mode and Median of the weekly wages of 88 Employees at the Marks & Spencer Company from the frequency distribution as shown in Table 1. Also verify that “Mean-Mode=3(Mean-Median)”. (25)

Find also (i) the 3rd quartile Q_3 , (ii) the 3rd decile D_3 , and (iii) also the 3rd percentile P_3 . Show how the results can be obtained from percentage ogive.

- 3 A collar manufacturer is considering the production of a new style of collar to attract young man. The following statistics of neck circumference are available based on measurements of a typical group of the college students: (25)

Mid value (in inches)	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0
Number of students	2	16	36	60	76	37	18	3	2

Compute the standard deviation and use the criterion $\bar{X} \pm 3\sigma$ where σ is the standard deviation and \bar{X} is the arithmetic mean to determine the largest and smallest size of the collar he should make in order to meet the needs of all the customers bearing in mind that collars are worn on average $\frac{1}{2}$ inch longer than the neck size.

- 4(a) A ball is drawn at random from a box containing 6 red balls, 4 white balls, and 5 blue balls. Determine the probability that the ball drawn is (i) red, (ii) white, (iii) blue, (iv) not red, and (v) red and white. (10)
- (b) Find the probability of boys and girls in families with three children, assuming equal probabilities for boys and girls. (15)

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

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
 COURSE NO. : CEE-4611 TIME : 1.5 Hours
 COURSE TITLE: **Design of Concrete Structures II** 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 two-way reinforced concrete building floor system is composed of slab panels measuring 14 x 20 ft in plan, supported by column-line beams cast monolithically with the slab. The floor system is carrying following loads in addition to its self-weight: floor finish = 30 psf, random wall = 50 psf and live load = 60 psf. Moment coefficients are: $C_{a(D)+} = 0.031$, $C_{a(L)+} = 0.050$, $C_{a-} = 0.076$, $C_{b(D)+} = 0.007$, $C_{b(L)+} = 0.011$, $C_{b-} = 0.016$. Given: $f'_c = 3$ ksi, $f_y = 50$ ksi, and size of all beams = 12 x 20 in. Design a typical interior panel using USD method. (25)

2. An office building is planned using a flat plate floor system with the column layout as shown in Figure 1. No beams, drop panels or column capitals are permitted. The floor system is carrying following loads in addition to its self-weight: floor finish = 30 psf, random wall = 50 psf and live load = 60 psf. Design panel 'A' by the direct design method. Given: panel size = 14 x 20 ft., column size = 12 x 12 in., $f'_c = 3$ ksi, $f_y = 60$ ksi. Use WSD method. (25)

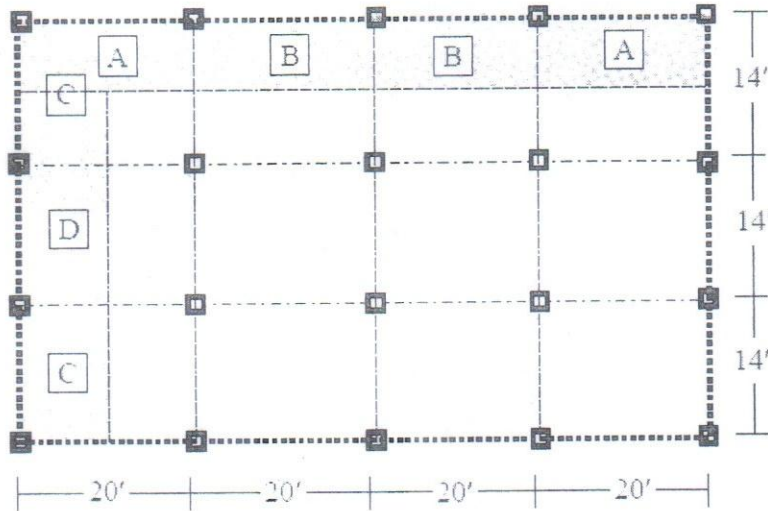


Figure 1: for Question 2

3. (a) Write the guidelines for establishing the axes of rotation and yield lines for slab analysis. (06)
- (b) Mention the limitations of yield line theory of slab analysis. (06)
- (c) Determine the load capacity of the one-way uniformly loaded continuous slab shown in Figure 2 using the method of virtual work. The resisting moments of the slab are 5 ft-kips/ft (at left support), 5 ft-kips/ft (at mid-span) and 7.5 ft-kips/ft (at right support). (13)

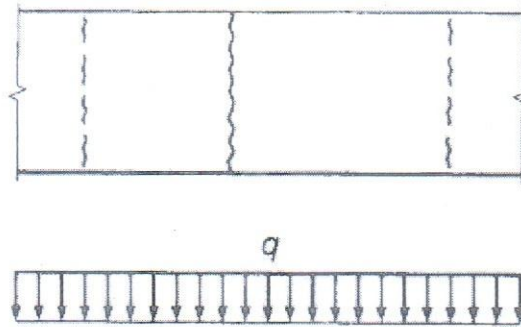


Figure 2: for Question 3

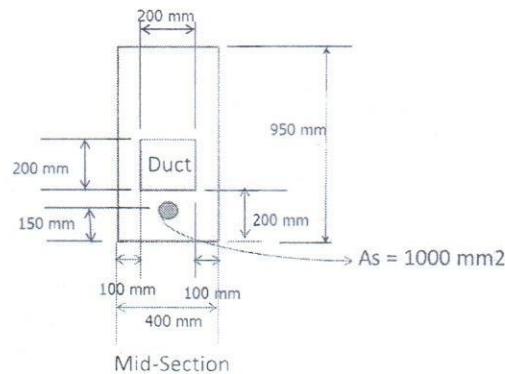
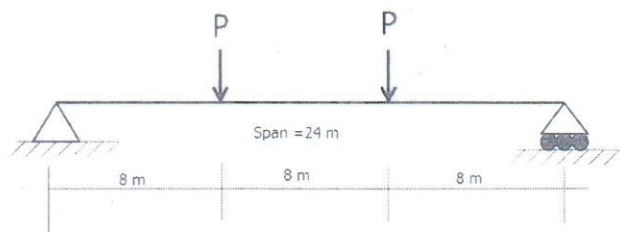
4. (a) What is two-way slab? Mention the differences between one-way and two-way slabs. (05)
- (b) What are corner reinforcements in two-way slabs? Mention the ACI provisions for corner reinforcements. (05)
- (c) Write the limitations of direct design method for designing two-way slab. (05)
- (d) Mention the advantages and disadvantages of flat slab. (05)
- (e) Write the ACI specifications for drop panel and column capital. (05)

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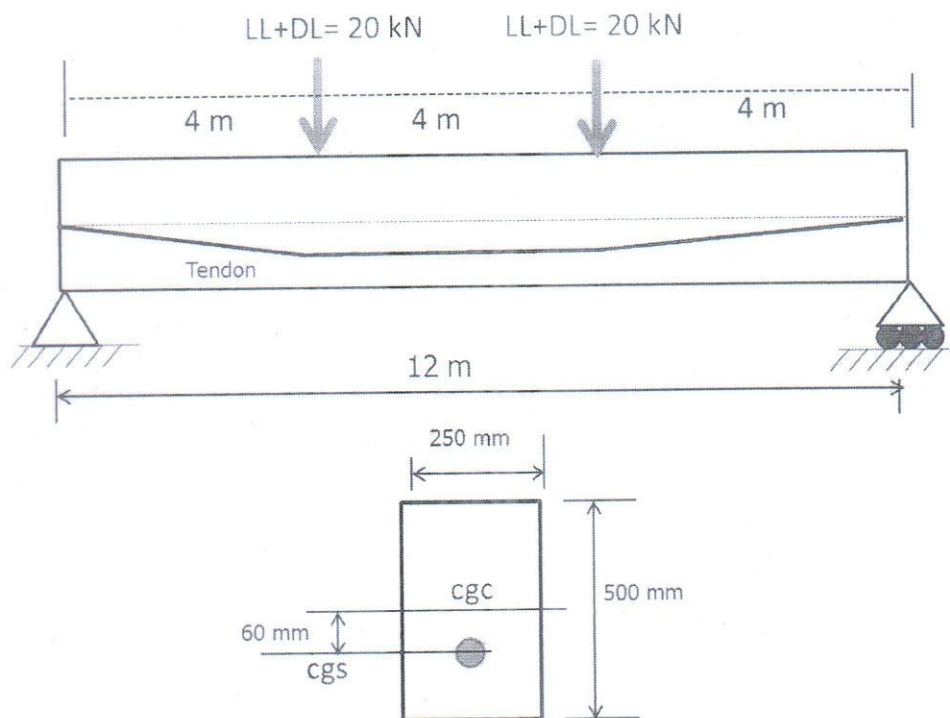
TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
 COURSE NO. : CEE 4613 TIME : 1.5 Hours
 COURSE TITLE: Design of Pre-Stressed Concrete Structures FULL MARKS: 75

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.

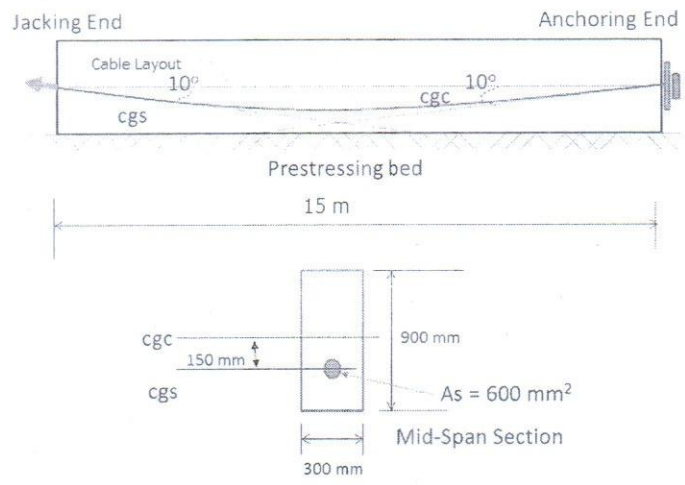
- 1 (a) Compare RC and PC concrete beams with respect to (i) Compressive strength of concrete, (ii) Grade of steel, (iii) Crack in concrete, (iv) Durability, (v) Economy, and (vi) Formation of resisting internal couple. 6
- (b) A rectangular concrete beam (span = 24 m), 400 mm wide and 950 mm deep with a rectangular duct of 200 mm by 200 mm as shown in the following figure, is prestressed by means of 1000 mm² high-tensile steel tendon located 150 mm from the soffit of the beam. If the initial prestress in the tendon is 800 N/mm², what is the maximum concentrated load (P) that can be applied in addition to the self-weight of the beam without causing tension at the soffit? Assume unit weight of concrete = 24 kN/m³, and loss of prestress = 25%, modular ratio = 8. Do the calculations based on sectional properties of the transformed section. 19



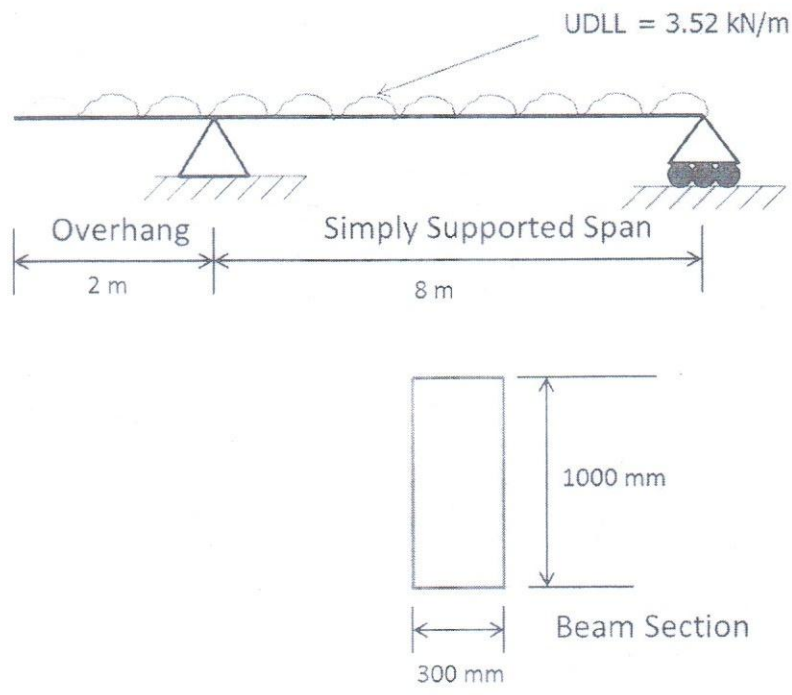
- 2(a) Compare (i) Pretensioned and Posttensioned concrete beams, (ii) Internal and external prestress, (iii) Partial and full prestress. 6
- (b) A prestressed concrete beam with a rectangular section 250 mm wide by 500 mm deep supports two concentrated loads of 20 kN each as shown in the following figure. The effective span of the beam is 12 m. The beam is prestressed with a tendon as shown in the following figure. Locate the position of the pressure line in the beam. Also, determine the stress distribution in the mid-span-section of the beam. Use the internal couple concept (2nd concept). The effective prestress in the tendon is 200 N/mm². Area of steel = 2100 mm². Neglect the self-weight of the beam. 19



- 3 (a) A straight post-tensioned concrete member 50 ft long with a cross section of 16 inch by 30 inch is concentrically prestressed with 5 tendons with 0.5 sq. in. per tendon. The tendons are tensioned one after another to the stress of 175,000 psi. Compute the loss of prestress due to elastic shortening of concrete. Given: $E_{ci} = 4,500,000$ psi, $E_s = 29,000,000$ psi. 10
- (b) Refer to the following post-tensioned RC beam. The initial prestress in the cable is 1000 N/mm² at one end. Calculate the loss of prestress due to friction. Coefficient of friction between duct and cable is 0.40, friction coefficient for wobble effect 0.002 per m. During anchoring, if there is a slip of 8 mm at the jacking end, calculate the final stress in the cable and the % of loss of prestress due to friction and slip. Young's modulus of prestressing cable is 210 kN/mm². 15



- 4 (a) List the different stages of operation for pre-tensioned RC beams. 5
- (b) A simply supported prestressed concrete beam with overhang at one end over a span of 8 m and the overhang is 2 m. The beam is of rectangular section 300 mm wide and 1000 mm deep and supports a UDLL of 3.52 kN/m over the entire length in addition to the self-weight. Determine the profile of the prestressing cable with an effective force of 500 kN which can balance the DL and LL on the beam. Sketch the profile of the cable along the length of the beam. Determine the stress distribution at the mid-span section of the beam. Make comments on the result. Make also comments on distribution of stress at the other sections of the beam. Use gross section in calculation. 20



B.Sc. Engg. (CE)/ 6th Sem.

09 August, 2018 (Afternoon)

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

MID TERM EXAMINATION

SUMMER SEMESTER: 2017-2018

COURSE NO. : CEE 4633

TIME: 1.5 Hours

COURSE TITLE: Wastewater Engineering and Environmental Sanitation

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 3 and 4 of this question paper contains necessary tables and figures. Use where necessary. The Symbols have their usual meaning.

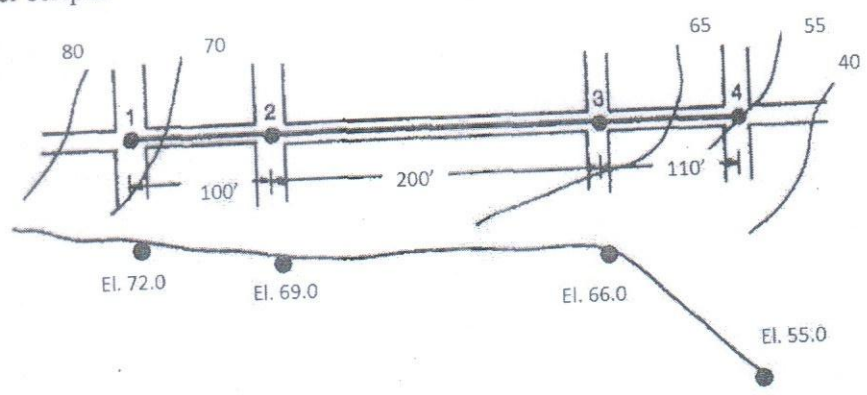
1. (a) Define wastewater and wastewater engineering. Classify and briefly explain different categories of wastewater treatment methods. (06)
- (b) Draw a schematic of typical wastewater treatment plant based on trickling filter system and discuss about the functions of grit chamber, trickling filters and sludge digester. (13)
- (c) What are the major functional differences between primary and secondary settling tank? (03)
- (d) What is screening? Briefly explain different classes of screening. (03)
2. (a) What are the necessities of sewage treatment? What are the major components of wastewater management? Identifying the role of Civil Engineers in wastewater management system in urban areas. (05)
- (b) What factors affect the BOD rate constant? Explain the significance of BOD/COD ratio of a wastewater. Is there any correlation among BOD, COD and TOC for untreated domestic wastewater? (05)
- (c) In a BOD test, 6 mL of the wastewater with zero dissolved oxygen are mixed with 294 mL of diluting water containing 8.16 mg/L of dissolved oxygen. After incubation for 5 days, the dissolved oxygen content of the mixture is 5.4 mg/L (06)
 - (i) Determine the BOD₅ of the wastewater.
 - (ii) If the oxygen utilization rate of this wastewater is 0.21 d⁻¹ at 20°C, what will be the BOD₃, if the test is run at 30°C?
- (d) What are the methods are available to estimate BOD rate constant and ultimate BOD from the BOD test data? Calculate the ultimate BOD and rate constant in base e from the following data: (09)

Day:	2	5	10	20	35
BOD (mg/L):	86	169	236	273	280
3. (a) What is sewer system? Define different types of sewer systems. (04)
- (b) How to evaluate net quantity of sewage? Explain. (04)
- (c) The sewer layout shown in figure 1 is to be designed given the following flow characteristics: (17)

Maximum flow = 3 MGD; Minimum flow = 0.2 MGD; Minimum allowable velocity = 2 ft/sec.; Maximum allowable velocity = 12 ft/sec.

~~220~~ 221
~~201~~

All manholes should be about 9ft deep. Design acceptable invert elevations for this system. The pipe material will be cast iron. Attach the nomograph (page 4) with answer scripts.



Rock at El. 40.0 @ 100' from manhole no. 2

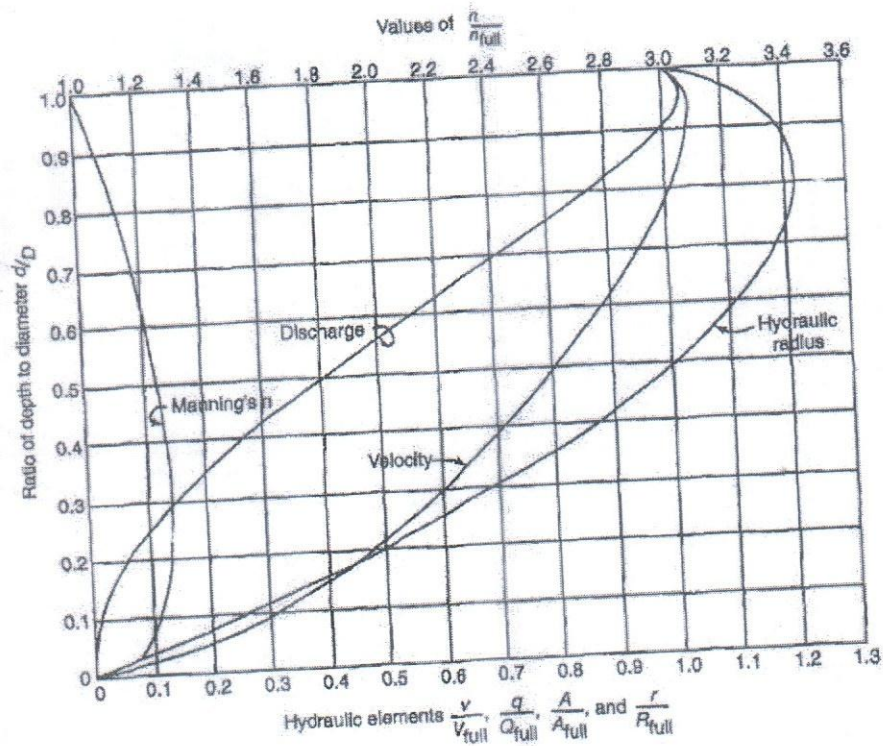
Figure 1: Sewer layout for question no. 3 (c)

4. (a) Determine the size of a high rate trickling filter for the following data available: (13)
 Sewage Flow = 5 MLD
 Recirculation ratio = 1.5
 BOD of raw sewage = 230
 BOD removal at primary settling Tank = 30%
 BOD of final effluent = 25 mg/L
 Organic Loading Rate should not exceed 0.9 kg/d/m³
- (b) Discuss variations of sewage flow with respect to maximum and minimum flow. What are the factors needed to be considered while designing a sewer system? (05)
- (c) A city has a projected population of 60,000 spread over area of 50 hectare. Find the design discharge for the separate sewer line by assuming rate of water supply of 250 LPCD and out of this total supply only 70 % reaches in sewer as wastewater. Make necessary assumption whenever necessary. (07)

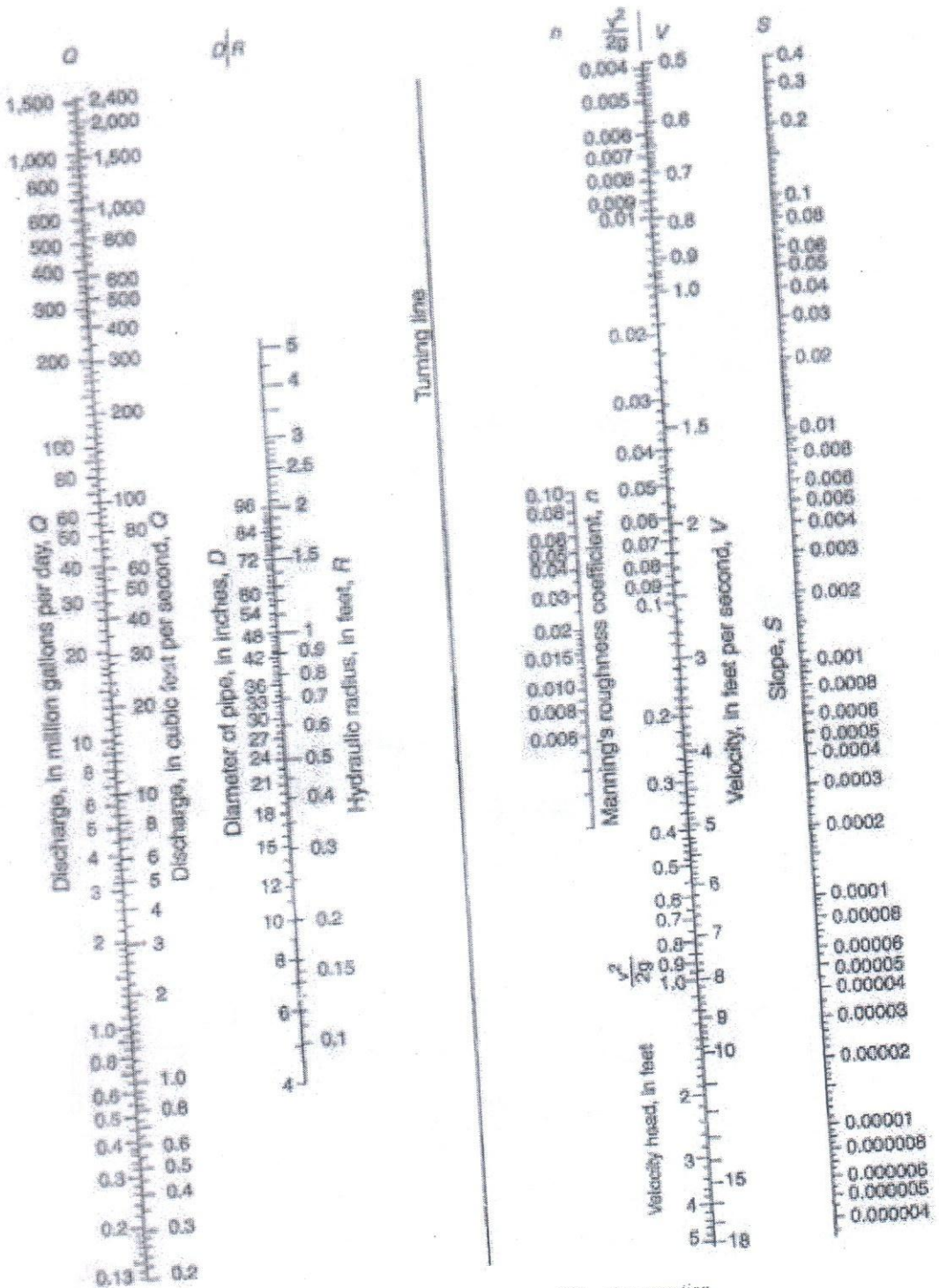
Necessary Tables and Figures

Type of channel, closed conduits	Roughness coefficient n
Cast iron	0.013
Concrete, straight	0.011
Concrete, with bends	0.013
Concrete, unfinished	0.014
Clay, vitrified	0.012
Corrugated metal	0.024
Brickwork	0.013
Sanitary sewers coated with slime	0.013

Manning roughness coefficient, n



Hydraulic elements chart for channel flow



Nomo graph for the solutions of Manning equation

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

Mid Semester Examination**Course No.: Hum 4651****Course Title: Project Planning and Management****Summer Semester: 2017-2018****Full Marks: 75****Time: 1.5 hours**

There are 4 (Four) Questions. Answer 3 (Three) questions including Question no. 4, i.e., Question no. 4 is compulsory. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning.

- 1(a) Construction Management is a complex and challenging discipline – Explain with reasons. (5)
 (b) What are the basic resources of construction management? In your opinion, which one is the most important? Why? (10)
 (c) What do you understand by WBS? What are the benefits of doing WBS? (5)
- 2(a) What do you understand by Project? Write down its characteristics. (10)
 (b) Briefly describe the phases of Project Life Cycle. (5)
 (c) Write down the key features of planning process. (5)
- 3(a) Write down the key features of Unit Price Contract. (5)
 (b) Why do we need written contract? (10)
 (c) Write down the essential documents that forms contract. (5)
- 4(a) Write down the differences between CPM and PERT? (7.5)
 (b) Describe briefly the drawbacks of Gantt Chart. (7.5)
 (c) Why do we plan? Why plan fails? (5)
 (d) Draw the network diagram. Find the total duration and critical path of a project from the following information: (15)

Activity	Predecessor	Estimated Time
a	-	7
b	-	10
c	a, b	7.5
d	b	6
e	c	6.5
f	c, d	5
g	e, f	6

225

B. Sc. Engg. (CEE)/ 6th Sem.

13 August, 2018 (Afternoon)

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

Mid Semester Examination

Course No.: CEE 4655

Course Title: Civil Engineering Data Analysis

Summer Semester: 2017-2018

Full Marks: 75

Time: 1.5 Hours

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. It's an **OPEN BOOK** exam. Only one text book is allowed.

- 1(a) Suppose that spot speeds of vehicles are assumed to follow a normal distribution with a mean 60 mph and standard deviation of 9 mph. What is the probability that the next observed speed will be 70 mph or less? What is the probability that the speed of the next vehicle is between 60 and 70 mph? Also find the probability that the next vehicle's speed is less than 50 mph? (10)
- (b) A traffic flow stream has a mean arrival rate of 361 vehicles per hour (vph) and a standard deviation of 19 vph. (09)
- (i) What probability distribution would you use to model the flow?
 - (ii) Write down the assumptions of the probability distribution you have chosen in question (i)?
 - (iii) What is the maximum number of car that can arrive in 1 minute?
- (c) The mean traffic flow on a one-way street during the peak period is 12 vehicles per minute and standard deviation is 2 vehicles per minute. If the road is closed for two minute at an MRT crossing, what is the probability that the queue formed in the first minute is exactly 9 cars? (06)
- 2(a) The number of surface flaws in plastic panels used in the interior of automobiles has a poisson distribution with a mean 0.10 flaws per square foot of plastic panel. Assume an automobile interior contains 25 square feet of plastic panel. (10)
- (i) What is the probability that there are no surface flaws in auto's interior?
 - (ii) If 10 cars are sold to a rental company, what is the probability that none of the 10 cars has any surface flaws?
 - (iii) If 10 cars are sold to a rental company, what is the probability that at most one car has any surface flaws?
- (b) Suppose measurements of an item with a metric micrometer A had a mean of 3.25 mm and a standard deviation of 0.01 mm, and suppose measurements of another item with an English micrometer B had a mean of 0.80 in and a standard deviation of 0.002 in. Which micrometer is relatively "more" precise and why? (05)
- (c) Errors in an experimental transmission channel are found when the transmission is (10)

checked by a certifier that defects missing pulses. The number of errors found in an eight-bit byte is a random variable with the following distribution:

$$F(x) = \begin{cases} 0 & x < 1 \\ 0.7 & 1 \leq x < 4 \\ 0.9 & 4 \leq x < 7 \\ 1 & 1 \leq x \end{cases}$$

Determine each of the following probabilities:

$$(i) P(X \leq 4) (ii) P(X > 7) (iii) P(X \leq 5)$$

$$(iv) P(X > 7) (v) P(X \leq 2)$$

3(a) Suppose that $f(x) = e^{-(x-4)}$ for $4 < x$. Determine the following probabilities: (10)

$$(i) P(1 < X) (ii) P(2 \leq X < 5) (iii) P(5 < X)$$

$$(iv) P(8 < X < 12) (v) \text{ Determine } x \text{ such that } P(X < x) = 0.9$$

(b) The gap width is an important property of a magnetic recording head. In coded units, if the width is a continuous random variable over the range from $0 < x < 2$ with $f(x) = 0.5x$, determine the cumulative distribution function of the gap width. (07)

(c) An insurance company believes that people can be divided into two classes- those that are accident prone and those that are not. Their statistics show that an accident-prone person will have an accident at sometime within a fixed 1-year period with probability 0.4, whereas this probability decreases to 0.2 for a non-accident-prone person. If we assume that 30 person of the population is accident prone, what is the probability that a new policy holder will have an accident within a year of purchasing a policy? (08)

4(a) A random sample of speed data having size $n_1 = 15$ is selected from a normal population with a mean of 70 km/hr. and a standard deviation of 5 km/hr. A second random sample of size $n_2 = 18$ is taken from another normal population with mean 65km/hr. and standard deviation 10 km/hr. Let \bar{X}_1 and \bar{X}_2 be the two sample means. Find (i) The probability that $\bar{X}_1 - \bar{X}_2$ exceeds 4 km/hr. (07)
(ii) The probability that $3.5 \leq \bar{X}_1 - \bar{X}_2 \leq 5.5$

(b) Suppose that 15 percent of the population of transportation engineers is left-handed. Find the probability that in a group of 50 individuals, there will be (i) at most 10 left-handers (b) at least 5 left-handers (c) between 3 and 6 left-handers inclusive and (d) exactly 5 left-handers. (10)

- (c) The weights of salmon grown at a commercial hatchery are normally distributed with a standard deviation of 1.2 pounds. The hatchery claims that the mean weight of this year's crop is at least 7.6 pounds. Suppose a random sample of 16 fish yielded an average weight of 7.2 pounds. Is this strong evidence to reject the hatchery's claims at the (08)
- (i) 5 percent level of significance
 - (ii) 1 percent level of significance
 - (iii) Calculate p-value of this problem? Draw conclusion based on p-value.

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

Mid Semester Examination

Course No: HUM 4659

Course Title: Technology, Environment and Society

Summer Semester (2017-2018)

Time : 1hr 30 min.

Full Marks : 75

There are 4 (four) questions. Answer any 3 (three).

Figures in the right margin indicate marks of the questions.

- | | |
|--|----|
| 1. A) Define the term "Environment". | 5 |
| B) Explain – "Earth as a life support system" or "Earth as a living planet". | 10 |
| C) How the growing population imposing pressure on environment? | 10 |
| 2. A) Describe Plate Tectonic Theory. | 10 |
| B) Define the term Biodiversity. | 5 |
| C) Briefly explain one of the major global environmental issues. | 10 |
| 3. A) Define Ecosystem Service. | 5 |
| B) Define the term limiting factor with example. | 10 |
| C) Draw a diagram of an ecosystem. | 10 |
| 4. A) Define Anthropocene time. | 5 |
| B) What are the major characteristics of the Anthropocene? | 10 |
| C) Describe Sustainable Development. | 10 |

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B.Sc. Engg. (CEE)/ 8th Sem.

10th August, 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
COURSE NO. : CEE 4803 TIME : 1.5 Hours
COURSE TITLE : Socio Economic Aspects of Development FULL MARKS: 50

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.

-
- 1 Design a Focus Group Discussion based on knowing the answer to following questions: (18)
- What do children perceive as being potentially negative or problematic when using the internet?
 - What do children perceive as positive and beneficial when using the internet?
 - What impacts and consequences can online negative experiences have?
 - How do they evaluate things that adults consider potentially problematic?
 - What do children do to avoid these problematic experiences?
 - What can children do after having such negative experiences?
 - What coping strategies work best from children's perspectives?
- 2 (a) What do you mean by Development Projects? What are some important characteristics of development projects? List names of 10 large infrastructure development projects currently going on in Bangladesh. (8)
- (b) Discuss about major social and economic issues related to large development projects in Bangladesh. (8)
- 3 (a) What are the key development indicators? Distinguish between GNI and GDP. Why do you think GNI/GDP is the most widely used development indicators? (9)
- (b) Discuss about the economic explanation of fertility. (7)
- 4 (a) Based on demographic characteristics do you think Bangladesh is a developing country? Justify your answer. (9)
- (b) Why do you think economic development is vastly dependent upon population growth? (7)

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

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
 COURSE NO. : CEE 4821 TIME : 1.5 Hours
 COURSE TITLE: **Integrated Water Resources Management** FULL MARKS: 75

There are 4 (Four) questions. Answer 3 (Three) of them with Question 1 is compulsory. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

- 1 (a) Define IWRM. Explain the key word "Coordinated development and management" associated with IWRM. 5+5 =10
- (b) Explain the 3 key pillars (environmental and ecological sustainability, equity and economic efficiency) of IWRM with specific examples in Bangladesh. 3x5 =15
- 2 (a) What are the key drivers of climate change? Explain the effect of temperature rise on precipitation with specific reference of 3 climatic ensemble members such as Q₀, Q₈ and Q₁₆. 5+10 =15
- (b) Discuss the trends of mean monthly temperature (°C) and precipitation (mm/day) over the Ganges-Brahmaputra-Meghna (GBM) sub-region for the period of 1981–2000 for the three selected ensemble members (Q₀, Q₈ and Q₁₆). 10
- 3 (a) Why deltas are usually considered hot spots in terms of opportunities and challenges? Explain with specific reference of GBM delta with the central key word "water resources". 15
- (b) Why trade-offs between the use of environmental resources/water resources and development are important? Explain with specific reference in the coastal region of Bangladesh. 10
- 4 (a) Discuss the impact of climate change (including sea level rise) on following biophysical drivers (in the coastal zone of Bangladesh): river hydrology and Salinity. 5x2 = 10
- (b) What will be impact of the above biophysical drivers to the following three socio-economic sectors? 5x3 =15
- i. Agriculture
 - ii. Fisheries
 - iii. Mangrove forest

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

Semester: Mid Semester Examination
Course No.: CEE 4835
Course Title: Environmental Modeling

Summer Semester: 2017-2018
Full Marks: 75
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 assimilation factor? Explain the relationship between assimilation factor and pollutant concentration of a waterbody. (03)
- (b) In the early 1970s Lake Michigan had a total phosphorus (TP) loading of 6950 metric tons per year and an in-lake concentration of $8 \mu\text{g L}^{-1}$. (06)
- (i) Determine the lake's assimilation factor ($\text{km}^3 \text{yr}^{-1}$).
- (ii) What percent reduction of loading would be required to bring the in-lake concentration of TP down to approximately $3 \mu\text{g L}^{-1}$.
- (c) A lake has two compounds A and B having zero and first order reaction, respectively. Both of the compounds have similar initial concentration of 20 mg/l and rate constant of 0.5d^{-1} . Determine which compound will have higher percentage of removal after 4 hours. (05)
- (d) You perform a series of batch experiments and found the following data: (11)
- | t (hr) | 0 | 2 | 4 | 6 | 8 |
|----------------------------|------|-----|-----|-----|-----|
| c ($\mu\text{g L}^{-1}$) | 10.8 | 5.3 | 3.2 | 2.9 | 2.3 |
- Determine the order (n) and the rate (k) of the underlying reaction using differential method. (5)
- 2(a) Derive the expression for steady state concentration of pollutant in a well-mixed lake. (5)
- (b) A lake with single inflow stream has the following characteristics: (12)
- Mean depth = 3 m
 Surface area = $2 \times 10^5 \text{m}^2$
 Inflow = Outflow = $9500 \text{m}^3 \text{d}^{-1}$
 Temperature = 28°C
- An urban sewer discharges 70kg d^{-1} of biochemical oxygen demand (BOD) and the inflow stream has a BOD concentration of 10mgL^{-1} . If the BOD decays at a rate of 0.1d^{-1} and settles at a rate of 0.1m d^{-1} at 20°C ($\theta = 1.05$),
- i) Compute the assimilation factor
 ii) Determine the steady state concentration
 iii) Estimate the rates of loadings at which BOD is being added to the system and lost from the system
 iv) Compute transfer function, water residence time, and pollutant residence time.

- (c) Referring to the problem 2(b), (6)
- i) Determine the general solution if all the loadings have been stopped after reaching steady state level.
 - ii) Calculate the 75%, 90%, and 95% response times for the lake.
- (d) Define homogeneous and heterogeneous reactions. (2)
- 3(a) Define: (04)
- i) Aquifer
 - ii) Aquiclude
 - iii) Aquifuge
 - iv) Aquitard
- (b) Write short notes on the following groundwater contaminants: (08)
- i) Nitrogen
 - ii) Metals
 - iii) Carbon dioxide
 - iv) Particles
- (c) Draw concentration vs. time graph for the following groundwater contaminants transport phenomena: (08)
- i) Advection
 - ii) Dispersion
 - iii) Adsorption
 - iv) Decay
- (d) Write the significance of delineating capture zones of groundwater wells. (05)
- 4(a) Following figure shows a contour representation of the potentiometric surface for a confined aquifer being discharged into a river. Hydraulic heads in different locations were measured at 15 monitoring wells. Table 1 presents these measurements. (12)
- The aquifer is considered homogeneous and isotropic and has an average thickness of 18 m with a porosity of 0.34 and hydraulic conductivity of 2.6×10^{-4} m/s. Assuming steady-state conditions, estimate –
- i. The average hydraulic gradient in the aquifer.
 - ii. Calculate the rate of water discharge from the aquifer to the stream.
 - iii. Determine the time it would take for a hypothetical tracer injected in Well #11 to reach the river. The specific discharge along the flow line intersecting Well #11 is 1.43×10^{-6} .

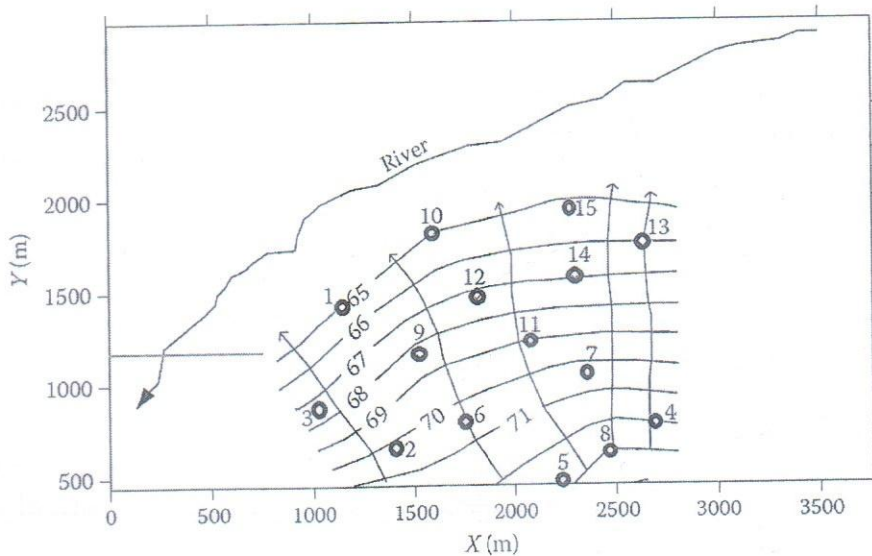
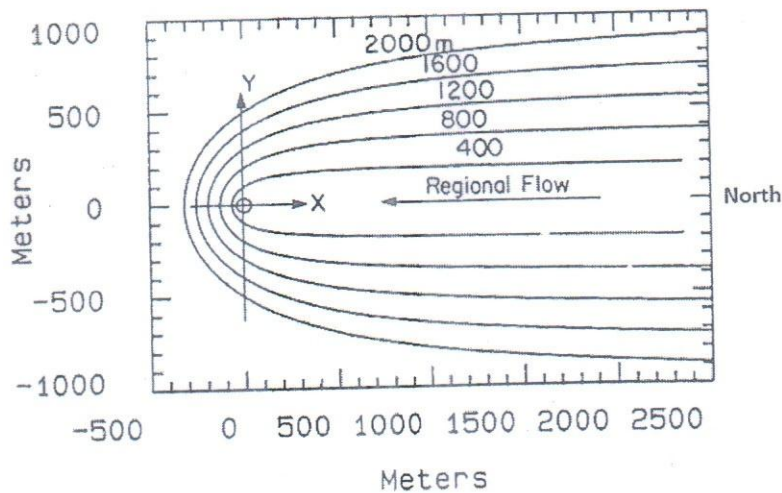


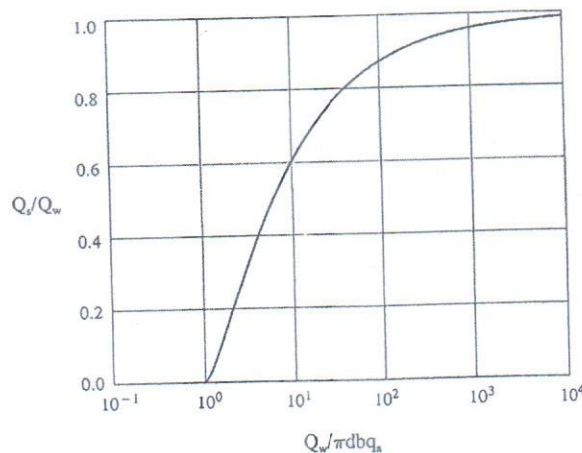
Table 1: Hydraulic Head Made at Five Streamlines

Streamline	l (m)	Δh (m)
1	900	-4
2	1000	-4
3	1150	-6
4	130	-7
5	1200	-8

- (b) A well serving an industry pumps at 12 L/s suddenly discovers hydrocarbon possibly from gasoline in the waste water and filed a lawsuit against every gas station within a 2.5 km radius. Station A is 2000m North and 300m East; station B is 300m east and station C is 200m southwest. Hydrogeologists determine that the phreatic aquifer is in an infinite flow domain, is 20m thick, has transmissivity of 0.003 m²/s and has a regional hydraulic gradient of 0.004 from north to south. Which of the lawyers will have a difficult time defending his client? The curves for the capture zone of the well located at the point (0,0), for several values of Q_w/bq_a are shown in the following figure. (07)



- (c) A well 20 cm in diameter is installed in a 3 m thick confined aquifer and is pumped at an average rate of 11 liter/min. While pumping, the well receives 40% of its pumped water from a stream nearby. If the specific discharge in absence of pumping is 0.2 m/d, find the distance between the stream and the well. The following figure shows the fraction of water in the well that comes from the stream (Q_s/Q_w) as a function of the dimensionless quantity Q_w/dbq_a . (06)



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

Semester Mid Semester Examination

Summer Semester: 2017-2018

Course No.: CEE 4837

Full Marks: 75

Course Title: GIS Application in Environmental 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 questions paper. The symbols have their usual meaning. The exam is **OPEN BOOK**. Each student is allowed to carry the course materials as one book. Students may have own writings inside the book.

- 1(a) Below are two raster maps of a land where the cell values represent production of crop A and crop B respectively. Identify the areas where i) only crop A is produced, ii) only crop B is produced, iii) none of the crops are produced, and, iv) both the crops are produced. In order to maximize your yield, what will be your strategy (which crop will be produced in which cell)? Answer the questions with appropriate raster analysis method and show the steps involved in calculation. (20)

0	5	2	6	0
6	5	1	9	0
10	0	7	2	0
2	5	0	4	4
0	1	3	3	7

Crop A

5	1	3	3	0
2	4	6	3	8
0	2	8	5	7
7	0	0	1	6
9	1	0	8	2

Crop B

- (b) Which file format takes less space – ASCII or Binary? Show with an example. (5)

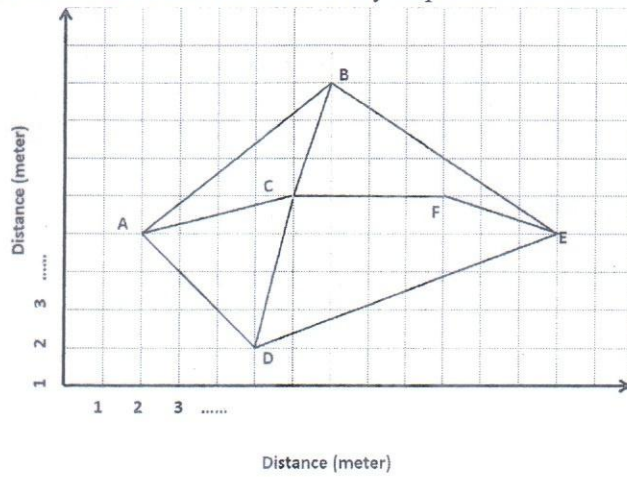
- 2(a) Write an SQL sentence where you, from the example table “Students” (see tables below), create a new table containing the names of all students with a mark lower or equal to 75. Draw the output table showing the results, too. (10)

Student ID	Name	Subject	Mark
12	Robert	CEE4101	50
51	Jacob	CEE4191	83
33	Chris	MATH101	74
47	Jeoff	CEE4101	91
4	Peter	CEE4191	38
78	Sara	CEE4101	62
48	Marta	CEE4191	58
37	Alvin	CEE4101	42

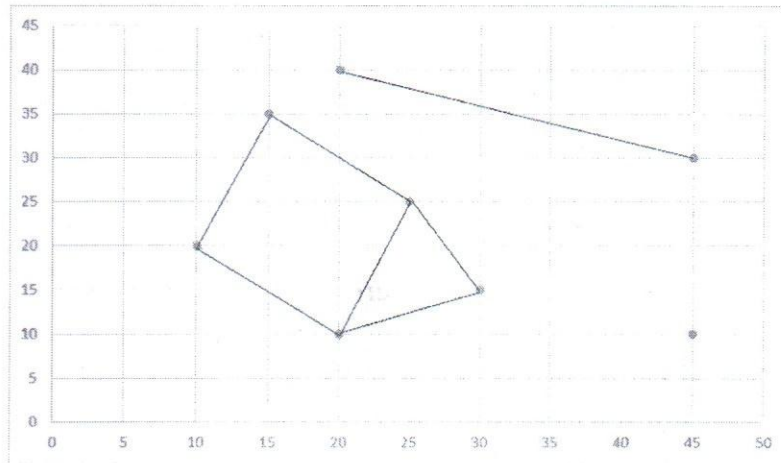
- (b) How do you calculate the RMSE error using a DGPS? Demonstrate mathematically (10)
- (c) When combining lines and polygons together, what features will contain the resulting theme? Will the result be a polygon theme, a line theme or both? Explain. (5)

3. Find the shortest route between A and E. Show every step of calculation.

(25)



4. Consider the vector map below. Show how to store this data in topological and simple polygon data structure.



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

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2017-2018
COURSE NO. : CEE 4851 TIME : 1.5 Hours
COURSE TITLE: HIGHWAY DESIGN AND RAILWAY ENGINEERING 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) Discuss in brief the most important properties of aggregate used for pavement construction. [5]
- (b) What are the different types of stresses developed in a concrete pavement? Explain the functions of all different types of joints used in concrete pavement. [10]
- (c) Discuss the design criteria by the PCA method for the thickness design of concrete pavements. A concrete pavement is to be designed for a four lane intercity road using the following information: [10]
The design period is 20 years and the annual growth rate is 5%. The current truck traffic volume (ADTT) is 22% of the current traffic volume. The percentage of one way trucks using design lane is 81%. The total no. of trucks in the design lane during the design period is 10.78×10^6 . What is the current traffic volume (ADT)?
- 2. (a) Explain the benefits of using bituminous soil stabilization. Describe the material requirements of such stabilization. [5]
- (b) Differentiate between: [10]
i) water bound macadam and bituminous macadam
ii) asphalt and bitumen
iii) prime coat and tack coat
- (c) It is given that the traffic using a pavement grows at a uniform rate of 8 percent and the design ESAL (number of equivalent 18-kip single axle loads) for a 10 year design period is 604640. Find the value of X shown below: [10]

Vehicle Type	No. of Vehicles	Truck Factor
Single-unit trucks		
Two-axle, four tire	90000	0.02
Two-axle, six tire	38000	X
Three-axle or more	1100	0.56
Tractor-semitrailers		
Three-axle	50200	0.51
Four-axle	7300	0.62
Five-axle or more	2100	0.94

- 3. (a) Write down the typical usage of the following highway construction equipments: [5]

- i) motor grader; ii) shovel; iii) sheep's-foot roller
- (b) Explain pumping of joints in concrete pavements. When will pumping through joints occur? How this problem can be handled? [10]
- (c) Find the optimum bitumen content for the medium traffic based on Marshall mix design method. Is the mix satisfactory? If not what adjustments may be suggested? [10]
Marshall Design Criteria for Medium Traffic
 Marshall stability (kg) = 545 (minimum)
 Marshall flow value(mm) = 2-4.5
 Air voids in total mix (%) = 3-5
 Voids in mineral aggregates (%) = 13
 Voids filled with asphalt (%) = 65-78

Test Results on Marshall Specimens

Asphalt Content (%)	% Air Voids in Total Mix	Voids in Mineral Aggregate	% Voids Filled with Asphalt	Marshall Stability (kg)	Flows (mm)
4	8.5	15.7	46	1065	3.75
4.5	6.6	15	56	1168	4.25
5	4.6	15.1	69	1456	3.50
5.5	3.8	15.5	71	1376	3.00
6	2.6	14.7	81	1310	3.50

4. (a) Define stability and durability? Why air void content is very important in paving mix? [5]
- (b) Draw typical cross-sections of a flexible pavement and a rigid pavement and state the function of each elements and layers. [10]
- (c) Design an aggregate blending for a dense graded asphaltic concrete surface mixture from the following data: [10]

Sieve		Specification	Field Observation		
Passing	Retained	% by weight	CA	FA	MF
¾ in	½ in	0-6	5	-	-
½ in	3/8 in	9-40	32	-	-
3/8 in	No.4	9-45	37	-	-
No.4	No.10	8-27	22	7	-
Total Coarse Aggregate		50-65			
No. 10	No. 40	6-22	4	28	-
No. 40	No. 80	8-27	-	39	5
No. 80	No. 200	5-17	-	24	30
No. 200	-	5-8	-	2	65
Total FA and MF		35-50			
Total Mineral Aggregate		100	100	100	100

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 6515****Full Marks: 75****Course Title: Applied Probability and Statistics in
Engineering****Time: 1.5 Hours**

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. It's an OPEN BOOK exam. Only one text book is allowed.

- 1(a) The average number of accidents occurring weekly on a particular stretch of a highway equals 4. Calculate the probability that there is at least one accident in a week. (05)
- (b) The weights of a population of bus drivers have mean 167 pounds and standard deviation is 27 pounds. (10)
- (i) If a sample of 36 workers is chosen, approximate the probability that the sample mean of their weights lies between 163 pounds and 170 pounds.
- (ii) Repeat part (i) when the sample is of size 144. What changes you observe in case (ii) while comparing with case (i)?
- (c) Historical records of rainstorms in a town indicate that on the average there had been 4 rainstorms per year over the last 20 years. Assuming that the occurrence of rainstorms in a Poisson process what is the probability that there would be no rainstorms next year? The probability that exactly 4 rainstorms will occur in the next year? (10)
- 2(a) Suppose, from historical record, that the total annual rainfall in a catchment basin is estimated to be normal N (mean=60 in, variance=15 in²). (15)
- (i) What is the probability that in future years the annual rainfall will be between 40 and 70 in?
- (ii) What is the probability that the annual rainfall will be at least 30 in?
- (iii) What is the 10- percentile annual rainfall in the basin 0(that is, the value of the variate at which the cumulative probability is 10%)? In other words, the probability that the annual rainfall will be less than the 10- percentile value is 10%
- (b) A soft-drink bottler is studying the internal pressure strength of 1- liter glass bottles. A random sample of 16 bottles is tested, and the pressure strength(psi) are obtained. The data are shown below. Plot these data on normal graph paper by using standardized normal scores. Does it seem reasonable to conclude that pressure strength is normally distributed? (10)

226.1	202.20	219.54	193.73	208.15	195.45	193.71	200.81
211.14	203.62	188.12	224.39	221.31	204.55	202.21	201.63

- 3(a) A quality control engineer is in charge of testing whether or not 90% of the DVD players produced by his company conform to specifications. To do this, the engineer randomly selects a batch of 12 DVD players from each day's production. The day's production is acceptable provided no more than 1 DVD player fails to meet specifications. Otherwise, the entire day's production has to be tested. (10)
- What is the probability that the engineer incorrectly passes a day's production as acceptable if only 80% of the day's DVD players actually conform to specification?
 - What is the probability that the engineer unnecessarily requires the entire day's production to be tested if in fact 90% of the DVD players conform to specifications?
- (b) A spark plug manufacturer claimed that its plugs have a mean life in excess of 22100 miles. Life of spark plugs follows the normal distribution. A fleet owner purchased a large number of sets. A sample of 18 sets revealed that the mean life was 23400 miles and standard deviation was 1500 miles. Is there enough evidence to substantiate the manufacturer's claim at the 0.05 significance level? (10)
- (c) The weights of salmon grown at a commercial hatchery are normally distributed with a standard deviation of 1.2 pounds. The hatchery claims that the mean weight of this year's crop is at least 7.6 pounds. Suppose a random sample of 16 fish yielded an average weight of 7.2 pounds. Is this strong evidence to reject the hatchery's claims at the 1 percent level of significance? (05)
- 4(a) A laboratory blood test is 95 percent effective in detecting a certain disease when it is, in fact, present. However, the test also yields a "false positive" result for 1 percent of the healthy persons tested. (That is, if a healthy person is tested, then, with probability 0.01, the test result will imply he or she has the disease). If 0.5 percent of the population actually has the disease, what is the probability a person has the disease given that the test result is positive? (08)
- (b) The probability density function of the time to failure of an electronic component in a copier (in hours) is $\frac{e^{-x/2000}}{2000}$ for $x > 0$. Determine the probability that (10)
- A component lasts more than 2000 hours before failure.
 - A component fails in the interval from 750 to 1500 hours.
 - Determine the number of hours at which 15% of all components have failed.
- (c) Suppose the duration (in months) of a construction job can be modeled as a continuous random variable T whose cumulative distribution function (CDF) is given by (07)
- $$F_T(t) = \begin{cases} t^2 - 2t + 1 & 1 \leq t \leq 2 \\ 0 & t < 1 \\ 1 & t > 2 \end{cases}$$
- Determine the corresponding density function $f_T(t)$
 - Compute $P(T > 1.5)$

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M.Sc. Engg. (CEE)

14 August 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM: MID SEMESTER EXAMINATION

SUMMER SEMESTER: 2017-2018

COURSE NO. : CEE-6113

TIME : 1.5 Hours

COURSE TITLE: **Analysis and Design of Tall Buildings**

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) Define tall building from the structural engineer's point of view. (03)
(b) What do you mean by determination of structural form? (04)
(c) Mention the factors that affect the choice of structural form. (08)
(d) "A 40-story residential building is generally of significantly less height than a 40-story office building." Explain the statement. (10)
2. (a) Discuss the advantages and disadvantages of the following types of lateral load resisting systems: (20)
(i) Braced-frame system
(ii) Wall-frame system
(iii) Framed-tube system
(iv) Hybrid system
(b) Describe the characteristics of floor systems of steel framed tall building. (05)
3. (a) What is a shear wall structure? What do you mean by proportionate and nonproportionate shear wall structures? (05)
(b) Write the assumptions of continuous medium method for the analysis of coupled shear walls. (05)
(c) Derive the governing differential equation of coupled shear walls in terms of axial force in the walls. (15)
4. The structure in Figure 1 and Figure 2 consists of 20 3.5-m stories (total height = 70 m). Five shear walls were provided (two symmetrical pairs (Types 1 and 2) and a central core (Type 3)). Two change levels, A and B, divide the structure into three regions. The wall dimensions and inertias are given in Table 1. Determine the bending moment in wall Type 1 at change level B due to uniform wind pressure of 1.5 kN/m^2 . Assume reasonable values of missing data, if any. (25)

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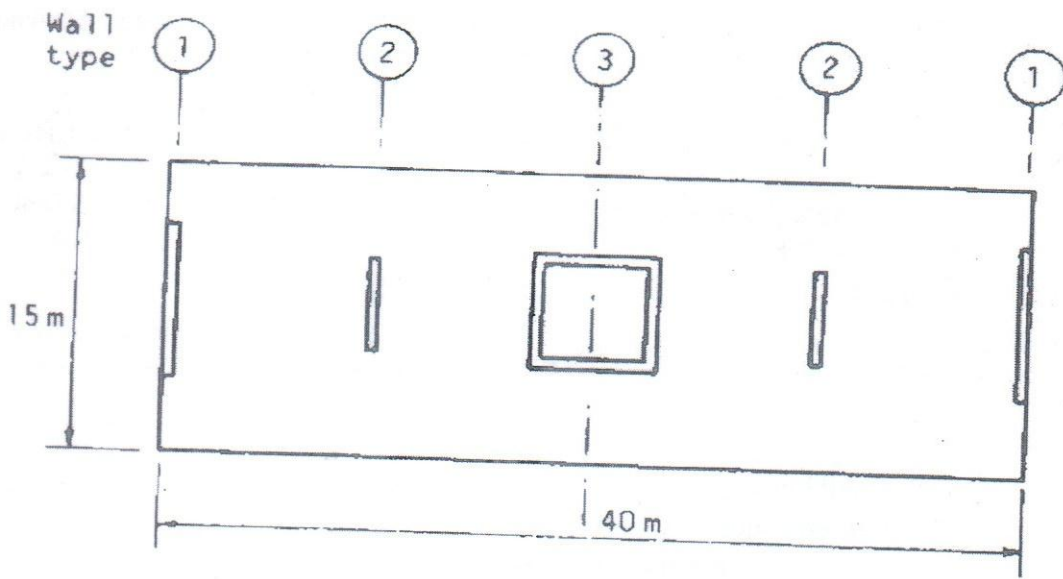


Figure 1: Plan of the given structure

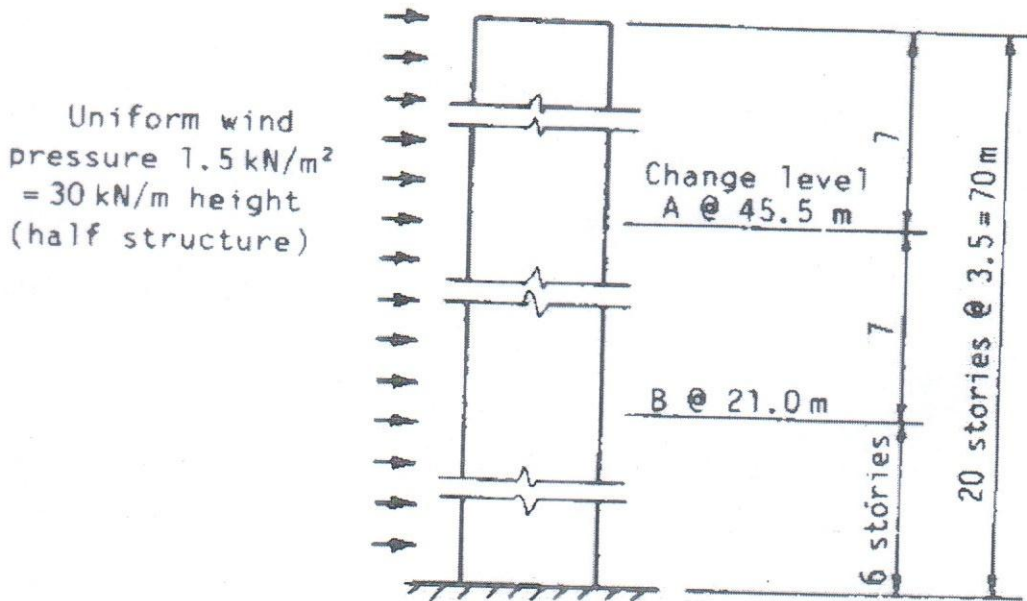


Figure 2: Elevation of the given structure

Table 1: Wall dimensions and inertias

	Wall 1		Wall 2		Wall 3		
	Dimensions (m)	Inertia I_1 (m ⁴)	Dimensions (m)	Inertia I_2 (m ⁴)	Dimensions (m)	Total Inertia I_3 (m ⁴)	Half Inertia $I_3/2$ (m ⁴)
Top region, 45.5-70 m	8 × 0.2	8.533	5 × 0.2	2.083	Outside 6 × 6, walls 0.2 m thick	26.046	13.023
Middle region, 21-45.5 m	8 × 0.3	12.800	5 × 0.3	3.125	Outside 6 × 6, walls 0.2 m thick	26.046	13.023
Bottom region, 0-21 m	8 × 0.45	19.200	7 × 0.5	14.292	Outside 6 × 6, walls 0.4 m thick	47.070	23.535

Given Equations:

$$k_{xj}^t = \frac{I_{xj}^t}{\sum_{j=1}^n I_{xj}^t}; k_{xj}^b = \frac{I_{xj}^b}{\sum_{j=1}^n I_{xj}^b}; \Delta k_{xj} = k_{xj}^b - k_{xj}^t$$

$$\rho_{xj}^t = \frac{-I_{xj}^t}{I_{xj}^t + I_{xj}^b}; \rho_{xj}^b = \frac{I_{xj}^b}{I_{xj}^t + I_{xj}^b}; \alpha_x = \sum_{j=1}^n \rho_{xj}^t \Delta k_{xj}$$

$$\beta_{xj}^t = \frac{1}{1-\alpha_x} (\rho_{xj}^t \Delta k_{xj} - \alpha_x k_{xj}^t); \beta_{xj}^b = \frac{1}{1-\alpha_x} (\rho_{xj}^b \Delta k_{xj} - \alpha_x k_{xj}^b)$$

$$M_{pxj}^t = k_{xj}^t M_x; M_{pxj}^b = k_{xj}^b M_x; M_{pij} = k_{ij} M_i$$

$$M_{sxj}^t = -\beta_{xj}^t M_x; M_{sxj}^b = -\beta_{xj}^b M_x$$

$$M_{s,x+1,j} = -0.268 M_{sxj}^t; M_{s,x+2,j} = (-0.268)^2 M_{sxj}^t$$

$$M_{s,x-1,j} = -0.268 M_{sxj}^b; M_{s,x-2,j} = (-0.268)^2 M_{sxj}^b$$

$$M_{fxj} = M_{pxj}^t + M_{sxj}^t; M_{fxj} = M_{pxj}^b + M_{sxj}^b; M_{fij} = M_{pij} + M_{sij}$$

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 6703

Full Marks: 75

Course Title: Constitutive Modeling of Soils

Time: 1.5 Hours

Answer all there 3 (Three) 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) Expand the following tensors- (9)

(i) $A_{ik}B_{kj}$ (ii) $Y_i = A_{ij}B_k X_{ij}$ (iii) $\frac{\partial f}{\partial \sigma_{ij}} \delta_{jk}$, where δ_{jk} is the Kronecker delta.

(b) Deduce (i) $\frac{\partial S_{ij}}{\partial \sigma_{kl}}$, (ii) $\frac{\partial \eta_{ij}}{\partial \sigma_{kl}}$ by partial differentiation. Where, $S_{ij} = \sigma_{ij} - p\delta_{ij}$, $\eta_{ij} = \frac{S_{ij}}{p}$, (8)
 and p is the mean stress.

(c) Compute the stress invariants ($I_{1\sigma}$, $I_{2\sigma}$, and $I_{3\sigma}$) for the stress tensor, (8)

$$[\sigma_{ij}] = \begin{bmatrix} 4.0 & 0.5 & 0.2 \\ 0.5 & 3.5 & 0.3 \\ 0.2 & 0.3 & 2.5 \end{bmatrix}$$

2(a) Derive the linear elastic constitutive model (generalized Hooke's law) for three-dimensional condition and express the equation in tensor form. (19)

(b) Draw qualitative graphs of (i) deviatoric stress (q) ~ deviatoric strain (ϵ_d), and (ii) volumetric strain (ϵ_v) ~ deviatoric strain (ϵ_d) for constant p and σ_3 in linear elastic model. (6)

3(a) Draw the graphs for points ① to ⑤, shown in Fig.1, showing the relations of (i) deviatoric stress (q) ~ deviatoric strain (ϵ_d), (ii) volumetric strain (ϵ_v) ~ deviatoric strain (ϵ_d), and (iii) stress ratio (q/p') ~ deviatoric strain (ϵ_d) in drain shear test under constant mean principal stress of clay. (15)

(b) Draw the graphs for points ① to ⑤, shown in Fig.1, showing the relation of deviatoric stress (q) ~ effective mean principal stress (p') in undrain shear tests of clay. (10)

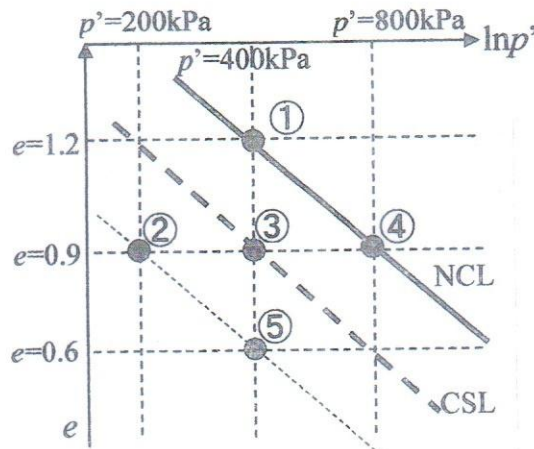


Fig. 1