

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

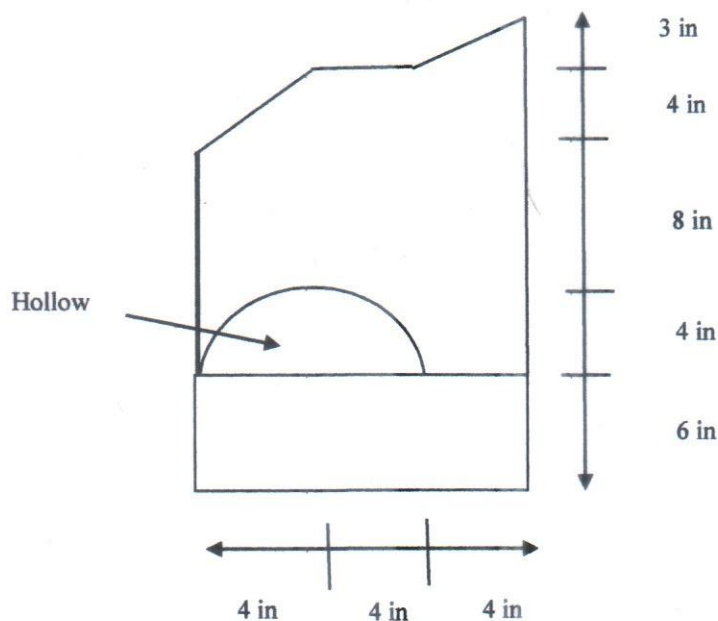
TERM: SEMESTER FINAL EXAMINATION  
 COURSE NO.: CEE 4201  
 COURSE TITLE: Analytic Mechanics

SUMMER SEMESTER: 2020-2021  
 TIME: 3 Hours  
 FULL MARKS: 200

There are 6 (Six) sets of questions. Answer all of them. Programmable calculators are not allowed. Do not write anything on this question paper. Marks of each question and corresponding CO and PO are written in the right margin. The Symbols have their usual meaning.

1. a) Find the centroid of the area shown in Figure 1.

Full Marks	CO	PO
(13 $\frac{1}{3}$ )	1	1



**Figure 1**

- b) Find the moment of inertial  $I_x$  and  $I_y$  of the composite area shown in Figure 2.

(20)	1	1
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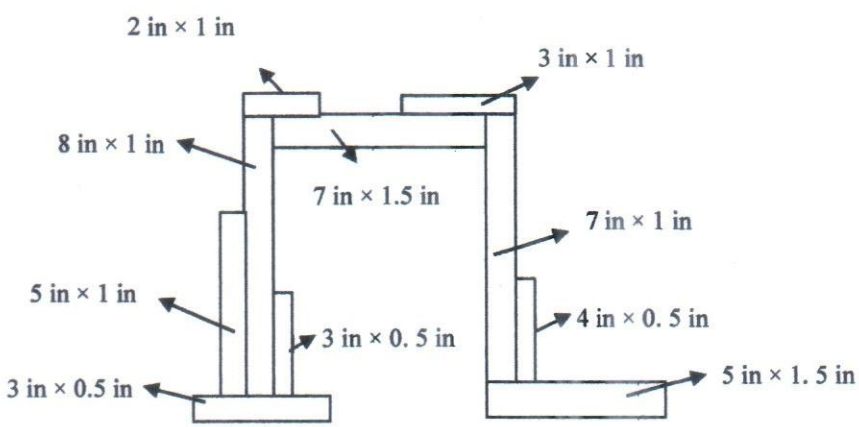


Figure 2

2. a) A freight car becomes uncoupled from a train which is moving up a 1.5% grade at a speed of 10fps. It is acted upon by a constant resistance to motion of 10 lb per ton of weight. (a) What is its speed in mph when it reaches a point 1 mile down grade from the point at which it became uncoupled? (b) If the car moves onto a level track after this 1 mile is traveled, how far does it go on the level before it comes to rest? Its motion is unobstructed except for friction. (20) 2 2
- b) A particle whose acceleration  $a = 3t^2 + 4t + 10$  is moving at a certain instant in a straight line with an initial velocity of 20 fps in the same sense as the initial acceleration. At end of  $t = 7$  sec, what are the velocity and displacement of the particle?  $(13 \frac{1}{3})$  2 2
3. a) In Figure 3, a disk A (200 lb weight and 4 ft diameter) has a weightless chord wrapped about its midsection. This chord passes over a frictionless sheave C (2 ft diameter), and then downward to a 100 lb weight B. Let  $\theta = 30^\circ$ ,  $I_A$  and  $I_C$  is 8 slug-ft<sup>2</sup> and 1 slug-ft<sup>2</sup>, respectively and let the displacement of B be 10 ft. (a) If the system starts from the rest, determine the final speed of the cg of A and the acceleration of B. (b) What is the tension in the chord? (20) 2 2

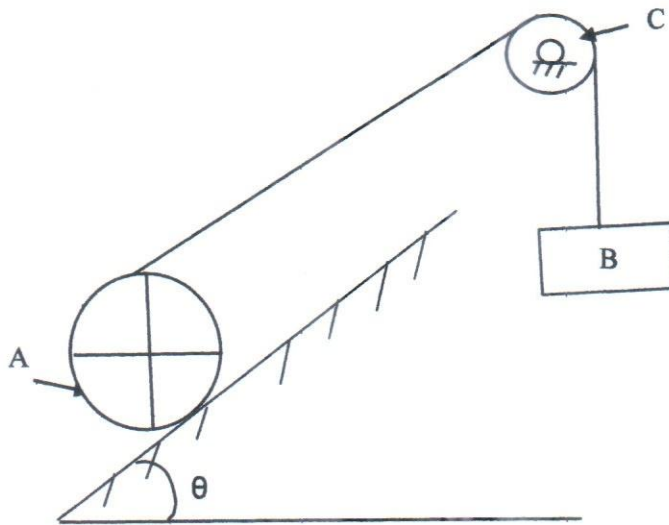


Figure 3

- b) A box of sand weighting 12 lb, is moving with a velocity of 10 fps towards the left on a horizontal plane where  $f=0.2$ . The box struck by a bullet weighing 0.4 lb and moving towards the right with a velocity of 1800 fps. The bullet embeds itself in the box. (13  $\frac{1}{3}$ ) 2 2  
 (a) What is the resulting velocity of the box? (b) As measured from the instant of impact, when does the box come to rest and how far does it move from the point of impact?
4. a) A good golfer imparts an initial velocity of 200 mph to a good golf ball. If the direction of the velocity is  $40^\circ$  with the horizontal, find (20) 2 2  
 (a) the horizontal distance travelled in the flight, (b) the time of flight, (c) the maximum height reached by the ball. Assume that the ground is level, and neglect air resistance.
- b) Find the centroid of a right circular cone, whose altitude is  $h$  and whose base has a radius  $r$ . (13  $\frac{1}{3}$ ) 1 1
5. a) In Figure 4, the bodies A and B weigh 700 lb and 300 lb, respectively. The rotating part C with outer diameter 10 ft and inner diameter 4 ft weighs 800 lb. The radius of gyration of this rotating part about its axis is 4 ft. (20) 2 2  
 (a) After B has moved 14 ft from rest, what is the speed of A and B. (b) What is the acceleration of A and B, and the angular acceleration of C? (c) What is the change of potential energy of the system?

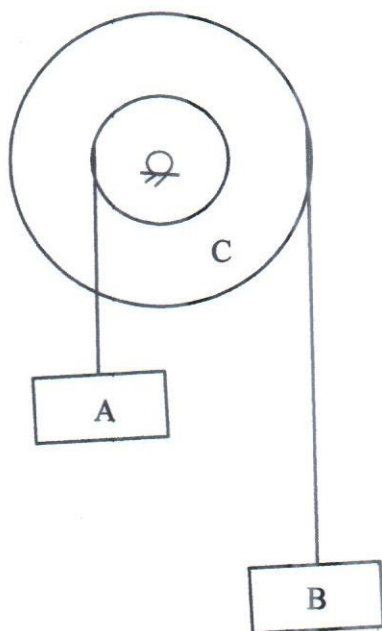


Figure 4

- b) A 700 lb disk 8 ft in diameter, is keyed to a 400 lb shaft which is 7 in in diameter. The shaft turning at 700 rpm, is supported by two bearings where  $f = 0.04$ . If there is no torque on the rotating members except that due to the frictional force in the bearings, how long does it take for the angular speed to be reduced to 100 rpm? (13  $\frac{1}{3}$ )      2      2
6. a) In Figure 5, the rotating elements B (inner diameter 4 ft), which weigh 1300 lb and have a radius of gyration of 3 ft, are turning 100 rpm. While it moves 80 ft downward, the 300 lb weight A is brought to rest by the constant frictional force at the brake shoe C, where  $f = 0.2$ . The shape of the brake arm is such that  $e = 4$  in. What is the value of the force Q applying the brake? (20)      2      2

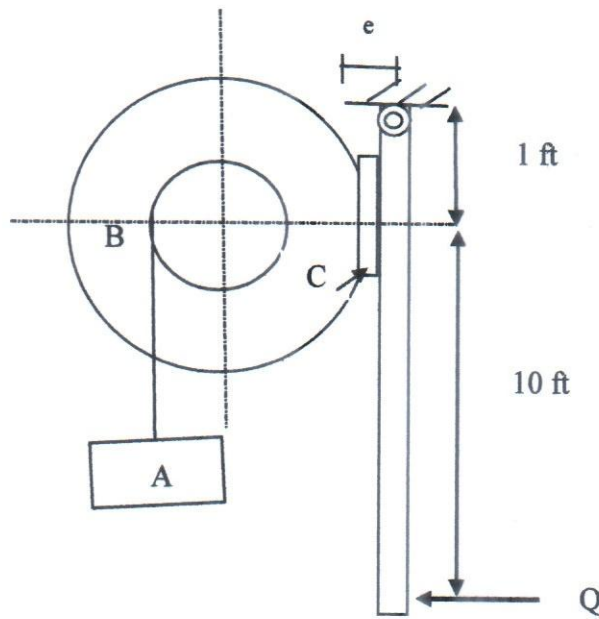


Figure 5

- b) A body A, Figure 6, is suspended from a cable wound about a drum with inner and outer diameter of 4 ft and 7 ft and is moving down with a constant velocity of 8 fps. When  $t = 4$  sec, (a) determine the angular and linear velocities of point P which is on the flywheel that turns with the drum and (b) the normal and tangential accelerations of point P.

$(13 \frac{1}{3})$

2

2

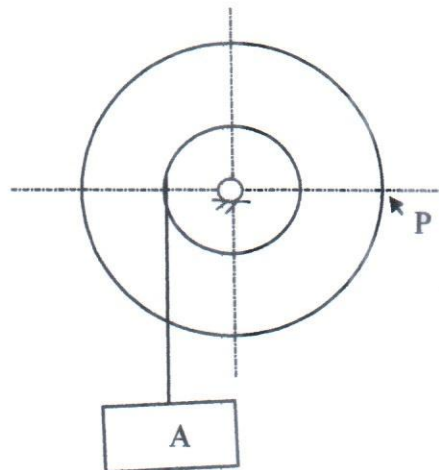


Figure 6

Name of the Program: B. Sc. (ME/IPE)  
Semester: 2<sup>nd</sup> Sem.

Date: April 5, 2022  
Morning

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF NATURAL SCIENCES(NSc)

Semester Final Examination  
Course Number: Math 4211  
Course Title: PDE, Special Functions, Laplace, and  
Fourier Analysis

Summer Semester: 2020 - 2021  
Full Marks: 150  
Time: 3.0 Hours

There are 6(six) questions. Answer all the questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. The Symbols have their usual meaning.

1. a) A differential equation is given below: (CO1)  
$$2x^2 y'' - xy' + (1+x)y = 0$$
 (PO1)  
[12]

Determine:

- (i) the singular points of the above differential equation.
- (ii) whether they are regular or irregular.
- (iii) the series solutions of the differential equation.

[3+10]

b) (i) State Gamma and Beta function.

(ii) Prove that 
$$\beta(m, n) = \frac{\Gamma m \Gamma n}{\Gamma(m+n)}$$

2. a) Evaluate Laplace transform of  $f(t)$  (CO2)  
where  $f(t) = \begin{cases} 0, & 0 \leq t < 3 \\ 2, & t \geq 3 \end{cases}$  (PO3)  
[10]

b) A mass and spring system satisfying the following initial value problem. [15]  
and illustrated in Fig. Q2(b).

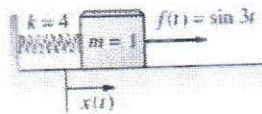


Fig. Q2(b)

$$x'' + 4x = \sin 3t; \quad x(0) = x'(0) = 0$$

The mass is initially at rest in its equilibrium position. Using the Laplace transform solve the initial value problem.

3. a) Use Convolution theorem to determine the inverse Laplace transform of (CO2)  
$$\frac{1}{s^2(s-a)}$$
 (PO2)  
[10]

b) Find the Fourier integral representation of the function [15]

$$f(x) = \begin{cases} 0 & \text{for } x < 0 \\ 1 & \text{for } 0 < x < 2 \\ 0 & \text{for } x > 2 \end{cases}$$

4. a) (i) Sketch the periodic function  $f(t)$  with period 4 and determine its Fourier series (CO2)  
when  $f(t)$  is given for  $-2 < t < 2$  by (PO2)

$$f(t) = \begin{cases} 2 & \text{for } -2 < t < 0 \\ t & \text{for } 0 \leq t < 2 \end{cases} \quad [10]$$

(ii) Also, determine the spectrum, amplitude spectrum and phase spectrum of  $f(t)$ . [3]

b) Determine a Fourier sine series and a Fourier cosine series of the function [12]  
 $f(t) = t(t-4)$  on the interval  $(0, 4)$ .

5. a) A periodic function  $f(t)$  with period  $2\pi$  defined for  $-\pi \leq t < \pi$  by: (CO2)  
(PO2)

$$f(t) = \begin{cases} 0 & \text{for } -\pi \leq t < 0, \\ 1 & \text{for } 0 \leq t < \pi \end{cases}$$

- (i) Determine the Fourier series of  $f(t)$ . [7]  
(ii) Describe the fundamental theorem and verify that  $f(t)$  satisfies the conditions of the [2+3]  
fundamental theorem.  
(iii) Use the fundamental theorem to show that [3]

$$\frac{\pi}{4} = \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{2n-1} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$$

b) Determine the Fourier transform of the function [10]

$$f(t) = \begin{cases} \cos t & \text{for } \frac{-\pi}{2} \leq t \leq \frac{\pi}{2}, \\ 0 & \text{for otherwise} \end{cases}$$

6. a) (i) State principles which are assumed to derive one dimensional heat equation. (CO3)  
(ii) In steady state conditions derive the one dimensional heat flow equation. (PO7)  
[2+8]

b) Consider an elastic string tightly stretched between two points O and A. Let, O be the origin and  $OA = l$  as x-axis. On giving a small displacement to the string, perpendicular to its length (parallel to the y-axis). Also,  $y(x, t)$  be the displacement at the point  $P(x, y)$  at any time and corresponding wave equation with associated initial and boundary condition of the system are given below: [15]

$$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$$

$$y(0, t) = y(l, t) = 0$$

$$y(x, 0) = y_0 \sin^3 \frac{\pi x}{l}, \quad \frac{\partial y}{\partial t} = 0 \text{ at } t = 0$$

Find the displacement of the string  $y(x, t)$ .

B.Sc. Engg. (CEE)/ 2<sup>nd</sup> Sem.  
Semester: Summer 2020-2021

Date: 28 March, 2022  
Time: 9.30 am – 12:30 pm

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

Semester Final Examination  
Course Number: GS 4253  
Course Title: Ecology and Environment

Summer Semester: 2020 - 2021  
Full Marks: 150  
Time: 3 Hours

There are two sections (Section A and Section B). Answer 3 (Three) questions from Section A and 3 (Three) questions from Section B. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

**Section A**

(From this section, answer any three out of four questions)

1. (a) Define (5)  
i) Ecological Footprint (CO1)  
ii) Per Capita Ecological Footprint (PO1)  
iii) Ecological Deficit

(b)

Country	Ecological Footprint (gha/capita)	Biocapacity (gha/capita)
Bangladesh	0.62	0.38
India	0.91	0.51
Nepal	3.56	0.55
Pakistan	0.77	0.43
Sri Lanka	1.21	0.45

(5)  
(CO2)  
(PO2)

From the table above, identify which South Asian countries have ecological reserve and which have ecological deficit.

- (c) The sustainable average carbon footprint per person should be no more than 2.0 metric ton per person per year. Bangladesh wants to achieve this target within 10 years by reducing 50% of the carbon footprint per person at present. (15)  
(CO3)  
(PO2)
- i) Calculate the total carbon footprint if population of Bangladesh is 164.7 million at present.



- ii) Determine the annual afforestation (million ha) required to achieve this target. 1 ha forestland can absorb 0.85 metric ton of carbon dioxide per year. Assume population stays the same.
2. (a) Write a short note on Short Lived Climate Pollutants (SLCP) (5)  
(CO1)  
(PO1)
- (b) On a particular day, the concentration of O<sub>3</sub> (8-hr) is 275 µg/m<sup>3</sup>, and concentration of PM<sub>2.5</sub> (24-hr) is 200 µg/m<sup>3</sup>. Calculate the AQI and "critical pollutant" for that particular day (using the USEPA chart provided in Appendix 1). [Assume pressure and temperature to be 1 atm and 25 °C, respectively]. (15)  
(CO3)  
(PO2)
- (c) Identify the Air quality category according to USEPA from Question 2(b) along with category descriptor, color and pollutant specific sensitive group. [Chart provided in Appendix 2] (5)  
(CO2)  
(PO2)
3. (a) Differentiate between point source and non-point sources. (5)  
(CO1)  
(PO1)
- (b) DDT, and especially its derivative DDE, are persistent molecules which are transferred from the point of application through the air (following evaporation), through water (in spite of very low water solubility) and through food webs to different organisms. Identify the phenomena (bioconcentration/bioaccumulation) occurring here (5)  
(CO2)  
(PO2)
- (c) A mixture consisting of 50 mL of waste and 250 mL seeded dilution water has an initial DO of 6 mg/L; after 5 days, it has a final DO of 4.75 mg/L. If the 5-day BOD of the waste is 5 mg/L then determine the 5-day BOD of the seeded dilution water. (15)  
(CO3)  
(PO2)
4. (a) What are the 4 major domains of earth? What are the natural resources we can obtain from each domain? (5)  
(CO1)  
(PO1)
- (b) Algal bloom has occurred in a saltwater lake. If the concentration of Nitrogen and Phosphorous is respectively 0.115 mg/L and 0.24 mg/L, identify the limiting nutrient in this case. (5)  
(CO2)  
(PO2)

- (c) Consider a lake with  $100 \times 10^6 \text{ m}^2$  of surface area for which the only source of phosphorus is the effluent from a wastewater treatment plant. The effluent flow rate is  $0.4 \text{ m}^3/\text{s}$  and its phosphorus concentration is  $10.0 \text{ mg/L}$ . The lake is also fed by a stream having  $20 \text{ m}^3/\text{s}$  of flow with  $0.01 \text{ mg/L}$  phosphorus. If the phosphorus settling rate is estimated to be  $10 \text{ m/year}$ , Estimate the average phosphorus concentration in the lake. (15)  
(CO3)  
(PO2)

### Section B

(From this section, answer any three out of four questions)

- 5 (a) Distinguish between inertia and resilience in the context of ecology. (5)  
(CO1)  
(PO1)
- (b) Case Study: Western Shoreline, Bangladesh (5)  
(CO2)  
(PO2)
- Geomorphic change in coastal Bangladesh is highly dynamic. There is heavy sedimentation in different areas of the western shoreline. In general, a grass (*Myriostachya wightiana*) colonises the land within two years following exposure to water. Germinated seeds of this species are commonly found floating in the water during the rainy season and colonisation occurs. Within a year after anchorage of these seeds the ground becomes covered with a dense mat of *M. wightiana*. In areas with heavy silt deposition, *Imperata cylindrica* is found. This species grows vigorously and establishes itself by complete removal of *M. wightiana* cover when the level of tidal inundation is low. With the maturity of lands, *Acanthus ilicifolius*, a mangrove thorny herb growing to a height of  $1.5 \text{ m}$ , is seen occupying huge basin type areas in addition to the existing species. With time, *Derris trifoliata*, a climber appears scattered.
- Draw the ecological succession pathway identifying the successional stages for the given case study.
- (c) A fishprint provides a measure of a country's fish harvest in terms of area. (15)  
The unit of area used in fishprint analysis is the global hectare (gha), a unit (CO4)  
weighted to reflect the relative ecological productivity of the area fished. (PO2)  
When compared with the fishing area's sustainable biocapacity, its ability to provide a stable supply of fish year after year in terms of area, its fishprint indicates whether the country's fishing intensity is sustainable. The fishprint and biocapacity are calculated using the following formulae:

Fishprint (in gha) = {metric tons of fish harvested per year/

$$\text{Biocapacity (in gha)} = \frac{\{\text{productivity in metric tons per hectare} * \text{weighting factor}\}}{\{\text{productivity in metric tons per hectare} * \text{weighting factor}\}}$$

Assume a country harvests 18 million metric tons of fish annually from an ocean area with an average productivity of 1.3 metric tons per hectare and a weighting factor of 2.68. Biologists determined that this country's sustained yield of fish is 17 million metric tons per year.

Is the county's fishing intensity sustainable? If not, how much reduction in fishprint is required to make it sustainable?

- 6 (a) Write 5 examples of renewable energy source. (5)  
(CO1)  
(PO1)
- (b) In March 2017, the journal Nature published data from aerial and underwater surveys of the Great Barrier Reef showing that coral bleaching was much more prevalent and severe than had been previously estimated. Overall, 91% of the reef displays some signs of bleaching, and about 50% of the reef is considered to be "extremely bleached". Because of multiple bleaching events since the 1980s, the coral cover of the entire reef area has been halved. Although the reef has displayed great resiliency under growing ecological pressures, the unprecedented decimation of so much of the reef today is alarming scientists, who fear that the reef will not be able to bounce back to health. (5)  
(CO2)  
(PO2)
- Identify and explain the reason of the coral bleaching incident above.
- (c) Analyzing the case study from Question 6(b), suggest some actions to reduce events like coral bleaching. (15)  
(CO4)  
(PO2)
- 7 (a) Describe Ozone Layer Depletion. (5)  
(CO1)  
(PO1)
- (b) Every 3-8 years, South America and some parts of the US faces increased precipitation and flooding while Australia and Indonesia face drought. Explain how a climate event causes this change. (5)  
(CO2)  
(PO2)
- (c) From the case study of question 7(c), explain the possible impacts of this event on food security. Suggest some actions to ensure food security. (15)  
(CO4)  
(PO2)
- 8 (a) Define air pollution and describe the key issues. (5)  
(CO1)  
(PO1)

- (b) Using the key issues of air pollution, show if indoor air pollution is more harmful or outdoor air pollution. (5)  
(CO2)  
(PO2)
- (c) The National Ambient Air Quality Standards (NAAQS) for fine particulate matter (PM<sub>2.5</sub>) in Bangladesh is 65 microgram (µg) per cubic metre for 24-hour on average. Centre for Atmospheric Pollution Studies in its survey found that the presence PM<sub>2.5</sub> in the country in 2021 was 102.41 microgram per cubic metre on average. The highest concentration was found in the district of Gazipur where PM<sub>2.5</sub> was 263.51 µg/m<sup>3</sup>. (The Financial Express, February 03, 2022). (15)  
(CO4)  
(PO2)

Analyze the air quality situation and recommend some engineering controls.

#### Appendix 1

Breakpoints							AQI
O <sub>3</sub> (ppm) 8 hr	O <sub>3</sub> (ppm) 1 hr	PM <sub>2.5</sub> (µg/m <sup>3</sup> ) 24 hr	PM <sub>10</sub> (µg/m <sup>3</sup> ) 24 hr	CO (ppm) 8 hr	SO <sub>2</sub> (ppm) 24 hr	NO <sub>2</sub> (ppm) Annual	
0.000-0.064	--	0-15.4	0-54	0.0-4.4	0.000-0.034	(ii)	0-50
0.065-0.084	--	15.5-40.4	55-154	4.5-9.4	0.035-0.144	(ii) *	51-100
0.085-0.104	0.125-0.164	40.5-65.4	155-254	9.5-12.4	0.145-0.224	(ii)	101-150
0.105-0.124	0.165-0.204	65.5-150.4	255-354	12.5-15.4	0.225-0.304	(ii)	151-200
0.125-0.174	0.205-0.404	150.5-250.4	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300
(iii)	0.405-0.504	250.5-350.4	425-504	30.5-40.4	0.605-0.804	1.25-1.64	301-400
(iii)	0.505-0.604	350.5-500.4	505-604	40.5-50.4	0.805-1.004	1.65-2.04	401-500

- i) In some cases, in addition to calculating the 8-hr ozone index, the 1-hr ozone index may be calculated, and the maximum of the two values reported.
- ii) NO<sub>2</sub> has no short term air quality standard and can only generate an AQI value above 200.
- iii) 8-hr Ozone values do not define higher AQI (>= 301), AQI values of 301 or higher are calculated with 1-hr O<sub>3</sub> concentrations.

## Appendix 2

AQI Categories (USEPA)		
AQI Value	Descriptor	Color Code
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Group	Orange
151-200	Unhealthy	Red
201-300	Very Unhealthy	Purple
>300	Hazardous	Maroon

Pollutant Specific Sensitive Groups	
When Pollutant has an Index Value > 100	Sensitive Group
Ozone	Children/People with Asthma
PM <sub>2.5</sub>	People with respiratory/heart disease; specially children and the elderly
PM <sub>10</sub>	People with respiratory disease
CO	People with heart disease
SO <sub>2</sub>	People with asthma

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

4<sup>th</sup> April, 2022

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

TERM: SEMESTER FINAL EXAMINATION  
 COURSE NO.: Chem 4253  
 COURSE TITLE: Chemistry II

SUMMER SEMESTER: 2020-2021  
 TIME: 3.0 Hours  
 FULL MARKS: 150

There are 7 (Seven) questions. Answer 6 (Six) questions. Do not write on this question paper. The figures in the right margin indicate full mark and corresponding CO and PO in the brackets. Symbols convey their usual meanings. Assume reasonable values for any missing data.

- 
1. (a) Write the definition of polymer. Distinguish between high polymer and low polymer. (4)  
 (CO1)  
 (PO1)
- (b) What is latex? Write the approximate composition of latex, How is latex being processed to obtain crude rubber? (8)  
 (CO1)  
 (PO1)
- (c) What do you understand by lubricant and lubrication? Specify the detrimental effects of friction between two solid surfaces. (5)  
 (CO1)  
 (PO1)
- (d) Point out the importance of quality of metal surface in the application of protective coatings. Describe the preparation of metal surface for the application of protective coatings. (8)  
 (CO1)  
 (PO1)
2. (a) Define paint. Write the names of different components of paints. Mention the functions of each components of paint. (9)  
 (CO1)  
 (PO1)
- (b) What are the main sources of liquid lubricants? Write the advantages and disadvantages of using mineral oils as liquid lubricants. Discuss refining of lubricating oils. (10)  
 (CO1)  
 (PO1)
- (c) Distinguish between the following: (6)  
 (i) Thermoplastic and thermosetting polymer (CO1)  
 (ii) Natural polymer and synthetic polymer (PO1)  
 (iii) Organic polymer and inorganic polymer
3. (a) What is vulcanization? Why is it so important for natural rubber? Briefly describe the important properties of rubber those have made it useful and distinguished from other substances. (9)  
 (CO1)  
 (PO1)
- (b) Describe in detail the different steps of polymer processing. (9)  
 (CO1)  
 (PO1)

- (c) What are meant by degree of API, viscosity and viscosity index? Describe them in brief. (7)  
(CO1)  
(PO1)
4. (a) Describe the preparation and application of vitreous porcelain enamel. (8)  
(CO1)  
(PO1)
- (b) With examples describe the functions of different substances used in compounding (7)  
(CO1)  
(PO1)
- (c) Describe the synthesis of the following polymers with chemical reactions: (10)  
(i) Melamine, (ii) Bakelite, (iii) Teflon, (iv) PVE and (v) Epoxy Resin (CO1)  
(PO1)
- 5 (a) What are elastomers? Describe the preparation properties of SBR and silicon rubber (7)  
(CO1)  
(PO1)
- (b) Write notes on (i) oxidative polymerization and (ii) ring opening polymerization. (6)  
(CO1)  
(PO1)
- (c) Classify the glasses. Discuss the mechanism of darkening and transparency properties of photochromic glass. (9)  
(CO1)  
(PO1)
- (d) Explain the role of arsenic trioxide in glass production. (3)  
(CO1)  
(PO1)
- 6 (a) Write down the basic raw materials of ceramics with appropriate formulas. (5)  
(CO1)  
(PO1)
- (b) Describe the phase diagram of  $Al_2O_3-SiO_2$  system. (10)  
(CO1)  
(PO1)
- (c) What are refractories? Describe the classification of refractories. (10)  
(CO1)  
(PO1)
- 7 (a) Define the terms 'conductor', 'semiconductor' and 'insulator' on the basis of band theory. (6)  
(CO1)  
(PO1)
- (b) Discuss the mechanism of n-type and p-type semiconductors. (12)  
(CO1)  
(PO1)
- (c) Explain why quartz does not absorb UV light while glasses do. (7)  
(CO1)  
(PO1)

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**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

TERM: SEMESTER FINAL EXAMINATION  
 COURSE NO.: Chem 4253  
 COURSE TITLE: Chemistry II

SUMMER SEMESTER: 2020-2021  
 TIME: 3.0 Hours  
 FULL MARKS: 150

There are 7 (Seven) questions. Answer 6 (Six) questions. Do not write on this question paper. The figures in the right margin indicate full mark and corresponding CO and PO in the brackets. Symbols convey their usual meanings. Assume reasonable values for any missing data.

- 
1. (a) Write the definition of polymer. Distinguish between high polymer and low polymer. (4)  
 (CO1)  
 (PO1)
- (b) What is latex? Write the approximate composition of latex, How is latex being processed to obtain crude rubber? (8)  
 (CO1)  
 (PO1)
- (c) What do you understand by lubricant and lubrication? Specify the detrimental effects of friction between two solid surfaces. (5)  
 (CO1)  
 (PO1)
- (d) Point out the importance of quality of metal surface in the application of protective coatings. Describe the preparation of metal surface for the application of protective coatings. (8)  
 (CO1)  
 (PO1)
2. (a) Define paint. Write the names of different components of paints. Mention the functions of each components of paint. (9)  
 (CO1)  
 (PO1)
- (b) What are the main sources of liquid lubricants? Write the advantages and disadvantages of using mineral oils as liquid lubricants. Discuss refining of lubricating oils. (10)  
 (CO1)  
 (PO1)
- (c) Distinguish between the following: (6)  
 (i) Thermoplastic and thermosetting polymer (CO1)  
 (ii) Natural polymer and synthetic polymer (PO1)  
 (iii) Organic polymer and inorganic polymer
3. (a) What is vulcanization? Why is it so important for natural rubber? Briefly describe the important properties of rubber those have made it useful and distinguished from other substances. (9)  
 (CO1)  
 (PO1)
- (b) Describe in detail the different steps of polymer processing. (9)  
 (CO1)  
 (PO1)



- (c) What are meant by degree of API, viscosity and viscosity index? Describe them in brief. (7)  
(CO1)  
(PO1)
4. (a) Describe the preparation and application of vitreous porcelain enamel. (8)  
(CO1)  
(PO1)
- (b) With examples describe the functions of different substances used in compounding (7)  
(CO1)  
(PO1)
- (c) Describe the synthesis of the following polymers with chemical reactions: (10)  
(i) Melamine, (ii) Bakelite, (iii) Teflon, (iv) PVE and (v) Epoxy Resin (CO1)  
(PO1)
- 5 (a) What are elastomers? Describe the preparation properties of SBR and silicon rubber (7)  
(CO1)  
(PO1)
- (b) Write notes on (i) oxidative polymerization and (ii) ring opening polymerization. (6)  
(CO1)  
(PO1)
- (c) Classify the glasses. Discuss the mechanism of darkening and transparency properties of photochromic glass. (9)  
(CO1)  
(PO1)
- (d) Explain the role of arsenic trioxide in glass production. (3)  
(CO1)  
(PO1)
- 6 (a) Write down the basic raw materials of ceramics with appropriate formulas. (5)  
(CO1)  
(PO1)
- (b) Describe the phase diagram of  $Al_2O_3-SiO_2$  system. (10)  
(CO1)  
(PO1)
- (c) What are refractories? Describe the classification of refractories. (10)  
(CO1)  
(PO1)
- 7 (a) Define the terms 'conductor', 'semiconductor' and 'insulator' on the basis of band theory. (6)  
(CO1)  
(PO1)
- (b) Discuss the mechanism of n-type and p-type semiconductors. (12)  
(CO1)  
(PO1)
- (c) Explain why quartz does not absorb UV light while glasses do. (7)  
(CO1)  
(PO1)

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

TERM : FINAL SEMESTER EXAMINATION      SUMMER SEMESTER: 2020-2021  
 COURSE NO : Math 4253      TIME : 3 Hours  
 COURSE TITLE: Vector Algebra, Vector Calculus and ODE      FULL MARKS: 150

There are 7 (Seven) questions. Answer 6 (Six) questions, where **Question No. 6 and 7 are compulsory**. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO in the brackets. Symbols convey their usual meanings.

1 (a) Solve the following differential equations

(i)  $x^2 p^2 + x(3y - 4x^2)p + 2y^2 - 4x^2 y = 0$  (8)  
 (CO1)  
 (PO1)

(ii)  $(D^5 - 5D^4 + 3D^3 + 7D^2 + 12D - 18)y = 0$  (8)  
 (CO1)  
 (PO1)

(b) The acceleration of a particle at any time  $t$  is  $e^t i + e^{2t} j + k$ , find  $\bar{v}$  (9)  
 given  $\bar{v} = i + j$  at  $t = 0$ . (CO2)  
 (PO2)

2 (a) Find the solution of the following equations

(i)  $(D^2 - 3D + 2)y = e^x + x^2$  (8)  
 (CO1)  
 (PO1)

(ii)  $(D^2 + 5D + 6)y = e^{-2x}(x + \sin 3x)$  (8)  
 (CO1)  
 (PO1)

(b) Find the equation of the tangent plane and normal to the surface  $xyz = 4$  (9)  
 at the point  $(1, 2, 2)$ . (CO2)  
 (PO2)

3 (a) Solve:  $[(2x + 1)^2 D^2 + 2(2x + 1)D - 16]y = x^2 + x$  (16)  
 (CO1)  
 (PO1)

- (b) An inductor of 4 henrys, a resistor of 32 ohms and a capacitor of .01 farads are connected in series with an e.m.f. of  $E$  volts. At  $t=0$  the charge on the capacitor and current in a circuit are zero. Find the charge at any time  $t > 0$  if  $E = 600$  volts. (9)  
(CO2)  
(PO2)
- 4 (a) Find the value of  $\frac{d^2\bar{r}}{dt^2} - (m+n)\frac{d\bar{r}}{dt} + mn\bar{r}$ , where  $\bar{r} = \bar{a}e^{mt} + \bar{b}e^{nt}$ ,  $\bar{a}$  and  $\bar{b}$  are constant vectors. Hence solve the equation  $\frac{d^2\bar{r}}{dt^2} - \frac{d\bar{r}}{dt} - 2\bar{r} = 0$ , where  $\bar{r} = i$  and  $\frac{d\bar{r}}{dt}$  at  $t = 0$ . (16)  
(CO1)  
(PO2)
- (b) Show that  $\text{grad}f(r) \times \bar{r} = 0$  (9)  
(CO2)  
(PO1)
- 5 (a) Find  $\iint_S \bar{F} \cdot \hat{n} dS$ , where  $\bar{F} = 18zi - 12j + 3yk$  and  $S$  is the part of the plane  $2x + 3y + 6z = 12$  which is located in the first octant. (16)  
(CO1)  
(PO2)
- (b) Give the physical significance of the divergence of a vector point function. (9)  
(CO2)  
(PO1)
- 6 (a) Clarify how  $r^n \bar{r}$  is irrotational, find  $n$  when it is solenoidal. (8)  
(CO3)  
(PO2)
- (b) Define directional derivative of a scalar point function, find the directional derivative of  $f(x, y, z) = x^2y^2z^2$  at the point  $(1, 1, -1)$  in the direction of the tangent to the curve  $x = e^t, y = 2\sin t + 1, z = t - \cos t$  at  $t = 0$  (10)  
(CO3)  
(PO2)
- (c) Evaluate  $\int_C \bar{F} \cdot d\bar{r}$ , where  $\bar{F} = zi + xj + yk$  and  $C$  is the arc of the curve  $\bar{r} = \cos t i + \sin t j + t k$  from  $t = 0$  to  $t = 2\pi$ . (7)  
(CO3)  
(PO2)
- 7 Give the statement of the Stoke's theorem. Verify Stoke's theorem for  $\bar{F} = (x + y)i + (2x - z)j + (y + z)k$  for the surface of a triangular lamina with vertices  $(2, 0, 0)$ ,  $(0, 3, 0)$  and  $(0, 0, 6)$ . (25)  
(CO3)  
(PO2)

B. Sc. Engg. (CEE)/ 4<sup>th</sup> Sem.

15 April, 2022 (Group B).

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

TERM	: FINAL EXAMINATION	SUMMER SEMESTER	: 2020-2021
COURSE NO	: CEE 4411	TIME	: 3 Hours
COURSE TITLE	: Engineering Materials and Concrete Technology	FULL MARKS	: 200

There are EIGHT questions. Answer SIX questions including Question No. 1 and Question No. 2. Question No. 1 and Question No. 2 are 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. CO, PO, and marks of each question are shown in the right side of each question.

- 
- 1 Concrete mix design is required for a building project based on the following data: CO3  
PO3  
(80)
- Volume ratio of sand to total aggregate = 0.44  
 FM of fine aggregate = 2.60  
 FM of coarse aggregate = 6.6  
 Type of aggregate = stone chips  
 Location of the Project : Gazipur  
 Specific gravity of cement = 2.9 (CEM Type II-B/M)  
 Specific gravity of sand (SSD) = 2.60  
 Specific gravity of coarse aggregate (SSD) = 2.70  
 Design compressive strength (28 days) = 4500 psi  
 Minimum required slump = 175 mm  
 Maximum aggregate size = ¾ inch, Aggregate type = Stone chips  
 Dosage of superplasticizer = 10 ml/kg of cement if W/C is less than 0.45.  
 Air content in concrete = 2%  
 (assume reasonable data, if necessary)

The following graphs are provided :

- Variation of compressive strength (28 days) with W/C (Fig. 1),
  - Variation of cement content with compressive strength (28 days) for different aggregate size and slump value (Fig. 2).
- (i) Prepare a mix design for the specified strength.
  - (ii) Prepare a mixture proportion table. Typical form of mixture proportion table is attached (Table 1).
  - (iii) Calculate the unit weight of concrete.
  - (iv) Calculate the volume ratio of the mix. Assume unit weights of cement, sand (SSD), and coarse aggregate (SSD) with void are 1410 kg/m<sup>3</sup>, 1450 kg/m<sup>3</sup> and 1600 kg/m<sup>3</sup>, respectively.
  - (v) Calculate the cost of concrete for one cubic meter. Assume the cost of 1 bag cement is Tk. 440, cost of 1 cft sand is Tk. 40, and cost of 1 cft stone chips is Tk. 200.

- (vi) List the other costs those are to be considered to decide selling price of concrete per cubic meter.
- (vii) Assume 2% surplus water in sand over SSD condition and the amount of bulking of sand is 10%. What adjustments are necessary in the mix design?
- (viii) Calculate the compaction factor of the mix.
- (ix) Explain the advantages and disadvantages of volumetric and weight based mix designs.
- (x) What changes in the mix design are necessary, if it is decided to increase strength of concrete to 5500 psi?
- (xi) If FM of fine aggregate is changed to 2.3 (instead of 2.6 as specified), what changes will occur in fresh and hardened properties of concrete?
- (xii) If CEM Type II A/M cement is used instead of CEM Type II B/M, what changes will occur in fresh and hardened properties of concrete?
- (xiii) If specific gravity of coarse aggregate at site is 2.40 instead of 2.70; what changes in mix design will be needed (write in words only, calculations are not necessary)?
- (xiv) If a mix design for high strength concrete is required, what changes will be required in the mix design of concrete?
- (xv) Write the steps of for mix design of concrete as per ACI 211.
- (xvi) If the slump is found at 70 mm during a trial mix of the proposed mix, what changes are required in the mix design to get the minimum required slump?

- 2 From a nearby market, sand and stone chip samples were collected and sent to the Concrete Laboratory of Islamic University of Technology (IUT) for sieve analysis. The sieve analysis data are given below:

CO2  
PO2  
(20)

ASTM Sieve	Amount Retained (g)	
	Sand	Stone Chips
3 inch	0	0
1.5 inch	0	0
1.06 inch	0	0
¾ inch	0	810
½ inch	0	1500
3/8 inch	0	1900
#4	0	700
#8	90	0
#12	120	0
#16	5	0
#30	5	0
#40	5	0
#50	80	0
#100	50	0
#200	45	40
Pan	100	50

- (i) Calculate the FM of the samples,
- (ii) Draw the grading curve of the samples,
- (iii) Comment on the samples based on the sieve analysis data and grading curves.
- (iv) How do you separate fine aggregate from coarse aggregate?

- (v) If all material of a sample is retained on #4 sieve, what will be the FM of the sample?

**Questions 3 to 8 are mapped with CO1 and PO1.**

- 3 (a)** Draw typical stress-strain curves concrete. Explain the salient features of this curve. How do you determine the modulus of elasticity from the stress-strain curve of concrete? (8)
- (b)** Compare modulus of resilience and modulus of toughness. (4)
- (c)** Define the following mechanical properties of a material: (4)
- (i) Ductility,
  - (ii) Fatigue Strength, and
  - (iii) Creep.
- (d)** How does brick get strength during burning? (4)
- (e)** "We need to use alternative materials to brick" – Justify. (5)
- 4 (a)** Compare false setting and flash setting of cement. (5)
- (b)** Write hydration reactions of cement. Explain morphology of hydration products of cement. (9)
- (c)** Compare CEM I, CEM II A/M and CEM II B/S cement. (6)
- (d)** Define fineness of cement. Explain the effect of fineness of cement on the following: (5)
- (i) Heat of hydration,
  - (ii) Early strength,
  - (iii) Long-term strength,
  - (iv) Workability of fresh concrete, and
  - (v) Microstructure of hardened concrete.
- 5 (a)** Explain seawater attack (chloride, sulfate and carbon-dioxide) of reinforced concrete structures with chemical reactions. (10)
- (b)** Assume that you are in-charge of a hotel construction project at Cox's Bazar. Discuss the main factors that are to be seriously considered to ensure the durability of the project. (5)
- (c)** Define workability of concrete. How is it measured? Explain five major factors related to the workability of concrete. (5)
- (d)** What do you mean by cold joint of concrete? Is it harmful for concrete? Explain. (5)
- 6 (a)** Discuss the following factors associated with the compressive strength of concrete: (5)
- (i) W/C,
  - (ii) Air content,
  - (iii) Size of coarse aggregate,
  - (iv) Compaction,
  - (v) Curing
- (b)** "Cube strength of concrete is higher than the cylinder strength of concrete" – why? (5)
- (c)** Write short notes on the followings: (10)
- (i) High range water reducing chemical admixtures,
  - (ii) High strength concrete,
  - (iii) Pervious concrete,
  - (iv) Roller compacted concrete, and
  - (v) Mineral Admixtures.

- (d) Write the importance of air entraining admixtures in concrete. (5)
- 7 (a) Define carbonation of concrete. Explain the effect of carbonation of concrete on corrosion of steel in concrete. (6)
- (b) How is a corrosion cell formed over the steel bar inside concrete? Explain with anodic and cathodic reactions. (6)
- (c) Discuss the methods related to cathodic protection of steel in concrete. (5)
- (d) "Cement is a hydraulic material but silica fume is a pozzonanic material" – Why? (4)
- (e) Explain alkali-silica reaction of concrete. (4)
- 8 (a) Sketch a cross-section of a timber and level its different parts accordingly. (5)
- (b) Explain the importance of seasoning of timber. (5)
- (c) Explain the uses of rubber and plastics in the field of Civil Engineering. (5)
- (d) Write the ingredients of varnish. Write the characteristics of good quality varnish. (5)
- (e) Calculate atomic radius and atomic packing factor for face centered plain cubic unit cell. (5)

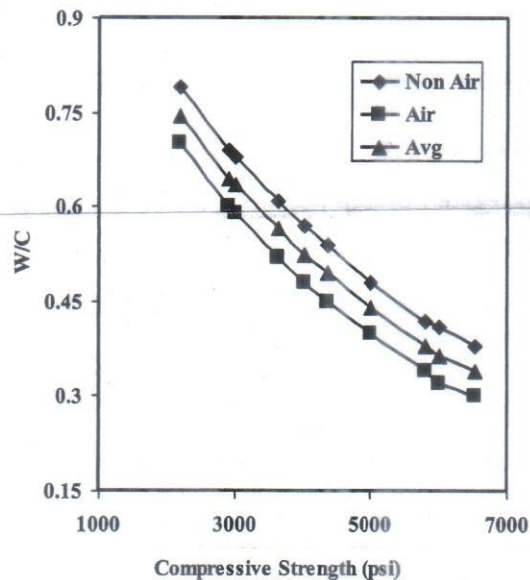


Fig. 1 W/C versus Compressive Strength (aggregate type = stone chips)

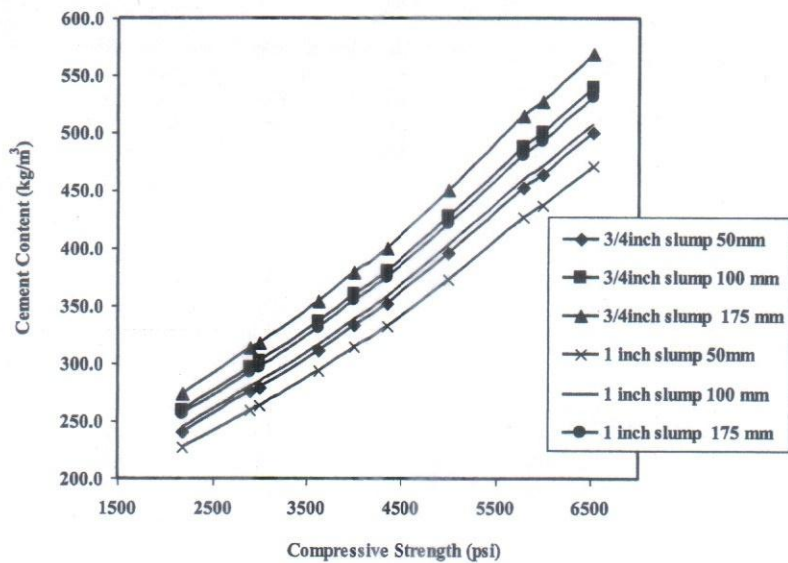


Fig. 2 Cement Content versus Compressive Strength (aggregate type = stone chips)

Table 1. Mixture Proportion of Concrete

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



## Traditional American and British Sieve Sizes

Aperture mm or $\mu\text{m}$	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	¾ in.	¾ 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 $\mu\text{m}$	0.0331	No. 18	No. 20
710 $\mu\text{m}$	0.0278	No. 22	No. 25
600 $\mu\text{m}$	0.0234	No. 25	No. 30
500 $\mu\text{m}$	0.0197	No. 30	No. 35
425 $\mu\text{m}$	0.0165	No. 36	No. 40
355 $\mu\text{m}$	0.0139	No. 44	No. 45
300 $\mu\text{m}$	0.0117	No. 52	No. 50
250 $\mu\text{m}$	0.0098	No. 60	No. 60
212 $\mu\text{m}$	0.0083	No. 72	No. 70
180 $\mu\text{m}$	0.0070	No. 85	No. 80
150 $\mu\text{m}$	0.0059	No. 100	No. 100
125 $\mu\text{m}$	0.0049	No. 120	No. 120
106 $\mu\text{m}$	0.0041	No. 150	No. 140
90 $\mu\text{m}$	0.0035	No. 170	No. 170
75 $\mu\text{m}$	0.0029	No. 200	No. 200
63 $\mu\text{m}$	0.0025	No. 240	No. 230
53 $\mu\text{m}$	0.0021	No. 300	No. 270
45 $\mu\text{m}$	0.0017	No. 350	No. 325
38 $\mu\text{m}$	0.0015	—	No. 400
32 $\mu\text{m}$	0.0012	—	No. 450

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**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**Semester Final Examination**

**Course No.: CEE 4413**

**Course Title: Mechanics of Solids II**

**Summer Semester: 2020-2021**

**Full Marks: 150**

**Time: 3 hours**

There are 7 (Seven) Questions. **Question 1 is compulsory. Answer any 5 (Five) from Questions 2-7.** All questions carry equal marks. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume reasonable values for any missing information.

- 1(a) Prove that the minimum cable tension is at the lowest point of catenary. (5)  
 CO1  
 PO1
- (b) Considering common failure types of bolted joints, which types of failure can become more likely for a net decrease of bolt area (a) by reducing n-number of bolts of same diameter or (b) by reducing a single larger diameter bolt. Net remaining area is same for (a) and (b). Show your reasoning. (5)  
 CO1  
 PO1
- (c) What is the Mohr-Coulomb failure theory? Discuss briefly. (5)  
 CO1  
 PO1
- (d) Find deflection of point at 1/3 length from the left support of a 15ft-span simply supported beam. The beam has uniformly distributed load of 1 kip/feet. EI constant. Use any method. (10)  
 CO2  
 PO2
- 2(a) Determine the tension in the cable at supports and at the lowest point if the cable is spanned over two pier supports at 80m distance. The cable (Figure 1) is subjected to uniformly distributed load of 15 kN/m over the span. The left support is below the right support by 5 m and the lowest point on the cable is located below left support by 1.5 m. Also compute the vertical and horizontal forces acting on right and left piers due to cable tension. (15)  
 CO3  
 PO2

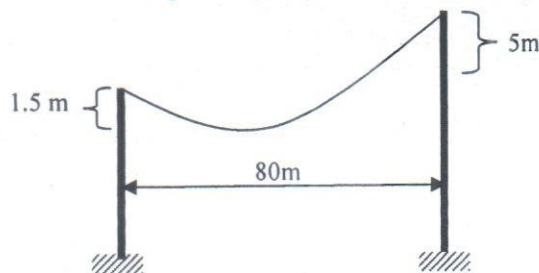


Figure 1

- (b) A concentrated moment of 550 kip-ft is acting at midspan of a 20ft simply supported beam. (10)  
 $E=29000$  ksi and  $I=250$  in<sup>4</sup>. Determine the strain energy of the beam due to bending. CO2  
 PO2

- 3(a) A steel compression strut is a 2.3m long tube with an outer diameter of  $d = 48$  mm and a wall thickness of  $t = 5$  mm, pin connected at both ends. Determine the factor of safety against elastic buckling if it carries 30 kN compressive force. What will be the factor of safety if one end is welded to make it fixed while other is pin connected?  $E = 210$  GPa and Yield stress = 340 MPa. (15)  
CO3  
PO2
- (b) A beam of 25ft is supported by two fixed supports at ends. Find deflection at the midspan if there is a downward 40kip load acting at midspan. Use any method.  $EI = 5000$  k-ft<sup>2</sup>. (10)  
CO2  
PO2
- 4(a) A cable (Figure 2) has the following coordinates: Support (A): (0,0), point B: (12,-15), point C: (24,-21), point D: (36, -18) and Support (E): (48, -9) (unit is in Feet). Downward load  $P_B = 40$  kip;  $P_C = 25$  kip,  $P_D = 10$  kip. Find the forces in the cable segments AB, BC, CD, DE. If the maximum allowable stress in cable 40 ksi, compute the required cross section area of the cable. (15)  
CO3  
PO2

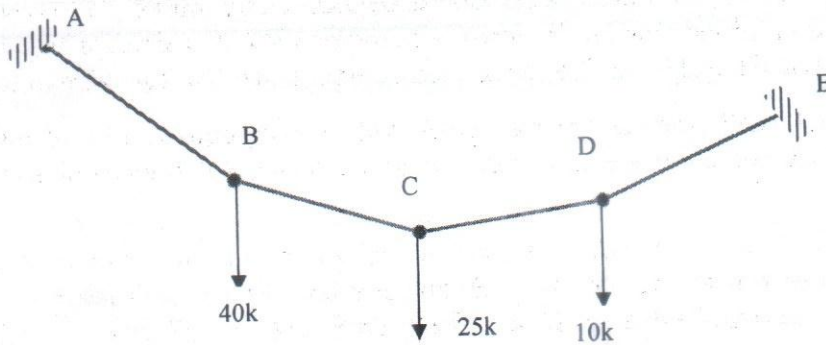


Figure 2

- (b) A 12m-span simply supported beam has 3 kN/m uniformly distributed load acting at 30° inclination with the vertical axis. The beam has a round cross section. If the vertical deformation is 8mm, what is the horizontal deformation? Assume missing info, if any. (10)  
CO2  
PO2
- 5(a) A single riveted lap joint with two cover plates is used to connect plates 12 mm thick and 80mm wide. If 12 mm diameter rivets are used at 25 mm pitch (3 on each side of the joint), determine the strength of joint. Cover plate dimensions are 15mm in thickness and 80mm in width. Working stress in shear in rivets = 80 N/mm<sup>2</sup> (MPa). Working stress in bearing in rivets = 250 N/mm<sup>2</sup> (MPa). Working stress in axial tension in plates and cover plates = 156 N/mm<sup>2</sup>. Check for all possible failure types. (15)  
CO3  
PO2

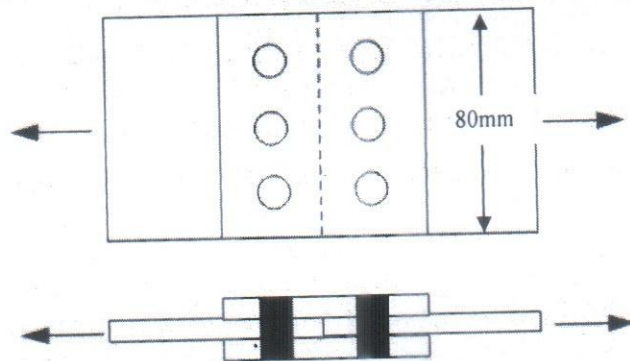


Figure 3

- (b) Develop the strain energy density formulation. A cylindrical rod made of elastoplastic material of 3m length and 20mm dia is extended to 3.05m by tension. However, after release of tensile force, the rod length was found to be 3.01m long. What percentage of strain energy was absorbed by the material? (10)  
CO2  
PO2
- 6(a) Design a suitable longitudinal fillet weld to connect the plates as shown in Figure 4 and to transmit pull equal to the full strength of the both plates. Allow weld on plate sides only. Allowable stress in the weld is 125 N/mm<sup>2</sup> and allowable tensile stress in the plate 220 MPa. 150mm wide plate is 10mm thick and 120mm wide plate is 12mm thick. (15)  
CO3  
PO2

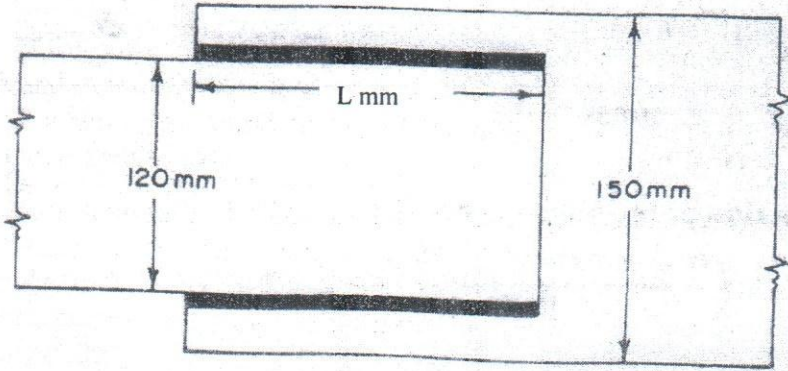


Figure 4

- (b) A cantilever beam of 12-ft span with uniformly distributed load has a deflection of 1" at the free end. What is the magnitude of load? EI=5000 k-ft<sup>2</sup>. Use any method. (10)  
CO2  
PO2
- 7(a) A Thin-walled pipe of 300mm diameter carries gas at 5 MPa pressure (Figure 5). The pipe is formed with bent sheet metal of 4 mm thickness whose ends are joined by a single cover plate of same thickness and rivets. Determine the net area of rivet(s) required per meter length of pipe on each side of joint considering bolt shear only. Consider Working stress in shear in rivets=80 N/mm<sup>2</sup> (MPa). Working stress in bearing in rivets=250 N/mm<sup>2</sup> (MPa). Ignore effect of bent plate near the joint for rivet design consideration. Assume any missing information. (15)  
CO3  
PO2

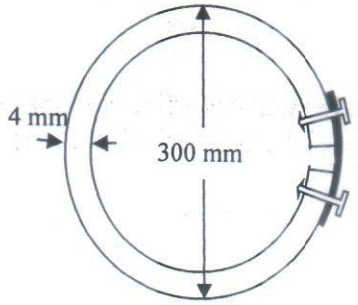


Figure 5

- (b) Develop the deflection equations at midspan for a parabolically distributed load  $w = 8 \frac{Lx - X^2}{L^2}$  for a simply supported beam of L length. EI constant. (10)  
CO2  
PO2

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

Semester Final Examination

Course No.: CEE 4431

Course Title: Water Supply Engineering

Summer Semester: 2020-2021

Full Marks: 150

Time: 3.0 hours

There are 8 (Eight) questions. **Questions 7 and 8 are compulsory.** Answer **One Question from Q1 or Q2** and any **3 questions from Q3, 4, 5 and 6.** The related CO-PO and marks are shown in the right. Programmable calculators are not allowed. Do not write on this question paper. The symbols have their usual meaning.

- 1(a) Distinguish among dissolved substances, suspended solids and colloidal substance based on their size and mechanism by which they can be removed from water. CO1, PO1: (03)
- (b) Why population projection is necessary in the design of public water supply scheme? For designing a WTP a Gazipur city, which population projection methods do you recommend and why? What are the data needed for population forecasting and how to get the data? CO1, PO1: (06)
- (c) What are the factors affecting Coagulation and Flocculation processes? How pH of water affects the coagulation process? CO1, PO1: (06)  
 Using the appropriate chemical reaction, calculate how much alum will be consumed by the addition of 1.0 mg/L of FeCl<sub>2</sub> coagulation process.
- 2(a) What are the basic differences of shallow, intermediate and deep tubewell? Treated water from the PSF may contain pathogenic microorganisms. What are the disinfection strategies that can be adopted for the disinfection of water from PSF? CO1, PO1: (04)
- (b) What physical, chemical and bacteriological tests are normally run on finished water on a routine basis? Why coliform organisms are used as microbial indicators of microbial water quality and what are the requirements of a good coliform indicator? CO1, PO1: (05)
- (c) The coastal people in Bangladesh normally depend on pond water for water supply. The result of the water quality analysis of such a pond water is given below: CO1, PO1: (06)

Parameter	Values
pH	6.25
Nitrate	10.0 mg/L
Fe	1.5 mg/L
Turbidity	40 NTU
<i>E.coli</i>	200/100 mL
Oil and grease	2.5 mg/L

Comment the suitability of the water to be used as water supply source. Suggest also the methods to improve the water quality.

- 3(a) The performance of plain sedimentation basin is low. What types of arrangements can you adopt to improve the performance of a plain sedimentation basin? Explain with neat sketches. CO2, PO2: (06)  
 Why the performance of a radial circular basin is higher than a horizontal flow rectangular basin? Explain with diagram.

- (b) Water of the river Sitalakhya is used for water supply in Dhaka city through Saidabad WTP. There are several medium to large industries located in the catchment of the river. List the possible major impurities present in the river water. Draw a schematic diagram to show the treatment of the river water and the list of chemicals to be needed in WTP. CO2, PO2: (06)
- (c) The design flow for a water treatment plant (WTP) is  $4.0 \times 10^3 \text{ m}^3/\text{d}$ . The rapid mixing tank will have a mechanical mixer and the average alum dosage will be 25 mg/L. The theoretical mean hydraulic detention time of the tank will be 2.0 minutes. Determine the following: CO2, PO2: (09)
- the quantity of alum needed on a daily basis in kg/day
  - the dimensions of the tank in meters with equal length, width and depth
  - the power input required for a  $G$  of  $1000 \text{ sec}^{-1}$  for a water temperature of  $10^\circ\text{C}$  in kW, if  $\mu = 1.307 \times 10^{-3} \text{ kg/m-sec}$ .
- (d) A small community has used an un-chlorinated ground water supply containing approximately 0.3 mg/L of iron and 0.1 mg/L manganese for several years without any apparent problems. A health official suggested that the town install chlorination equipment to disinfect the water and provide a chlorine residual in the distribution system. After initiating chlorination, consumers complained about water staining washed clothes and bathroom fixtures. Explain, what is occurring due to this chlorination? CO2, PO2: (04)
- 4(a) An engineer has proposed to add coagulants to improve the Type I solids removal in the sedimentation process and thereby increase the overall solids removal. Is this a good idea? Will this increase the removal of Type I solids in sedimentation process? CO2, PO2: (04)
- (b) A water has the following ionic constituents in mequiv/L: CO2, PO2: (09)
- $\text{Ca}^{+2} = 4.7$      $\text{HCO}_3^- = 2.5$   
 $\text{Mg}_{+2} = 1.0$      $\text{SO}_4^{-2} = 2.9$   
 $\text{Na}^+ = 2.2$      $\text{Cl}^- = 2.5$   
 $\text{CO}_2 = 0.6$
- Calculate the chemical requirements required to remove as much as Ca as possible and to re-stabilize the water (Mg hardness removal is not required)
  - Calculate the daily quantity of lime and soda ash to treat  $15,000 \text{ m}^3/\text{day}$  of this water and also the amount of sludge produced per day.
- (c) Based on a hydraulic analysis, it was found that the travel time for water to be carried to the most distant customer is 26 hours in Gazipur city area. A laboratory study of the decay of chlorine in the filtered water yielded the results shown below. What **dose of chlorine** is required to maintain a residual of 0.5 mg/L of chlorine at the most distant customer's tap? The decay of chlorine in water can be expressed as CO2, PO2: (06)

$$C_t = C_0 e^{-kt}$$

Time (hr)	Chlorine residual, mg/L
0	1.1
1	1.02
3	0.90
6	0.76

- (d) (i) Why aeration is more commonly used in groundwater than surface water? CO2, PO2: (06)
- (ii) In coagulation and flocculation process, a through and rapid mixing is done in rapid mixing chamber and slow and gentle mixing is done in Flocculator-Why?
- (iii) Aeration of groundwater prior to chemical softening can save a significant amount of chemical required for softening-explain how?

- 5(a) Show the flow diagram of iron removal under the following conditions: CO2, PO2: (08)
  - (i) Iron alone in ground water, which contains no organic matter with reasonable alkalinity
  - (ii) Water contains iron with low alkalinity
  - (iii) Water contains both iron and organic matter with low alkalinity.

You are assigned to design a WTP for the removal of both Fe and Mn. What are the essential environmental factors that control this process?

- (b) Determine the storage required to supply the demand shown in the following table if the inflow of water to the reservoir is maintained at a uniform rate throughout 24 hours. (Use mass curve method and analytical method.) CO2, PO2: (07)

Time (hrs)	00-04	04-08	08-12	12-16	16-20	20-24
Demand (million Liters)	0.48	0.87	1.33	1.00	0.82	0.54

- (c) State the characteristics of UV disinfection of water. Do you think that UV disinfection is suitable for water industry in Bangladesh? What are the limitations of this process? CO2, PO2: (05)

- (d) Calculate the volume of chlorine contact basin and the quantity of chlorine needed in kg/day. The average design flow is 0.2 m<sup>3</sup>/sec, the contact time is 18 minutes, total chlorine demand is 6.0 mg/L and the chlorine residual maintained is 1.5 mg/L. CO2, PO2: (05)

- 6 (a) State the guidelines for the design of slow sand and rapid sand filtration units. Mentions the operation and maintenance problems of rapid sand filter. Why slow sand filter is not used in water treatment plants in Bangladesh? CO2, PO2: (06)

- (b) What are the desirable properties of pressure pipe? CO2, PO2: (06)  
A water transmission line is placed in the middle of Mirpur road. What are external loads that should be considered in designing a pipe section for this transmission line? State the recommended procedure for testing of a newly constructed pipeline.

- (c) A water contains organic matter and also color producing substances. The water is disinfected by chlorination. What are the health risks associated with chlorination of this water? CO2, PO2: (06)

What is the allowable limit of THMs in drinking water? What are the strategies that can be followed in controlling THMs formation in the treated water?

- (d) A filter plant is to be constructed to process 75,000 m<sup>3</sup>/day. Pilot plant analysis on mixed media indicates that a filtration rate of 15 m/h will be acceptable. Assuming a surface configuration of approximately 4.5m x 8m, how many filter units will be required? Allow one unit out of service for backwashing. CO2, PO2: (07)  
The backwash velocity required to expand the above filters is 35 m/hr. Each backwash period requires 20 minutes and the water is wasted for the first 10 min of each filter run. Determine the net production of each filter, if it is backwashed once in a day.

- 7(a) Design of an ion exchange system (volume of the resin and tank configuration) used to treat the raw water described in **Q. 4(b)** to allow continuous operation if the regeneration time is 2 hours. CO3, PO3: (14)

The resin has an exchange capacity of  $95 \text{ kg/m}^3$  when operated at a flow rate of  $0.35 \text{ m}^3/\text{m}^2 \cdot \text{min}$ . Calculate also chemical requirement for regenerating of ion-exchange system, if regeneration is accomplished using 140 kg of sodium chloride (NaCl) per cubic meter of resin in 10% solution.

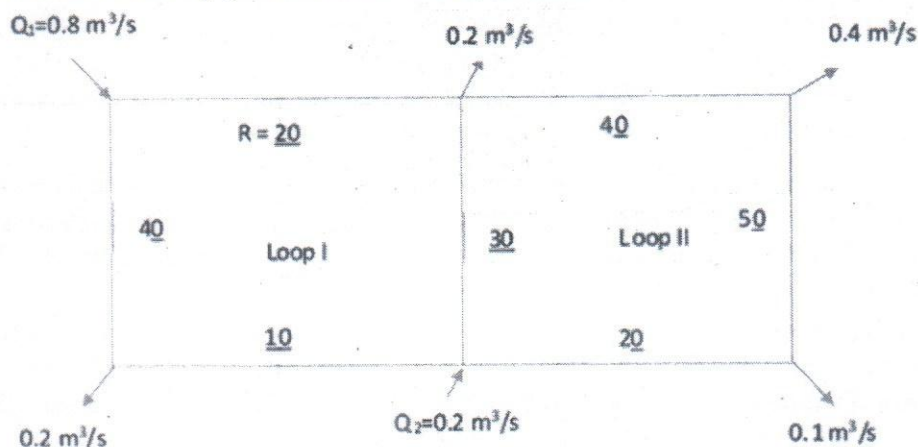
- (b) Results of sieve analysis of an aquifer material is given below: CO3, PO3: (15)

Sieve No.	Sieve Size (mm)	% material retained
4	4.75	0
8	2.36	0
16	1.18	0
30	0.60	0.5
40	0.425	1.0
50	0.30	4.4
100	0.15	64.8
200	0.075	27.1
Pan	-	2.2

Design the gravel pack and the slot size of the strainer to be used for the tubewell. The diameter of the well strainer is 100 mm and the opening of the strainer is 15% of the total surface area of the strainer, calculate the yield of this tubewell per meter length, assume entrance velocity = 0.03 m/sec.

- (c) Design a rapid gravity sand filter and a slow sand filter for a community of 12,000 people. The per capital water consumption is 125 lpcd. Assume a filtration rate of 0.15 m/hr for slow sand filter and 8.0 m/h for rapid sand filter. Assume other data, as per design recommendations. CO3, PO3: (06)

- 8(a) For the network as shown below, the head loss is given by  $h = RQ^{1.85}$ . The water supply and demand at each nodal points are also shown. Using the Hardy Gross method, design the network (diameter of each pipe). Assume a reasonable velocity of water in each pipe. Use at least 02 iterations. CO3, PO3: (18)



- (b) Design the minimum capacity of the storage tank required for a family of 10 persons to be supplied with 12 lpcd of rainwater. The yearly rainfall intensity is 2650 mm and the rainfall distribution is such that at least 35% of the rainwater must be stored for uninterrupted water supply throughout the year. Also calculate the minimum catchment area required, if the runoff coefficient is 0.85. CO3, PO3: (07)



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**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

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

Summer Semester: 2020-2021  
 Full Marks: 200  
 Time: 3.0 Hours

There are 7 (Seven) questions. Questions 1, 6 and 7 are compulsory. Answer three questions from questions 2 to 5. Programmable calculators are not allowed. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

- 1(a). Briefly describe Atterberg limits. Demonstrate the process of obtaining the shrinkage limit from laboratory test. (8)  
(CO1), (PO1)
- 1(b). Illustrate soil fabric and structure with details. (9)  
(CO1), (PO1)
- 1(c). Write down the terms related to the properties of soils. (5)  
(CO1), (PO1)
- 1(d). The moist density of soil is  $1750 \text{ kg/m}^3$ . Given,  $w = 16\%$  and  $G_s = 2.72$ . Determine: (10)  
(i) Dry density  
(ii) Void ratio  
(iii) Degree of saturation  
(CO1), (PO1)
- 2(a). For anisotropic soils, derive the expressions of the coefficient of permeability for the horizontal ( $k_H$ ) and vertical ( $k_V$ ) directions for two layers of ground. Use the parameters  $k_1, d_1$  of the top layer, and  $k_2, d_2$  of the bottom layer. (10)  
(CO2), (PO2)
- 2(b). Derive the equations of primary consolidation settlement from  $e - \log \sigma'$  curve for three different soil conditions. (10)  
(CO2), (PO2)
- 2(c). Derive the equation of Terzaghi's one-dimensional consolidation. Also, write down the assumptions behind the equation. (13)  
(CO2), (PO2)
- 3(a). Answer the following questions considering one-dimensional flow through soils shown in Fig. 1. Here,  $A_1 = 24 \text{ m}^2$ ,  $k_1 = 3 \times 10^{-4} \text{ m/s}$ ,  $A_2 = 24 \text{ m}^2$ ,  $k_2 = 5 \times 10^{-5} \text{ m/s}$ ,  $A_3 = 12 \text{ m}^2$ ,  $k_3 = 1 \times 10^{-4} \text{ m/s}$ . (15)  
(i) Compute flow velocities,  
(ii) Compute the amount of flow in 1 hour.  
(iii) Draw the graphs of the total head and pressure head with the distance.  
(CO2), (PO2)

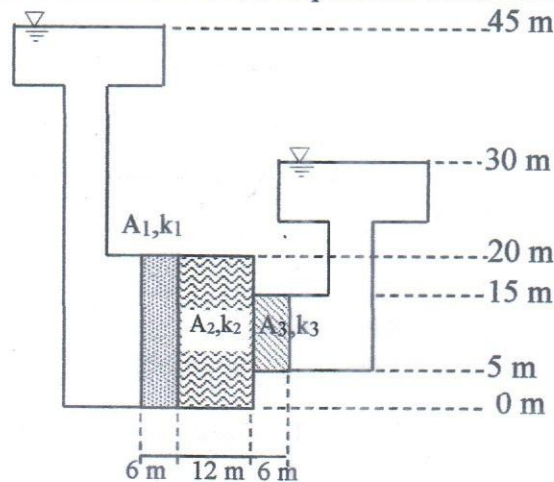


Fig.1

- 3(b). Fig.2 shows flow-nets inside an earth dam. Answer the following questions - (18)  
 (i) Calculate seepage for one year. The coefficient of permeability,  $k = 5 \times 10^{-3}$  cm/s. (CO2), (PO2)  
 (ii) Draw the pore water pressure distribution at the bottom of the earth dam.  
 (iii) If clay soil is filled in the middle of the embankment, what will be the effect on the quantity of flow and pore water pressure?

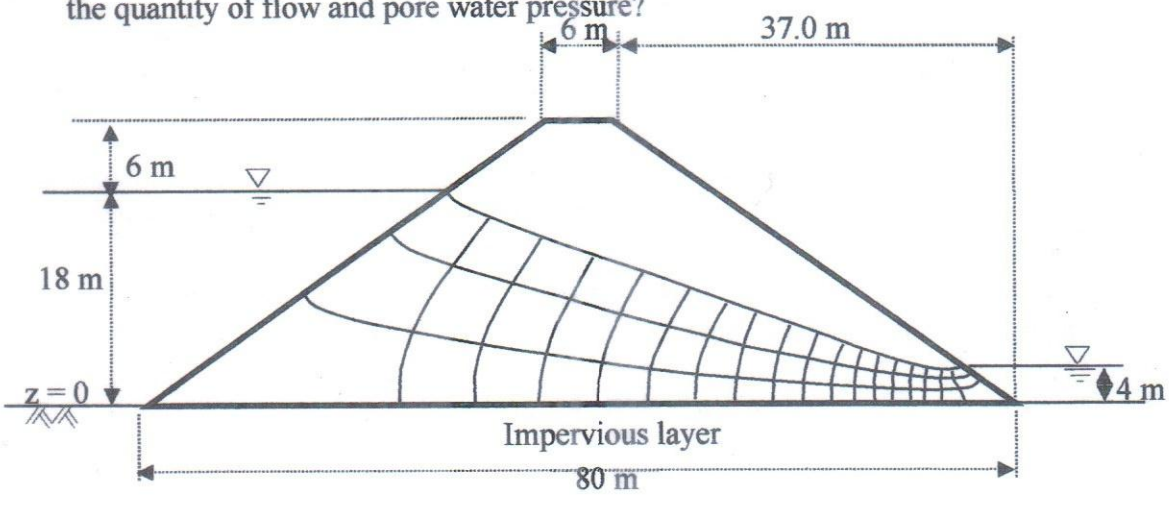


Fig.2

4. Answer the following questions related to Fig.3. (33 1/3)  
 (i) Draw flow-nets of the ground. Estimate the seepage per day under the concrete dam having a width of 11 m. Here, the coefficient of permeability of the soil,  $k = 2.0 \times 10^{-5}$  m/s. (CO2), (PO2)  
 (ii) Compute total head, pressure head and elevation head at points A, B, C, D, E and F. Here, E is located at the center of points A & B, and F is situated in the center of points C & D.  
 (iii) If the saturated unit weight of soil,  $\gamma_{sat} = 1.65$  t/m<sup>3</sup>, check the condition of piping (Fig.2)

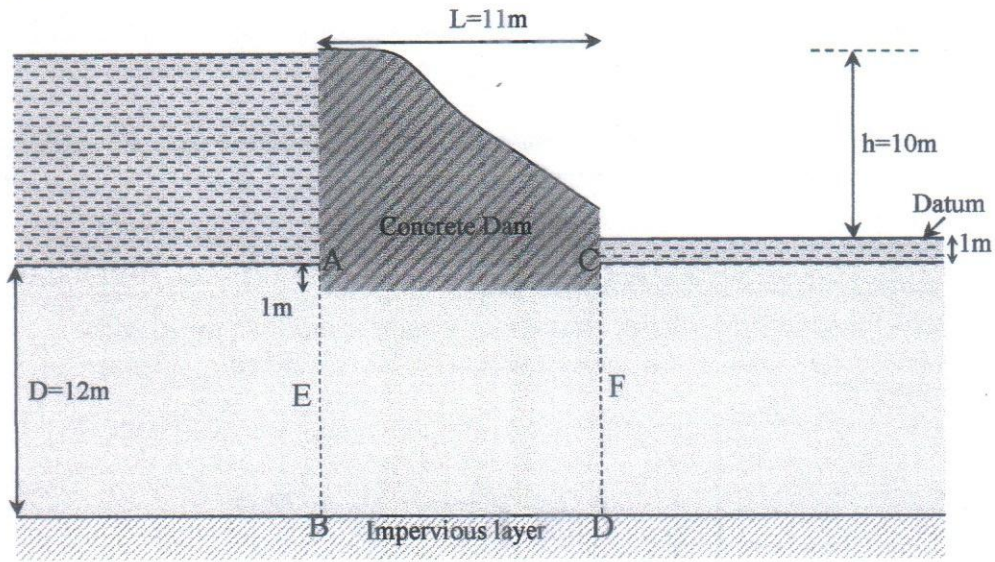


Fig.3

5. Answer the following questions for a clay layer shown in Fig.4,  $\gamma_{sat} = 19.81$  kN/m<sup>3</sup>,  $\gamma_w = 9.81$  kN/m<sup>3</sup>,  $C_c = 0.30$ ,  $C_s = 0.05$ ,  $e = 1.1$  at an effective stress of 30 kPa,  $C_v = 4.0$  m<sup>2</sup>/year, and  $c_\alpha = 0.005$ . (33 1/3)  
 (i) Compute the 90% of the primary consolidation settlement of the clay layer, considering the soil as Normally Consolidated. (CO2), (PO2)

- (ii) Compute the time required to reach the 90% consolidation where the time factor,  $T_v=0.848$ .
- (iii) Calculate also total settlement after 50 years after applying the surcharge. Use,  $T_v=1.781$  for 100% primary consolidation.

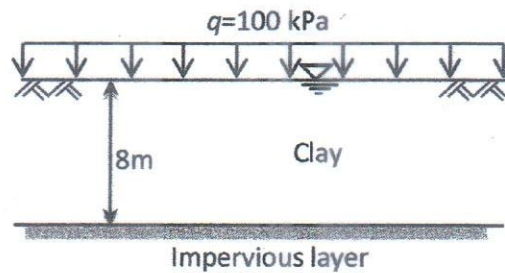


Fig.4

- 6(a). A proposed earth fill needs to be compacted to 90% of standard proctor density. Tests on a borrowed material indicate  $\gamma_{d(\max)}=18.0 \text{ kN/m}^3$ ,  $w_{\text{opt}}=12\%$ . The void ratio of the borrowed material is 0.6,  $G_s=2.65$ . Use,  $\gamma_w=9.80 \text{ kN/m}^3$ . Compute the required volume of borrowed material to make  $1000.0 \text{ m}^3$  of acceptable compacted fill. (15)  
(CO3), (PO3)
- 6(b). Compaction tests are carried out for two borrow pits. An earth dam having a volume of  $20,000 \text{ m}^3$  will be constructed with  $\gamma_d=1.60 \text{ t/m}^3$ . Soil characteristics of probable pit A,  $G_s=2.7$ ,  $e=0.75$ ,  $w=20\%$ ,  $w_{\text{opt}}=6\%$ ; and at pit B,  $G_s=2.65$ ,  $e=0.86$ ,  $w=8\%$ ,  $w_{\text{opt}}=14\%$ . At both sites  $\gamma_{d(\max)}=1.60 \text{ t/m}^3$ . Answer the following questions- (19)  
(CO3), (PO3)
- Determine  $S_r$  and  $\gamma_d$  at pits A and B.
  - For constructing the dam, briefly explain which pit is suitable?
  - What will be the soil volume required in  $\text{m}^3$ ?
  - What water content should be kept for getting the maximum density in the dam? How much water should be added?
7. Answer the following questions regarding earth pressure on the wall in sandy soil ( $c=0$ ) when the wall moves towards the left due to the failure of the ground (Fig.5). (34)  
(CO3), (PO3)
- Compute Rankine active and passive earth pressure coefficients.
  - If active and passive earth pressures are equal ( $P_a=P_p$ ), find  $z_p$ , consider water table is far below the tip of the wall.
  - Compute active earth pressure and pore water pressure when the water table rises due to the rainfall to the position 5.0 m below the surface of the right side. Use,  $\gamma_w=9.81 \text{ kN/m}^3$ . Also, compute the distance of resultant force from the bottom of the wall.

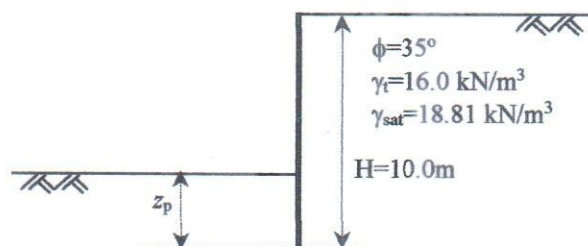


Fig.5

B.Sc. Eng. (CEE)/ 4<sup>th</sup>Sem.

Date: April 7, 2022

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**

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**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

TERM : SEMESTER FINAL EXAMINATION:

SUMMER SEMESTER: 2020-2021

COURSE NO: Math-4453

TIME: 3 Hours

COURSE TITLE: Probability and Statistics

FULL MARKS: 150

There are 7 (Seven) questions. Answer 6 (Six) of them (any one from 1 and 2). Programmable calculators are not allowed. Do not write anything on this question paper. Marks of each question and corresponding CO and PO are written in the right margin. The Symbols have their usual meaning.

1. a) Calculate Median and the lower and upper quartiles from the following distribution of marks obtained by 49 students in a class. Compute also the semi-interquartile range and the mode. Marks (12) CO 1 PO 1

Marks	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45
No. of students	5	6	15	10	5	4	2	2

- b) In a survey, data on daily wages paid to workers of two factories A and B are as follows: (13) 1 1

Daily Wages	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Factory A	15	30	44	60	30	14	7
Factory B	25	40	60	35	20	15	5

Find out:

- (i) Which factory pays higher average wages?  
(ii) Which factory has greater variability about paying wages?

**Alternative**

2. a) A factory produces two types of electric lamps A and B. In an experiment relating to their life, the following results were obtained: (12) 1 1

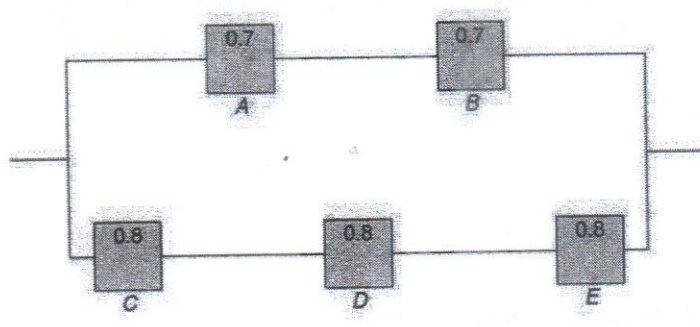
Daily Wages	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Factory A	15	30	44	60	30	14	7
Factory B	25	40	60	35	20	15	5

Compare the variability of the life of the two varieties using Coefficient of Variation.

- b) What is Skewness and Kurtosis? Calculate the Skewness and Kurtosis from the following data and interpret them. (13) 1 1

Weight	30-40	40-50	50-60	60-70	70-80	80-90
Frequency	18	37	45	27	15	8

3. a) The time to recharge the flash is tested in three cell-phone cameras. The probability that a camera meets the recharge specification is 0.8, and the cameras perform independently. (7) 2 1
- (i) Find the probability that the first and second cameras pass the test and the third one fails?
- (ii) What is the probability that the 3<sup>rd</sup> failure is obtained in five or fewer tests?
- b) The probability that a married man watches a certain TV show is 0.4 and that a married woman watches the show is 0.5. The probability that a man watches the show, given that his wife does, is 0.7. Find (10) 2 1
- (i) The probability that a married couple watches the show.
- (ii) The probability that a wife watches the show given that her husband does.
- (iii) The probability that at least one person of a married couple will watch the show.
- c) An electrical circuit system consists of five components is illustrated in the following figure. The reliability (probability of working) of each component is also given in the figure. Assume that the components fail independently. (8) 2 1
- (i) Determine the probability that the entire system works?
- (ii) If you are given the condition that the system works, then find the probability that the component A is not working?



4. a) The lifetime of transistors obtained from a manufacturing process is a random variable  $X$ , measured in hours, which is assumed to have the probability density function (10) 3 2
- $$f(x) = \begin{cases} \frac{1}{100} e^{-x/100}, & x \geq 0 \\ 0, & \text{otherwise} \end{cases}$$
- What is the probability that a transistor will function (i) between 25 and 75 hours? (ii) at least 100 hours?
- b) Marketing Two new product designs are to be compared on the basis of revenue potential. Marketing believes that the revenue from design A can be predicted quite accurately to be \$3 million. The revenue potential of design B is more difficult to assess. Marketing concludes that there is a probability of 0.3 that the revenue from design B will be \$7 million, but there is a 0.7 probability that the revenue will be only \$2 million. Which design do you prefer? (7) 3 2

- c) The probability that a patient recovers from a rare blood disease is 0.4. If 15 people are known to have contracted this disease, what is the probability that (i) at least 10 survive, (ii) from 3 to 8 survive, and (iii) exactly 5 survive? (8) 3 2
5. a) A traffic control officer reports that 75% of the trucks passing through a check post are from within Dhaka city. What is the probability that at least three of the next five trucks are from out of the city? (7) 3 2
- b) Twenty percent of the TVs produced in an industry are defective. If 4 TVs are put in a box for marketing. In how many boxes do you expect to have (i) one defective TV, (ii) two defectives' TVs, (iii) at most 2 defective TVs in a consignment of 2000 such boxes? (8) 3 2
- c) The Phillips Bangladesh manufactures electric bulbs that have a length of life that is normally distributed with mean equal to 800 hours and standard deviation of 40 hours. Find the probability that a bulb burns between 778 and 834 hours. (Necessary chart is attached). (10) 3 2
6. a) To study the tensile strength of a certain type of wire, the following pairs of observations were recorded, where  $x$  is the diameter in cm and  $y$  is the mass supported kg/cm.
- |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| $x$ | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 |
| $y$ | 14  | 26  | 50  | 56  | 42  | 98  | 82  | 88  | 134 | 124 |
- (i) Calculate the two regression equations that are associated with the above values.
- (ii) Extrapolate the regression line to a diameter of 0.2 cm and explain your result.
- b) What does a coefficient of correlation measure? Discuss the situation when  $r = -1$ ,  $r = 0$ ,  $r = +1$ . (5) 4 2
- c) The Edison Electric Institute has published figures on the annual number of kilowatt-hours expended by various home appliances. It is claimed that a vacuum cleaner expends an average of 46 kilowatt-hours per year. If a random sample of 12 homes included in a planned study indicates that vacuum cleaners expend an average of 42 kilowatt-hours per year with a standard deviation of 11.9 kilowatt-hours, does this suggest at the 0.05 level of significance that vacuum cleaners expend, on the average, less than 46 kilowatt-hours annually? (Given that at  $\nu = 11$ ,  $t_{0.05} = 1.796$ ). (10) 4 2
7. a) An American theater knows that a certain hit movie ran an average of 84 days in each city and the corresponding standard deviation was 10 days. The manager of the southeastern district was interested in comparing the movie's popularity in this region with that in all of America's other theaters. He / she randomly choose 75 theaters in his/her region and found that they run the movie an average of 81.5 days. State appropriate hypothesis for testing whether there was a significant difference in the length of the movie runs between theaters in the southeastern district and all of American other theaters. Use 0.01 level of significance (Given that at 1% level of significance;  $z = \pm 2.58$ ). (10) 4 2

- b) A certain drug was administered to 500 people out of a total 800 included in the sample to test its efficacy against typhoid. The results are given below: (5) 4 2

	Typhoid	No. Typhoid	Total
Drug	200	300	500
No. Drug	280	20	300
Total	480	320	800

Based on these data, can it be concluded that the drug is effective in preventing typhoid using 5% level of significance. (Given that at  $\nu = 1$ ,  $\chi^2_{0.05} = 3.84$ ).

- c) A teacher wishes to test three different teaching methods: I, II and III. To do this, three groups of five students each are chosen at random, and each group is taught by a different method. The same examination is then given to all the students and the grades in the following table are obtained. Determine whether there is a difference between the teaching methods at significance levels of (i) 0.05 and (ii) 0.01. (Necessary charts are attached). (10) 4 2

Method I	75	62	71	58	73
Method II	81	85	68	92	90
Method III	73	79	60	75	81

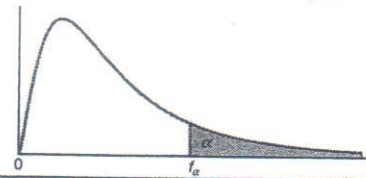


Table A.6 Critical Values of the F-Distribution

		$f_{0.05}(v_1, v_2)$								
		$v_1$								
$v_2$	1	2	3	4	5	6	7	8	9	
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	

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Table A.6 *F*-Distribution Probability TableTable A.6 (continued) Critical Values of the *F*-Distribution

		$f_{0.01}(v_1, v_2)$								
		$v_1$								
$v_2$	1	2	3	4	5	6	7	8	9	
1	4052.18	4999.50	5403.35	5624.58	5763.65	5858.99	5928.36	5981.07	6022.47	
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15	
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09	
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	
$\infty$	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	



**Program: B.Sc. CEE 4<sup>th</sup> Semester**  
**Semester : Summer**

**Date: 31<sup>st</sup> March, 2022**  
**Time: 10:00 am – 01:00 pm**

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

**Semester Final Examination**  
**Course Number: Hum 4459**  
**Course Title: Science, Technology and Islam**

**Academic Year: 2020 - 2021**  
**Full Marks: 100**  
**Time: 3 Hours**

There are 8 (eight) questions. Answer 6 (six) questions. Question number 1 (one) is compulsory.

- |    |                                                                                                                                               |    |          |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------|----|----------|
| 1. | a) Explain the importance of faith and surrender in Islam as the main two fold nature of Islam.                                               | 10 | CO1      |
|    | b) How does salah as the most auspicious gift from ALLAH swt to develop mental and spiritual state of your religious and worldly life?        | 15 |          |
| 2. | a) Describe ten Muslim inventions that shaped the modern world.                                                                               | 10 | CO2      |
|    | b) Assert the roots to the western world that had been used to transfer of knowledge and science from the Muslim world in medieval period.    | 05 |          |
| 3. | a) Explain how Mohammad Ibn Zakariya Al-Razi's contribution was famous in different scientific fields.                                        | 10 | CO2, CO1 |
|    | b) Are Islamic beliefs compatible with science?                                                                                               | 05 |          |
| 4. | a) Expose the life and contribution of Ibn Sina as the father of early modern medicine.                                                       | 10 | CO2      |
|    | b) Why Muhammad Ibn Musa al-Khwarizmi is called the father of algebra?                                                                        | 05 |          |
| 5. | a) How ancient chemistry turned from superstition into a pure scientific field in the hand of Muslim scientists?                              | 10 | CO1, CO3 |
|    | b) Explain the Islamic viewpoints of knowledge and science within the spectrum of incorporation.                                              | 05 |          |
| 6. | a) Embryonic phases of a fetus described in the Quran certainly indicate to the scientific miracle of the Holy Quran. Narrate this statement. | 10 | CO3      |
|    | b) Explain the scientific miracle of the Quran in honey bee.                                                                                  | 05 |          |
| 7. | a) Define the Pentateuch as the nucleus of Hebrew and Christian Bible.                                                                        | 10 | CO1      |
|    | b) Outline the both prophetic lines in the Semitic religions.                                                                                 | 05 |          |
| 8. | a) Describe a summary of the Old Testament and the New Testament.                                                                             | 10 | CO1      |
|    | b) What is the movement of reformation in the Christian theology?                                                                             | 05 |          |

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

**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**SEMESTER FINAL EXAMINATION**

**Course No. : CEE 4461**

**Course Title : Civil and Environmental Technology II**

**Summer Semester :2020-2021**

**Time : 3 hours**

**Full Marks : 150**

There are 6 (six) questions. Answer **all** of them. All questions carry equal marks. Marks in the margin indicate full marks.

-----

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CO  | PO  | Marks |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| 1. Chalk Hills Company has been the producer of magnesite of both calcination and refractory grades, for more than a century. A new magnesite mining project is going to be launched soon. The mining activity, comprising drilling, blasting, loading of waste, transport of over burden and crushing of ore is having considerable impacts on the environment. Dust generation, noise levels and ground vibration were monitored as part of the Environmental Impact Assessment (EIA)             |     |     |       |
| (a) Which method would you prefer for the impact analysis of this new project?                                                                                                                                                                                                                                                                                                                                                                                                                      | CO1 | PO1 | (5)   |
| (b) Prepare a network diagram for the new project to analyze the impacts on social and environmental components.                                                                                                                                                                                                                                                                                                                                                                                    | CO3 | PO6 | (20)  |
| 2. A road linking Cameron Highlands to Kuala Lipis in the state of Pahang in West Malaysia is proposed. This road linkage would greatly reduce travel distance and time between the two areas. However, the proposed road needs to traverse through forested areas and relatively hilly terrain along certain stretches. Physical environment and land resources, climatic, hydrological conditions, noise levels, air quality, water quality, flora and fauna conditions are needed to be checked. |     |     |       |
| (a) Write down the difference between IEE and EIA.                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CO1 | PO1 | (5)   |
| (b) Prepare a baseline showing environmental components, parameters and sources.                                                                                                                                                                                                                                                                                                                                                                                                                    | CO1 | PO1 | (10)  |
| (c) TIDE (Tidal River Development) is a new project taken by Ministry of Shipping to improve the present condition of Jamuna River. Prepare a table using simple checklist to identify possible environmental impacts caused by this project. (You have to consider the four facets of environment in identifying the impacts)                                                                                                                                                                      | CO2 | PO1 | (10)  |

3. (a) To find out the possible environmental impacts a public consultation was performed for your project. A total no. of 200 people participated in the survey. Find out the total *EIV in a tabular form* from the following information and comment about the results whether it should be established or not. CO3 PO6 (25)
- Ecological Impact: -**
- Fisheries [10]: 100 people answered severe negative impact, 50 people answered higher negative impact, 30 people answered moderate negative impact and 20 people answered very low negative impact.
- Tree plantation [5]: 60 people answered higher negative impact, 80 people answered very low negative impact, and others answered no change of environment.
- Wetland [1]: 70 people answered no change, 20 people answered moderate negative impact, and 30 people answered very low positive impact.
- Physio-chemical: -**
- Drainage Congestion [5]: 45 people answered low negative impact, 95 people answered very low negative impact, and the remaining people answered no change.
- Obstruction to wastewater flow [4]: 90 people answered moderate negative impact, 20 people answered very low negative impact and remaining answered no change.
- Human Interest: -**
- Employment opportunities [8]: 85 people answered severe positive impact, 30 people answered higher positive impact and 55 people answered low positive impact and remaining answered no change.
- Industrial activities [3]: 150 people answered very low positive impact.
4. (a) Prepare a mitigation and monitoring plan for a rural highway project (pre-construction, construction and operation phase). CO4 PO7 (20)
- (b) What are the positive impacts of this project? How can you enhance positive impacts of your project? CO4 PO7 (10)
5. (a) Discuss the level of public consultation in SIA with respect to EIA. CO1 PO1 (6)
- (b) Describe the five overlapping categories of social impact. CO1 PO1 (7)
- (c) Describe the major advantages for undertaking a SIA. CO1 PO1 (7)
6. (a) Develop a questionnaire for assessing the demographic situation of a sub-urban society. CO2 PO1 (10)
- (b) How can you improve the response rate of your questionnaire? CO1 PO1 (5)
- (c) Prepare a FGD guide to assess the probable social impact of a power plant project. CO2 PO1 (10)

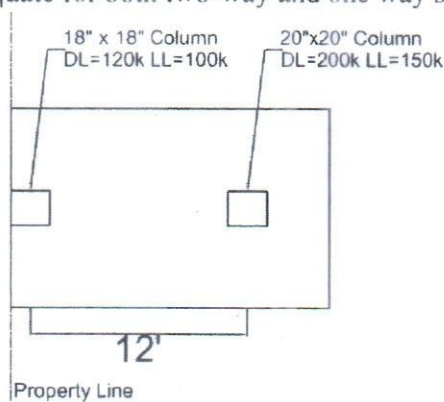
**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
 ORGANISATION OF ISLAMIC COOPERATION (OIC)  
 DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

**Final Examination**  
**Course Number: CEE 4611**  
**Course Title: Design of Concrete Structures**

**Summer Semester: 2020–2021**  
**Full Marks: 150**  
**Time: 3.0 Hours**

There are **8 (eight)** questions. Answer **6 (six)** of them. Question **1** and **7** are *compulsory*. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

1. (a) What is ACI spiral? Derive the equation for calculating the volumetric ratio of ACI spiral. CO1, PO1: [7.5]
- (b) Design a rectangular tied column to support an axial dead load of 400 K and a live load of 232 K using  $f'_c = 4$  ksi,  $f_y = 60$  ksi, and a steel ratio of about 3%. Design the necessary ties. Assume the width of the column as 14 in. CO2, PO3: [10]
- (c) Derive the equation for calculating the load and moment for a short column subjected to eccentric loading. CO1, PO1: [7.5]
2. Design a rectangular footing for the column designed in Question 1 (b). Consider the length of the long side equal to twice the width of the short side,  $f_y = 60$  ksi,  $f'_c = 4$  ksi, and  $q_a = 4$  ksf. Assume the base of the footing is 5 ft below grade. CO2, PO3: [25]
3. Calculate the flexural reinforcement and show the detailing of the reinforcement in a neat sketch for a rectangular combined footing as shown in Fig. 1. Given that,  $q_a$  is 5 ksf,  $f'_c$  is 3000 psi and  $f_y$  is 60 ksi. Assume that depth of the footing is 27-in. and the base of the footing is 5 ft below the grade. CO2, PO3: [25]  
 Note: the depth is adequate for both two-way and one way shear.



**Fig. 1 for Question 3**

4. A cantilever retaining wall is to retain a bank of 11.5 ft high including a live surcharge of 400 psf. The preliminary design of the retaining wall is given in Fig. 2. If the compressive strength of concrete is 4.5 ksi and yield strength of steel is 60 ksi, investigate the stability of the retaining wall. Other given data are unit weight of backfill 120 pcf, angle of friction is  $30^\circ$ , base friction co-efficient is 0.5, and the allowable bearing pressure is 8 ksf. CO2, PO3: [25]

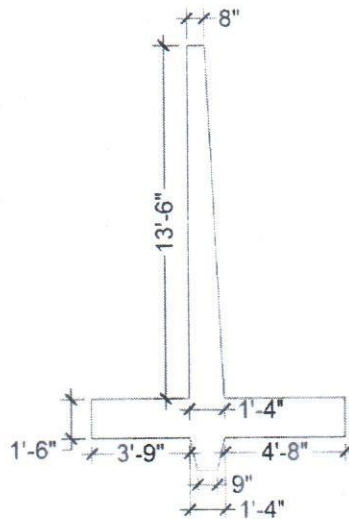


Fig. 2 for Question No. 4

5. For the situation given in Question 3, design the following parts of the cantilever retaining wall of Fig. 2 and show the reinforcement detailing in a neat sketch. CO2, PO3: [25]
- Arm and key
  - Toe slab
  - Heel slab
6. A  $12 \times 20$  in. column is reinforced with four No. 9 bars of area  $1.0 \text{ in}^2$  each, one in each corner as shown in Fig. 3. The concrete cylinder strength is 4 ksi and the steel yield strength is 60 ksi. Determine (a) the load,  $P_b$ , the moment  $M_b$ , and corresponding eccentricity  $e_b$  for balanced failure; (b) the load and moment for a representative point in the tension failure region of the interaction curve; (c) the load and moment for a representative point in the compression failure region of the interaction curve; (d) the axial load strength for zero eccentricity. Then (e) sketch the strength interaction diagram for this column. Finally, (f) design the transverse reinforcement based on ACI Code provisions. CO2, PO3: [25]

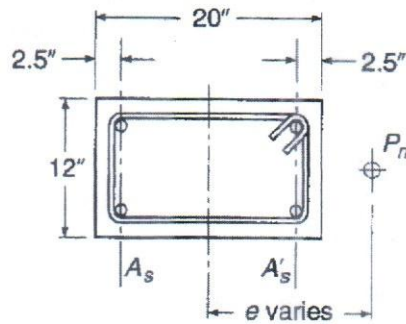


Fig. 3 for Question 6

7. (a) Explain the effects of frame stiffness on the shear force and bending moment of shear wall using qualitative SFD and BMD. CO1, PO1: [6]
- (b) From 3 computer aided model of 3 structural systems the deflection data as shown in following table were found. Based on stiffness, explain which system is the most acceptable and a win-win situation: CO1, PO1: [9]

Structure Type	Load Applied (kips)	Top Deflection (cm)
18 story wall	300	173.68
18 story MRF	300	36.35
18 Story Dual System Structure	300	13.68

- (c) A three storied shear wall is subjected to factored wind force as shown in Fig. 4. The dimensions of the shear wall are also given in the figure. Design the shear wall reinforcement at first level.  $f'_c = 3000$  psi  $f_y = 60000$  psi. Use No. #4 bar to design the horizontal and vertical reinforcement. CO2, PO3: [10]

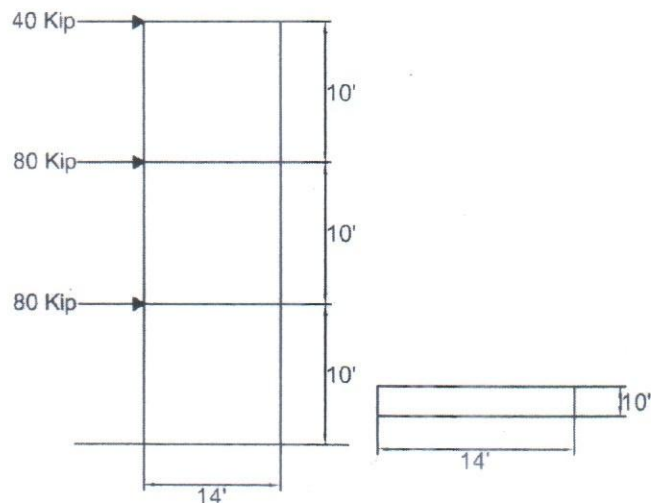


Fig 4 For Question 7 (c)



8. Design and calculate the reinforcement of the beam supported slab system given in Fig. 5 using USD method and show them in a plane and cross sectional view. CO2, PO3: [25]  
The system is carrying floor finish = 30 psf, random wall = 50 psf and live load = 60 psf. Given data:  $f'_c = 4\text{ksi}$ ,  $f_y = 50\text{ksi}$ ]

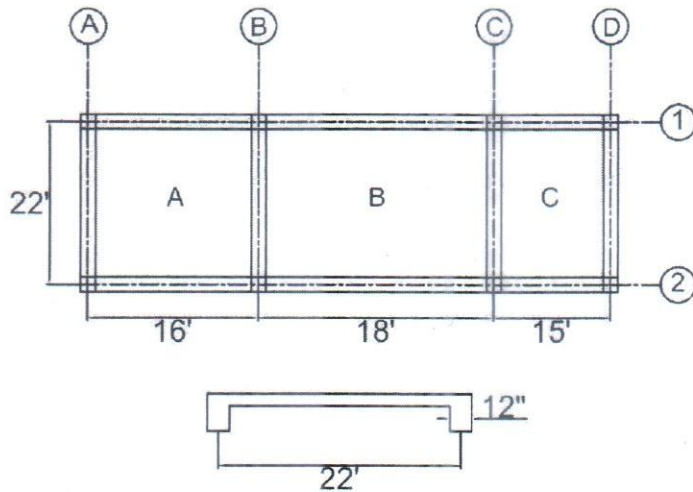


Fig. 5 Question 8

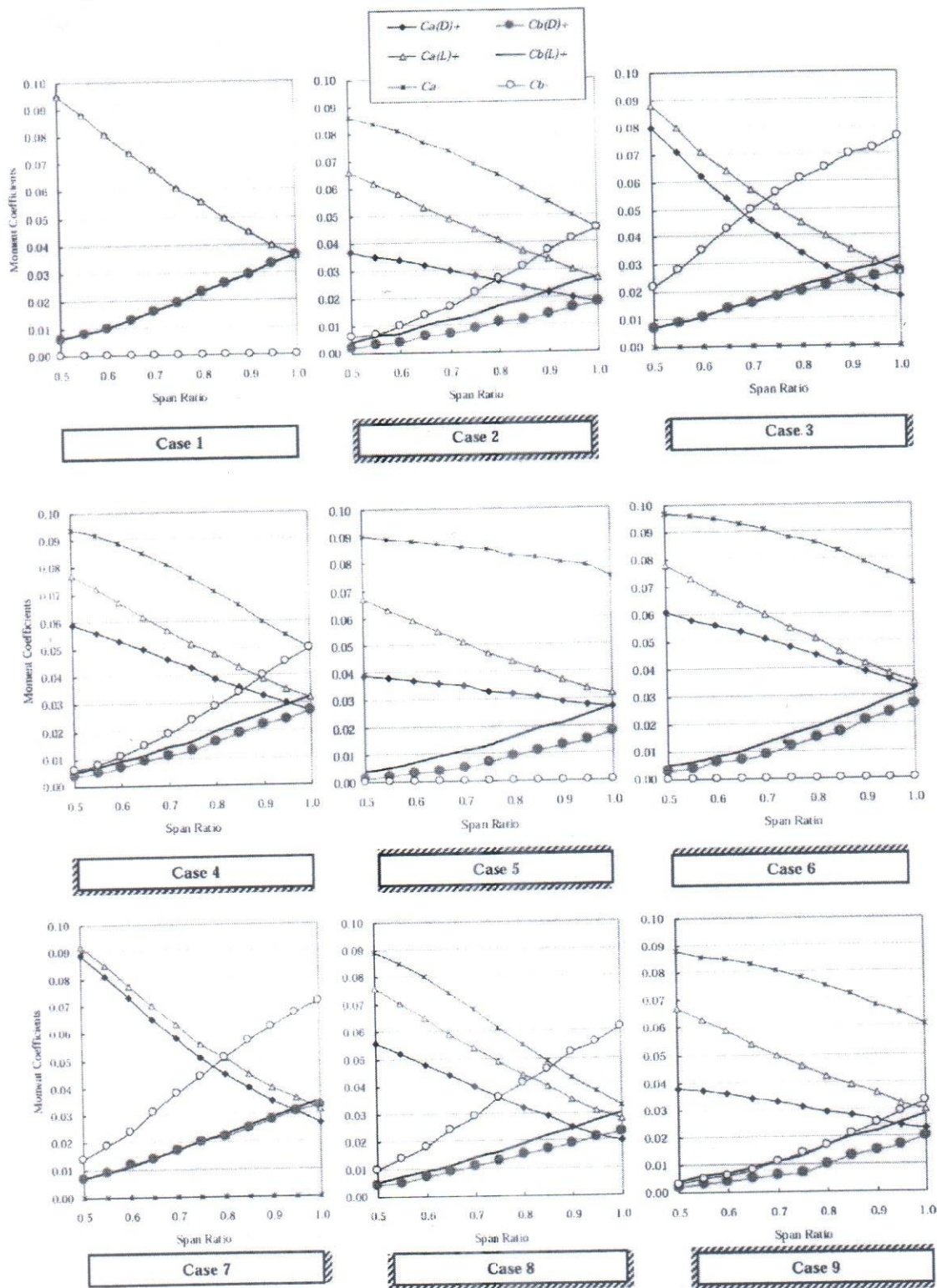


Fig. 1.5: Moment coefficients for different support conditions

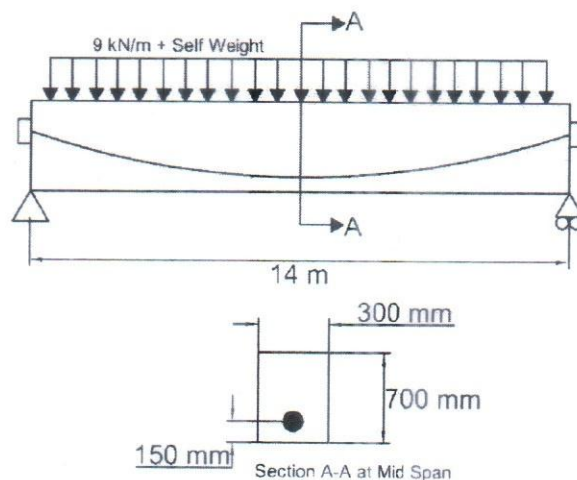
**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
 ORGANISATION OF ISLAMIC COOPERATION (OIC)  
 DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

**Final Examination**  
**Course Number: CEE 4613**  
**Course Title: Design of Pre-Stressed Concrete Structures**

**Summer Semester: 2020–2021**  
**Full Marks: 150**  
**Time: 3.0 Hours**

There are **8 (EIGHT)** questions. Answer any **3 (THREE)** from **Question No. 1 to 4** and any **3 (THREE)** from **Question No. 5 to 8**. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable value for any missing data.

1. (a) A post tensioned simple beam on a span of 14 m is shown in Fig. 1. It carries a superimposed load of 9.0 kN/m in addition to its own weight. The initial prestress in the steel is 980 MPa reducing to 840 MPa after deducing all losses but assuming no bending of the beam. Compute the stress in the steel at midspan, assuming steel to be bonded by grouting. Assume,  $n = 6$ ,  $A_{ps} = 1400 \text{ mm}^2$  and  $\gamma_{con} = 25 \text{ kN/m}^3$ . CO2, PO2: [10]



**Fig. 1 for Question 1 (a)**

- (b) For the above problem [(a)], determine the total uniform load that can be supported by the beam without causing any tension at bottom fibre. Also determine the cracking moment for this beam section if modulus of rupture of concrete is 4.5 MPa. CO2, PO2: [15]
2. (a) A pretensioned concrete beam, 12 m long is eccentrically prestressed with  $1400 \text{ mm}^2$  of steel wires which are anchored to the bulk heads (Fig. 2). The stress at this situation is 1020 MPa. Compute the loss of prestress due to elastic shortening of concrete at the transfer of prestress. Use,  $\gamma_{con} = 25 \text{ kN/m}^3$  and  $n = 6$ . CO2, PO2: [15]

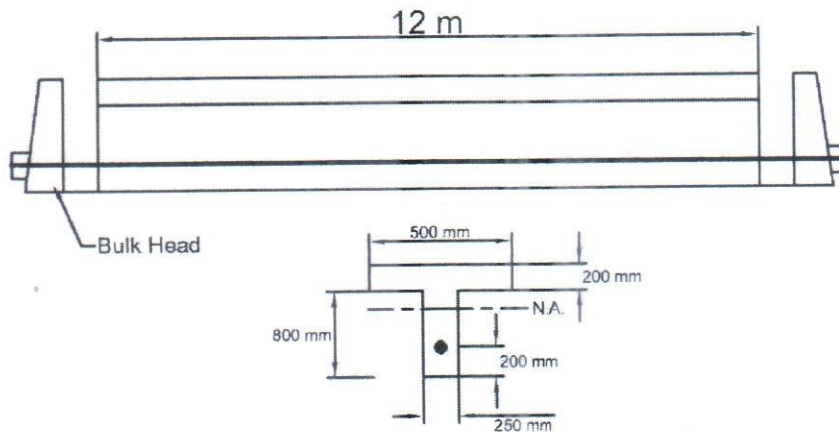


Fig. 2 for Question 2 (a)

(b) Compute the initial deflection at midspan of a simply supported beam of width 400 mm and depth 800 mm due to prestress and uniformly distributed load of 40 kN/m (self wt. included). Estimate the deflection after six months assuming a creep coefficient,  $C_c = 2.5$ . Use  $f_o = 1200$  MPa,  $f_{se} = 1000$  MPa, span of beam = 12.0 m and  $A_{ps} = 820$  mm<sup>2</sup>. The c.g.s with constant eccentricity is at 100 mm from the bottom surface of the beam. All symbols carry the usual meaning. CO2, PO2: [10]

3. An I-shaped beam is prestressed with  $A_{ps} = 2368$  mm<sup>2</sup> as prestressing steel with an effective stress,  $f_{se}$  of 1103 N/mm<sup>2</sup>. The c.g.s of the strands which supply the prestress is 115 mm above the bottom of the beam as shown in Fig. 3 along with shape of the concrete section. Material properties are  $f_{pu} = 1862$  N/mm<sup>2</sup> and  $f'_c = 48$  N/mm<sup>2</sup>. Find the ultimate resisting moment for the section for design following any method of ACI. CO2, PO2: [25]

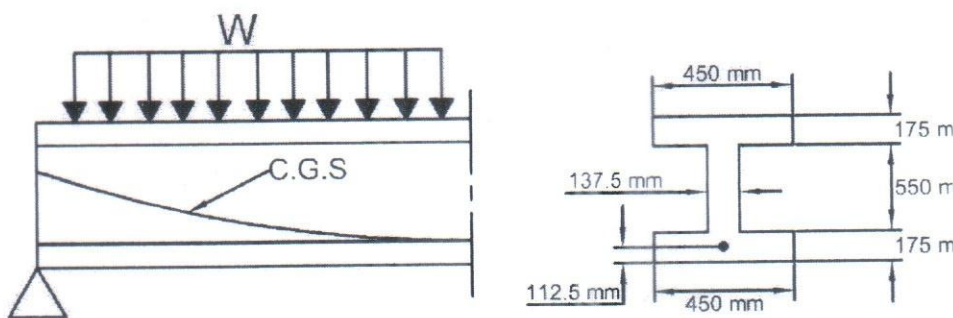


Fig. 3 for Question 3

4. A post tensioned bonded concrete beam, as shown in Fig. 4 has a pre-stress of 350 kips in the steel immediately after prestressing, which eventually reduces to 300 kips due to losses. The beam carries two live loads of 10 kips each in addition to its own weight 300 lb/ft. Compute the extreme fibre stresses at midspan (a) under the initial condition with full prestress and no live load, and CO2, PO2: [25]

(b) under the final condition, after the losses have taken place, and with full live load.

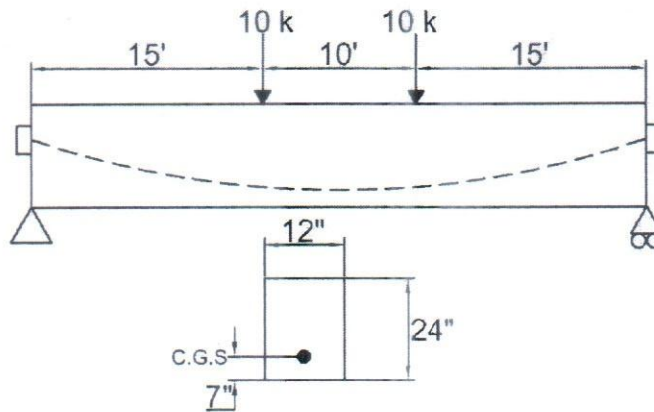


Fig. 4 for Question 4

5. Design a symmetrical I-shape section with  $h = 1000$  mm for a simply supported beam (Fig. 5) carrying the following service loads: (a) Self weight,  $w_g$ , Super imposed Dead load,  $W_D = 12$  kN/m and Live Load,  $W_L = 5$  kN/m. Assume normal weight concrete with  $f'_c = 42$  MPa,  $f'_{ci} = 32$  MPa, and 12.7 mm diameter 1860 MPa Grade strands;  $A_{ps} = 100$  mm<sup>2</sup>/strand,  $f_{pu} = 1860$  MPa and transfer stress of  $0.7 f_{pu}$ . Loss = 20%. Use two stage prestressing if a lighter section results and consider no tension to be allowed in concrete. Second stage post-tensioned strands to be grouted for perfect bond. CO3, PO3: [25]

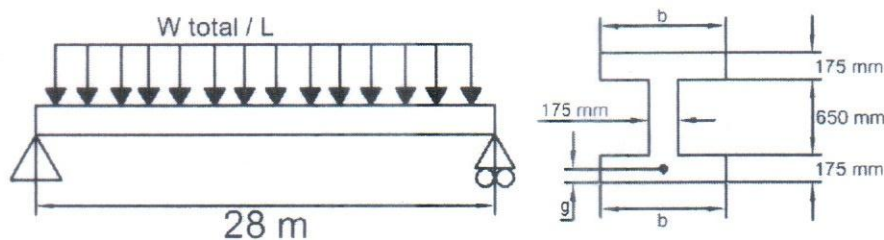


Fig. 5 for Question 5

6. (a) Make an initial design for section of a prestressed beam to resist a total moment of 750 kN-m of which  $M_G = 300$  kN-m. Assume.  $f_c = 15$  MPa,  $f_{se} = 980$  MPa and a trial depth of  $41\sqrt{M_T}$  (mm) where  $M_T$  in kN-m. CO3, PO3: [10]  
 (b) Make the final design from the initial section obtained above. Given,  $f_b = -18$  MPa,  $f_t = -16$  MPa,  $f_{so} = 1080$  MPa and allow no tension. CO3, PO3: [15]
7. Design the shear reinforcement for the beam shown in Fig. 6 at section 1 - 1 (1.5 m from the left support) and 2-2 (6.5 m from the left support) respectively. Given that the section is adequate for  $W_u = 60$  kN/m based on its flexural strength. Given: Effective prestress = 1100 MPa, Initial prestress = 1400 MPa, Use ACI Equations provided in Table 7.1. CO3, PO3: [25]

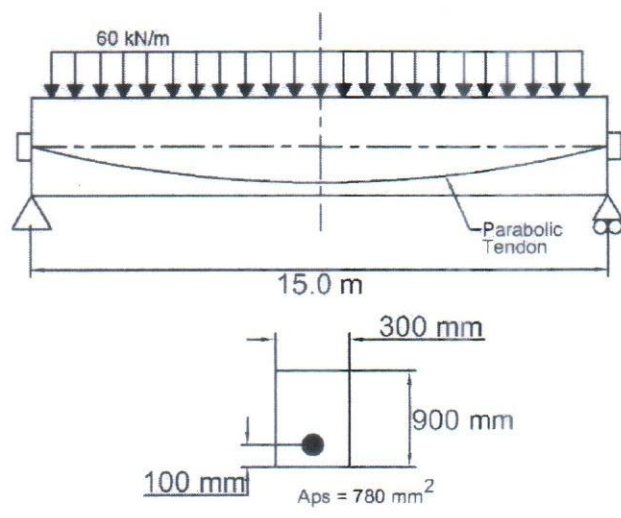


Fig. 6 for Question 7

8. A post tensioned beam has a midspan section with a duct hole of 50 mm by 80 mm to house the tendons (see Fig. 7). It is prestressed with  $840 \text{ mm}^2$  of steel to an initial stress of 1020 MPa. At transfer the stress is reduced by 6% due to elastic shortening and anchorage take up. Compute the stresses in concrete soon after transfer considering. CO3, PO3: [25]

- i) Gross concrete section
- (ii) Net concrete section (excluding hole)

Compare the difference in concrete stress obtained by the two methods and comment on your findings.

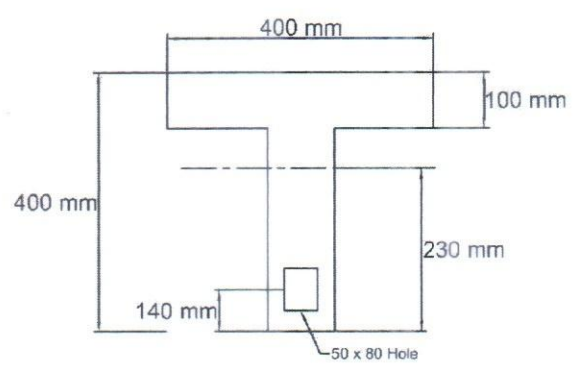


Fig. 7 for Question 8

Table 7-1 ACI Equations for shear strength evaluation: Shear stress =  $\frac{\text{shear force}}{b_w d}$

Shear Stress Equations (following 1971 ACI Code)	Shear Force Equations (following 1977 ACI Code)
$v_u = \frac{V_u}{\phi b_w d}$	<p>(7-3) <math>V_u =</math> Factored shear force at section</p> <p>(7-6) <math>V_u \leq \phi V_n</math></p>
<p>where <math>V_u</math> in design is factored shear force at section. Use <math>\phi = 0.85</math> for shear.</p>	<p>Design for <math>V_u/\phi</math> as the nominal shear strength, <math>V_n</math>. Use <math>\phi = 0.85</math> for shear.</p>
$v_{ci} = 0.05\sqrt{f'_c} + \frac{V_d + \left(\frac{V_l M_{cr}}{M_{max}}\right)}{b_w d} \geq 0.14\sqrt{f'_c}$ (7-4)	$V_{ci} = 0.05\sqrt{f'_c} b_w d + V_d + \frac{V_l M_{cr}}{M_{max}} \geq 0.14\sqrt{f'_c} b_w d$ (7-7)
<p>where <math>M_{cr} = (I/y_t)(0.5\sqrt{f'_c} + f_{pe} - f_d)</math></p>	<p>(7-9) where <math>M_{cr} = (I/y_t)(0.5\sqrt{f'_c} + f_{pe} - f_d)</math></p>
$v_{cw} = 0.29\sqrt{f'_c} + 0.3f_{pc} + \frac{V_p}{b_w d}$ (7-5)	$V_{cw} = (0.29\sqrt{f'_c} + 0.3f_{pc})b_w d + V_p$ (7-8)

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

Semester Final Examination

Winter Semester: 2020-2021

Course No.: HUM 4651

Full Marks: 150

Course Title: Project Planning and Management

Time: 3 Hours

There are 8 (Eight) questions. Answer any 6 (Six) questions including Question No. 1&2. Question No. 1 & 2 are 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) Explain  $C = f(P, T, S)$  (10) CO2 PO2  
 (b) A firm has estimated the following time for its project. The company has fixed 17 months to complete the project. What is the probability of success that the project will complete on time (times are in months)? (25) CO3 PO11

Activity	Predecessor	Optimistic Time	Most likely Time	Pessimistic Time
a	-	3	4	5
b	-	3	5	7
c	-	5	6	7
d	a	2	3	4
e	b	6	8	10
f	b	5	3	7
g	c	5	6	7
h	d,e	5	3	7
i	f,g	1	2	3

Determine the total duration of the project, free float, total float of each activity and identify critical path of the project.

2. Suppose you have joined in a construction firm as an assistant project manager. The site is at a densely populated residential area. The assignment is to build ten storied residential building which requires excavation, piling, RCC works (i.e. substructure and superstructure), plumbing, sanitary, electrification, life fitting and some ancillary works (i.e. land scaping and internal road) in 2 years' time of which 6 months have already been passed. Total cost of the project is \$200 million. In your team, you have one site engineer, one junior engineer, one QA/QC supervisor, one site safety supervisor and five foremen. Your role as a key member of the project team, is to complete the project on time, within budget while maintaining the specified quality. The activities and their duration are shown in Ques. No. 1. During the last 6 months, you found that, the work estimated was \$100 million, work completed was \$90 million although \$96 million have been spent for the work. You have also found that the excavation work has been completed; out of 60, 40 pre-cast piling have been completed during this rainy season. Though you have sufficient labors in the site, the weather forecast states that there will be two depressions in a row for next two months. The junior engineer also told you that an



accident had happened in the site which caused three unskilled workers a week hospitalization during last month.

Apart from construction supervision, your another important role is to prepare reports and give presentations to PM as well as top management regarding project progress in a quarterly basis. Based on your project management knowledge;

- (a) Assess the progress of the project. (10) CO3 PO11
- (b) Identify the areas that need to monitor in construction site and project (10) CO1 PO1
- (c) Justify your report (i.e. your supporting tools and techniques that you use for reporting) in preparing schedule, cost, safety and quality attainment of the project. (15) CO3 PO11

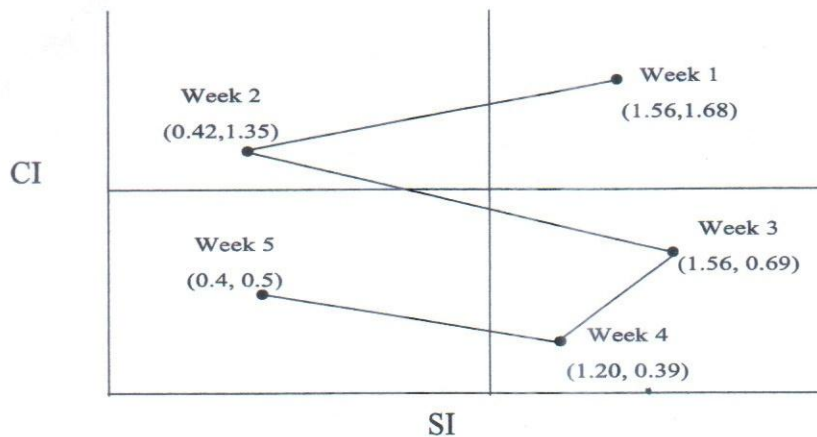
- 3. (a) What do you understand by 'Time Value of Money'? (5) CO1 PO1
- (b) Why and when should you choose replacement of an asset? (5) CO2 PO2
- (c) A factory has a current market value of \$60,000 and can be kept in service for 4 more years. With a MARR of 12% per year, when should it be abandoned? The following data are projected for future years: (10) PO2 PO2

	Year 1	Year 2	Year 3	Year 4
Net revenue	\$50,000	\$50,000	\$15,000	\$10,000
Market value	\$35,000	\$20,000	\$15,000	\$5,000
Overhaul cost	-	\$10000	-	-

- 4. (a) Define the economic life of an asset. (5) CO1 CO1
- (b) Dr. Chowdhury purchased a car 10 years back at a cost of \$5.10 million whose market value is \$6.00 million now. It can be used for 3 more years at which time its value will be \$3.5 million. Operation and maintenance expenses are \$1.80 million per year. Dr. Chowdhury can purchase a reconditioned car with the same functionality for \$25.0 million In 5 years the value of this car is estimated to be \$15.0 million. Operation and maintenance expenses will be \$36000 per year. Should Dr. Chowdhury replace the old car using before Tax MARR of 12%? (15) CO2 PO2
- 5. (a) Discuss the role of a safety supervisor to ensure safety in construction site. (5) CO1 PO1
- (b) Describe the seven principles to prevent accident in construction site. (5) CO2 PO2
- (c) Do you think construction safety in Bangladesh is up to the standard? Justify your answer? (10) CO2 PO2
- 6. (a) Discuss the benefits of EVM. (5) CO1 PO1
- (b) A project was originally planned to be completed with an investment of \$300 millions and was planned to be completed in 30 months. After reviewing the project after 10 months, it was found that work worth \$80 millions have been completed instead of \$90 millions as per plan though the expenses incurred till date was found \$75 million. Determine the cost and schedule variance. Also determine the expected cost and time of completion with same performance. Also suggest your strategy to the management. (10) CO2 PO2

(c) Interpret the following Figure of a drainage project and summarize your opinion to the top management for execution.

(5) CO2 PO2



7. (a) Discuss the duties of a prime contractor for construction safety in his project.

(5) CO1 PO1

(b) Mention the corrective actions to be taken if a project slips from its master schedule in details?

(10) CO2 PO2

(c) State the steps and describe briefly if any accident happens in a work place

(5) CO2 PO2

8. (a) What is meant by procurement?

(5) CO1 PO1

(b) Please justify the necessity of tender security and performance security.

(5) CO2 PO2

(c) Describe briefly Open Tendering Method (OTM).

(10) CO2 PO2

MARR 12%

Interest Rate	12.00%								
n	F/P	P/F	A/F	A/P	F/A	P/A	A/G	P/G	N
1	1.120	0.8929	1.0000	1.1200	1.000	0.893	0.000	0.000	1
2	1.254	0.7972	0.4717	0.5917	2.120	1.690	0.472	0.797	2
3	1.405	0.7118	0.2963	0.4163	3.374	2.402	0.925	2.221	3
4	1.574	0.6355	0.2092	0.3292	4.779	3.037	1.359	4.127	4
5	1.762	0.5674	0.1574	0.2774	6.353	3.605	1.775	6.397	5
6	1.974	0.5066	0.1232	0.2432	8.115	4.111	2.172	8.930	6
7	2.211	0.4523	0.0991	0.2191	10.089	4.564	2.551	11.644	7
8	2.476	0.4039	0.0813	0.2013	12.300	4.968	2.913	14.471	8
9	2.773	0.3606	0.0677	0.1877	14.776	5.328	3.257	17.356	9
10	3.106	0.3220	0.0570	0.1770	17.549	5.650	3.585	20.254	10
11	3.479	0.2875	0.0484	0.1684	20.655	5.938	3.895	23.129	11
12	3.896	0.2567	0.0414	0.1614	24.133	6.194	4.190	25.952	12
13	4.363	0.2292	0.0357	0.1557	28.029	6.424	4.468	28.702	13
14	4.887	0.2046	0.0309	0.1509	32.393	6.628	4.732	31.362	14
15	5.474	0.1827	0.0268	0.1468	37.280	6.811	4.980	33.920	15

**Z Score Table- chart value corresponds to area below z score.**

<b>z</b>	<b>0.09</b>	<b>0.08</b>	<b>0.07</b>	<b>0.06</b>	<b>0.05</b>	<b>0.04</b>	<b>0.03</b>	<b>0.02</b>	<b>0.01</b>	<b>0.00</b>
-3.4	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
-3.3	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
-3.2	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007
-3.1	0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010
-3.0	0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013
-2.9	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019
-2.8	0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026
-2.7	0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035
-2.6	0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0043	0.0044	0.0045	0.0047
-2.5	0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.0060	0.0062
-2.4	0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.0080	0.0082
-2.3	0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107
-2.2	0.0110	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139
-2.1	0.0143	0.0146	0.0150	0.0154	0.0158	0.0162	0.0166	0.0170	0.0174	0.0179
-2.0	0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228
-1.9	0.0233	0.0239	0.0244	0.0250	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287
-1.8	0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359
-1.7	0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446
-1.6	0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548
-1.5	0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.0630	0.0643	0.0655	0.0668
-1.4	0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808
-1.3	0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968
-1.2	0.0985	0.1003	0.1020	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151
-1.1	0.1170	0.1190	0.1210	0.1230	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357
-1.0	0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587
-0.9	0.1611	0.1635	0.1660	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841
-0.8	0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.2090	0.2119
-0.7	0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.2420
-0.6	0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743
-0.5	0.2776	0.2810	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.3050	0.3085
-0.4	0.3121	0.3156	0.3192	0.3228	0.3264	0.3300	0.3336	0.3372	0.3409	0.3446
-0.3	0.3483	0.3520	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821
-0.2	0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.4090	0.4129	0.4168	0.4207
-0.1	0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602
-0.0	0.4641	0.4681	0.4721	0.4761	0.4801	0.4840	0.4880	0.4920	0.4960	0.5000



B. Sc. Engg. (CEE)/ 6<sup>th</sup> Sem.

29 March, 2022(Afternoon)

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

Term Final Examination

Summer Semester: 2020-2021

Course No.: CEE 4653

Full Marks: 150

Course Title: Pavement Design &amp; Railway Engineering

Time: 3.0 Hours

**There are 8 (Eight) questions. Question No. 4, 5, 6 are compulsory. Answer any 2 (Two) questions from Question No. 1, 2 and 3. Answer any 1 (One) question from Question No. 7 and 8.**

No marks will be assigned if the student fails to write appropriate question number on the answer script in a distinct and clearly visible manner or does not follow specific question selection process as mentioned above.

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. Assume reasonable values for any missing data.

- 1(a) Discuss different types of railway slippers focusing their advantages and disadvantages. (7½)  
(CO1-PO1)
- (b) Why are marshalling yards necessary? How stations are classified based on operational based on operational considerations? Describe in brief. Differentiate between junction and terminal. Draw diagrams both of them. (3+7+5)  
(CO2-PO2)
- 2(a) Describe general usage of sheep foot roller, smooth vibratory roller, grader and pneumatic tire roller. (7½)  
(CO1-PO1)
- (b) Define interlocking and state its principles. Write down the differences between ordinary (acute) crossing and double (obtuse) crossing with figures. Find out the maximum speed of a train on a B.G. track having a curvature of four dereed and cant 10 cm. Assume allowable cant deficiency as 60 mm. (5+3+7)  
(CO2-PO2)
- 3(a) Compute the maximum slope a locomotive can negotiate maintaining its design speed. Considering, weight of each wagon = 10 t, number of wagons = 6, weight of locomotive = 170 t, tractive effort of locomotive = 15 t, rolling resistance of locomotive = 2.5 kg/t, rolling resistance of wagon = 2.2 kg/t, speed of the train = 55 km/h. Assume reasonable values for any missing data. (7½)  
(CO1-PO1)
- (b) Draw a neat sketch of a left hand turnout and show various parts on it and describe their functions. (15)  
(CO2-PO2)

- 4(a) Briefly state the function, requirement and procedure for a transverse Contraction joint. Draw a diagram of a transverse contraction joint. What are the different types of stresses developed in concrete? Why are these stresses developed? Give reasoning. (6+5<sup>1</sup>/<sub>4</sub>) (CO3-PO2)
- (b) What are the design steps for the thickness design of concrete pavement as per PCA method? (4+6+5) (CO4-PO3)
- For the thickness design of a concrete pavement for a four lane two way national highway, the following information are available:  
 Four-lane, two-way current traffic(ADT)= 3410  
 Volume of truck traffic=60 percent  
 Percentage of truck using design lane=80  
 For a 10 year design period, projection factor= 2.5  
 Modulus of rupture of concrete=650 psi  
 Combined modulus of subbase-subgrade, k= 130 pci
- (i) Calculate the total number of trucks in the design lane.  
 (ii) The design engineer assumed a thickness of 9.5 inch and found the data tabulated below. Check whether the assumed thickness is safe or not. Assume reasonable value for missing data, if any.

Axle load, kips	Expected repetitions	Allowable repetitions for fatigue analysis	Allowable repetitions for erosion analysis
30S*	6310	27000	1500000
28S	14690	77000	2200000
26S	30140	230000	3500000
24S	64410	1200000	5900000
22S	106900	Unlimited	11000000
52T*	21320	1100000	920000
48T	42810	Unlimited	1500000
44T	124900	Unlimited	2500000
40T	372900	Unlimited	4600000
36T	885800	Unlimited	9500000
32T	930200	Unlimited	24000000

S\*- means single axle; T\*-means tandem axle

- 5(a) Write down the name of the tests of bituminous materials used in road construction to check the property of the purity of asphalt cement, consistency, ductility and volatility. Which properties of aggregate is tested by Los Angles Abrasion test? Describe testing procedure. What do you mean by chemical stability of aggregates? Explain in brief. (4+4+3<sup>1</sup>/<sub>4</sub>) (CO3-PO2)

- (b) What are the two stress-strain conditions on which 'The Asphalt Institute' method of flexible pavement design is based? Explain with figures. (7+8)

The following information are available for the design of a flexible pavement by AASHTO method. (CO4-PO3)

Design ESAL =  $12.5 \times 10^6$

Reliability Level = 85 percent

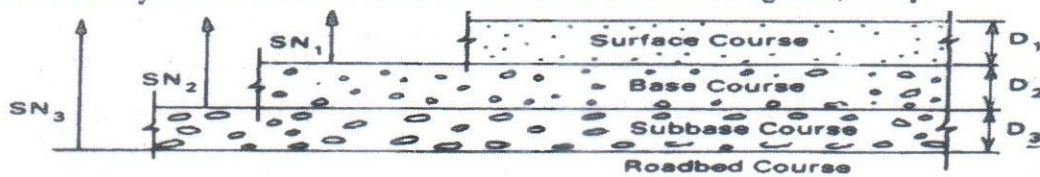
Standard deviation = 0.45

Serviceability loss,  $\Delta PSI = 2.0$

The structural numbers, layer co-efficient and drainage modifying factors are given as follows:

$a_1 = 0.42$ ,  $SN_1 = 2.05$ ,  $a_2 = 0.13$ ,  $SN_2 = 3.3$ ,  $m_2 = 0.95$ ,  $a_3 = 0.075$ ,  $SN_3 = 6.5$ ,  $m_3 = 0.90$

Find the layer thickness. Assume reasonable value of missing data, if any.



$$D^{\circ}_1 \geq \frac{SN_1}{a_1}$$

$$SN^{\circ}_1 = a_1 D^{\circ}_1 \geq SN_1$$

$$D^{\circ}_2 \geq \frac{SN_2 - SN^{\circ}_1}{a_2 m_2}$$

$$SN^{\circ}_1 + SN^{\circ}_2 \geq SN_2$$

$$D^{\circ}_3 \geq \frac{SN_3 - (SN^{\circ}_1 + SN^{\circ}_2)}{a_3 m_3}$$

- 6(a) Differentiate between:

(i) Truck factor and load equivalency factor

(ii) Effective roadbed soil resilient modulus and modulus of subgrade reaction

(iii) Asphalts and tars

(11  $\frac{1}{4}$ )  
(CO3-PO2)

- (b) An asphalt mix is being optimized using Marshall method. Using a given job mix composition, several lab specimens were prepared and tested using Marshall method. For starting optimization process, asphalt volumetrics need to be calculated. Determine Gmb, VMA, air voids for the mixes with different bitumen content for mix design purpose and comment on the values obtained (VMA and air void).

(15)  
(CO4-PO3)

Aggregate type	Weight in mix	Bulk specific gravity
Course	45%	2.68
Fine	48%	2.76
Filler	7%	2.72

Bitumen Content	Weight of Specimen, gm		Stability (kN)	Flow (mm)	Gmm
	In Air	In Water			
4% (Mix1)	1330	780	7.11	2.6	2.54
5% (Mix 2)	1380	825	7.65	3.1	2.57
6% (Mix 3)	1392	828	7.49	3.3	2.55

7(a) Distinguish between 1) bulk and apparent specific gravity, 2) VMA and VFA. Also, describe the significance of Maximum Specific Gravity.

(11<sup>1</sup>/<sub>4</sub>)  
(CO3-PO2)

(b) For low cost road, the consultant suggests a target aggregate blend. You have two sources but you may need to find a 3rd source to meet the target blend. Please provide an expected gradation for the 3rd source (if required) and find blend percentage from each source. (Max 2% variation from target blend is allowed). You will need to use at least 15% from each source in the job mix.

(15)  
(CO4-PO3)

	Size	Size (mm)	Target Grading (passing)	Source 1 (Passing)	Source 2 (passing)	Source 3 (passing)
Passing	1 -1/2	(37.5)	100	100	100	?
Passing	1	(25.0)	100	100	100	?
Passing	3/4	(19.0)	100	100	100	?
Passing	1/2	(12.5)	95.52	86	100	?
Passing	3/8	(9.5)	84.34	52	100	?
Passing	#4	(4.75)	64.58	10	90	?
Passing	#8	(2.36)	50.27	7	69	?
Passing	#16	(1.18)	36.36	6	56	?
Passing	#30	(0.60)	25.45	6	47	?
Passing	#50	(0.30)	17	5	36	?
Passing	#100	(0.15)	10.15	4	23	?
Passing	#200	(0.075)	5.757	2.8	12	?

8(a) What is the procedure and design parameters of Marshall test method? Discuss the parameters that are obtained from this test, usual range of these parameter and corresponding potential pavement distresses if the mix is shown inadequate from Marshall test.

(11<sup>1</sup>/<sub>4</sub>)  
(CO3-PO2)

(b) As a consultant, you are requested to troubleshoot several types of asphalt mixes, each showing one or more issues. Provide preliminary solution for following mix issues:

(15)  
(CO4-PO3)

1. Low flow value
2. High flow value
3. Low voids and good stability
4. High voids and good stability
5. Good voids and low stability
6. Low voids and low stability



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

Referred Final Examination

Summer Semester: 2020-2021

Course No.: CEE 4655

Full Marks: 150

Course Title: Civil Engineering Data Analysis

Time: 3.0 Hours

There are 8 (Eight) questions. Question No. 1, 2, 3, 8 are compulsory. Answer any 2 (two) questions from Question No. 4, 5, 6 and 7. Programmable calculators are not allowed. It's an **OPEN BOOK** exam. Only **ONE TEXT BOOK** is allowed in the exam. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1(a) Suppose that the distribution function of X is given by

(10)

(CO1-PO1)

$$F(b) = \left\{ \begin{array}{ll} 0 & b < 0 \\ \frac{b}{4} & 0 \leq b < 1 \\ \frac{1}{2} + \frac{b-1}{4} & 1 \leq b < 2 \\ \frac{11}{12} & 2 \leq b < 3 \\ 1 & 3 \leq b \end{array} \right\}$$

(i) Find  $P\{X = i\}, i = 1, 2, 3.$ (ii) Find  $P\left\{\frac{1}{2} < X < \frac{3}{2}\right\}$ 

(b) The amount of time, in hours, that an instrument in environmental laboratory functions before breaking down is a continuous random variable with probability density function given by (10)

(CO1-PO1)

$$f(x) = \begin{cases} \lambda e^{-\frac{x}{100}} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

What is the probability that

- (i) the instrument will function between 50 and 150 hours before breaking down  
(ii) it will function less than 100 hours?

(c) A recent survey by the Department of Civil and Environmental Engineering in IUT revealed 77 percent of students graduating with a major in Structural Engineering don't select Steel Structure course. Suppose we select a sample of 15 recent graduates. What is the probability five select steel structure? (05)

(CO1-PO1)

- (d) Automobiles arrive at Elkhart exit of the Indiana Toll Road at a rate of two per minute. The distribution of arrivals approximates a Poisson distribution. What is the probability that fewer than three automobiles arrive during a particular minute? (05) (CO1-PO1)
- (2) Consider the model result from STATA below: (30) (CO3-PO4)

The regression equation is

$$Y = 517.46 + 11.5X_1 - 8.14X_2 + 10.9X_3$$

Predictor	Coefficient	Standard Error	T-value	P-value
Constant	517.46	11.76	?	?
$X_1$	11.4720	?	36.50	?
$X_2$	-8.1378	0.1969	?	?
$X_3$	10.8565	0.6652	?	?

S=10.2560      R-Sq=?    R-Sq(adj) = ?

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	?	347300	115767	?	?
Residual Error	16	?	105		
Total	19	348983			

- (a) Fill in the missing values. Use bounds for the P-values.
- (b) Is the overall model significant at  $\alpha = 0.05$  ? Is it significant at  $\alpha = 0.01$  ?
- (c) Discuss the contribution of the individual regressors to the model.
- (3) Bardi Trucking Co., located in Cleveland, Ohio, makes directives in the Great Lakes region, the Southeast, and the Northeast. Jim Bardi, the president, is studying the relationship between the distance a shipment must travel and the length of time, in days, it takes the shipment to arrive at its destination. To investigate, Mr. Bardi selected a random sample of 20 shipments made last month. Shipping distance is the independent variable, and shipping time is the dependent variable. The results are as follows: (30) (CO3-PO4)

Shipment	Distance (miles)	Shipping Time(days)	Shipment	Distance (miles)	Shipping Time(days)
1	656	5	11	862	7
2	853	14	12	679	5
3	646	6	13	835	13
4	783	11	14	607	3
5	610	8	15	665	8
6	841	10	16	647	7
7	785	9	17	685	10

8	639	9	18	720	8
9	762	10	19	652	6
10	762	9	20	828	10

- i) Draw a scatter diagram using a normal graph paper. Based on these data, does it appear that there is a relationship between how many miles a shipment has to go and the time it takes to arrive at its destination?
- ii) Determine the coefficient of correlation. Can we conclude that there is a positive correlation between distance and time? Use the 0.05 significance level.
- iii) Determine and interpret the coefficient of determination.
- iv) Determine the standard error of estimate.
- 4(a) The daily dissolved oxygen (DO) concentration for a stream at a station has been recorded for 30 days. The daily level of DO concentration is known to vary with a standard deviation  $\sigma = 2.05$  mg/l. From the sample of 100 observations, the sample mean is calculated to be  $\bar{X} = 3.50$  mg/l. Determine 88% confidence interval for the mean daily DO concentration. Explain your result. (10)  
(CO2-PO2)
- (b) The school nurse thinks the average height of 7th graders has increased. The average height of a 7th grader five years ago was 145 cm with a standard deviation of 20 cm. She takes a random sample of 200 students and finds that the average height of her sample is 147 cm. Are 7th graders now taller than they were before? Conduct a hypothesis test using a 0.02 significance level. Draw a conclusion of your analysis based on the p-value of the test. (10)  
(CO2-PO2)
- 5(a) A car showroom owner knows that, on average, sales in its stores are 20% higher in December than in November. For a random sample of six stores the percentages of sales increases were found to be: 19.2, 18.4, 19.8, 20.2, 20.4, and 19.0. Assuming a normal population, test at a 10% significance level the null hypothesis (use a p-value approach) that the true mean percentage sales increase is at least 20, against a one-sided alternative. (10)  
(CO2-PO2)
- (b) In order to meet the standards in consignments of a chemical product used in environmental engineering laboratory, it is important that the variance of their percentage impurity levels does not exceed 4. A random sample of twenty consignments had a sample quasi-variance of 5.62 for impurity level percentages. Perform a suitable test of hypothesis ( $\alpha = 0.1$ ). (10)  
(CO2-PO2)

- 6 (a) The manager of a fleet of automobiles is testing two brands of radial tires. He assigns one tire of each brand at random to the two rear wheels of eight cars and runs the cars until the tires wear out. The data (in kilometers) follow. Find a 99% confidence interval on the difference in mean life. Which brand would you prefer, based on this calculation? (10)  
(CO2-PO2)

Car	Brand 1	Brand 2
1	36925	34318
2	45300	42280
3	36240	35000
4	32100	31950
5	37210	38015
6	48360	47800
7	38200	37810
8	33500	33215

- (b) Two suppliers manufacture a gear used in a car. The impact strength of these gears measured in foot-pounds is an important characteristic. A random sample of 10 gears from supplier 1 results in  $\bar{X}_1 = 290$  and  $s_1 = 12$ , while another random sample of 16 gears from the second supplier results in  $\bar{X}_2 = 321$  and  $s_2 = 22$ . Is there sufficient evidence to conclude that the variance of impact strength is different for the two suppliers? Use  $\alpha = 0.05$ . (10)  
(CO2-PO2)
- (7) The spot speed data shown in Table below was taken from Airport Road between 10AM and 11AM on Thursday Mar 28, 2021. Use Chi-square Goodness-of-Fit test to justify whether the sample is assumed to be represented by normal distribution or not. (20)  
(CO2-PO2)

Spot Speed Data				
85	69	101	98	86
66	91	61	69	93
101	74	59	50	69
83	75	70	74	75
66	72	78	77	99
63	77	93	59	77
88	82	75	82	86
54	70	59	51	87
69	74	75	75	75
91	85	51	62	58
75	83	86	77	80
59	58	101	99	69
93	91	85	95	77

- 8(a) A sample of 300 cars having cellular phones and 400 cars without phones were tracked for 1 year. The following table gives the number of these cars involved in accidents over that year. (10) (CO2-PO2)

	Accident	No Accident
Cellular phone	22	278
No phone	26	374

Use the above to test the hypothesis that having a cellular phone in your car and being involved in an accident are independent. Use the 5 percent level of significance.

- (b) An experiment was initiated to study the effect of a newly developed gasoline detergent on automobile mileage. The following data, representing mileage per gallon before and after the detergent was added for each of eight cars, resulted. (10) (CO2-PO2)

Car	Mileage without Additive	Mileage with Additive
1	24.2	23.5
2	30.4	29.6
3	32.7	32.3
4	19.8	17.6
5	25	25.3
6	24.9	25.4
7	22.2	20.6
8	21.5	20.7

Find the p-value of the test of the hypothesis that mileage is not affected by the additive when

- (i) the sign test is used;
- (ii) the signed rank test is used.

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Name of the Program: B. Sc. in Civil Engineering

Date: 4<sup>th</sup> April, 2022Semester: 8<sup>th</sup> Semester

Time: 10:00 am – 1:00 pm

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

Semester: Final Semester Examination

Summer Semester: 2020-2021

Course No.: CEE 4831

Full Marks: 100

Course Title: Environmental and Social Impact Assessment

Time: 3 hours

There are 7 (Seven) questions. Answer 6 (Six) questions, where Questions from 1 to 5 are **COMPULSORY** and answer either **Question 6 or 7**. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks and corresponding CO and PO. Symbols convey their usual meanings. Assume reasonable data/values for any missing data/info.

		Full Marks	CO	PO
1.	An important Liquefied Natural Gas (LNG) industry will be established in a coastal region in Teknaf of Bangladesh. The activity of this company is to be very rigorous and requires conducting an EIA. As a consultant, you are conducting a baseline study in the area. The project action may affect several physical, biological, and social environments like topography, soil, geology, seismology, meteorology, air quality, noise, hydrology, groundwater, surface water, flora, fauna, social impact, land use pattern.			
(a)	Describe the flow chart of various activities during the Baseline Survey.	7	CO1	PO1
(b)	Prepare a table showing all the mentioned (above) environmental components, parameters to be studied, and sources of data.	7	CO3	PO6
(c)	Write down the merits and demerits of public participation to obtain sustainability of a project.	3	CO4	PO7
2.	(a) Explain the concept of environmental impact with a graph.	3	CO1	PO1
(b)	Write down the different characteristics and methods for impact identification, prediction, and evaluation.	7	CO2	PO2
(c)	Calculate the EIV from the following data and comment on your result.	7	CO3	PO6
	Scale : +5 severely positive impact	0: change	no	+5 severely negative impact

ENVIRONMENTAL PARAMETERS	Relative Importance Value	Degree of Impact	ENVIRONMENTAL PARAMETERS	Relative Importance Value	Degree of Impact
<b>I. PHYSIO-CHEMICAL</b>			<b>III. ECOLOGICAL</b>		
Erosion and Siltation	2	-2	Fisheries	10	-3
Regional Hydrology/Flooding Drainage	8	-2	Forest	5	-2
Congestion/Water Logging	6	-3	Tree Plantation	4	3
Obstruction to Waste Water Flow	5	-1	Wetland/Wetland Habitat	7	1
Dust Pollution/ Noise Pollution	6	-2	Plant/Eutrophication	3	-4
Water Pollution	7	-3	Endanger Species	5	-2
Bank stability	3	-1	Species Diversity	5	-2
<b>II. HUMAN INTEREST</b>					
Loss of Agricultural Lands	10	3			
Employment Opportunities	12	5			
Navigation/Boat Communication	10	-3			
Commercial and Service Facilities	14	3			
Industrial Activities	8	4			
Irrigation Facilities	8	5			
Landscape	5	-1			

3. You are a part of a team of renowned consultancy firm working for the Bangladesh Economic Zones Authority (BEZA) on "Development of Mirsarai Economic Zone (30,000 acres) at Mirsarai Upazila, Chittagong on the bank of Sandwip channel in Bangladesh" project. You must undertake a detailed Environmental Impact Assessment (EIA) report for the proposed economic zone at Mirsarai.
- (a) Describe the fundamental characteristics of a good quality EIA report. 4 CO1 PO1
- (b) Prepare a 'Table of Contents' for an EIA report on the proposed project. 12 CO1 PO1
4. A national development project, MRT (Phase I), is proposed from Diabari, Uttara to Mirpur. As a consultant you have identified several significant environmental impacts from the proposed project. Now you are in the final stage of the report and preparing an EMMP to protect environment from deterioration.
- (a) What is EMMP? Sketch the elements of impact mitigation strategy and discuss briefly. 6 CO1 PO1
- (b) Analyze the framework for the preparation of EMMP during construction and O&M of the MRT project with a diagram. 5 CO2 PO2
- (c) What would be your prescribed mitigation measures to reduce adverse impacts to obtain sustainability? Explain the compensation or off-set measures in impact mitigation strategy to make it a sustainable development project. 6 CO4 PO7
5. (a) Differentiate between SIA and SEA. 2 CO1 PO1
- (b) Analyze the different procedures in conducting a review of the quality of EIA report prepared for BEZA (in Question 3). 6 CO2 PO2

- (c) State the requirement for air quality standards according to National Ambient Air Quality Standards [NAAQS, 2005] in Bangladesh and WHO guidelines (with Interim Target values). 9 CO5 PO8
  
- 6. A power plant construction project is proposed to establish adjacent to the IUT campus. What would be your prescribed EMMP in mitigation stage for the potential environmental impacts from the project? Mention the possible project activities, potential environmental impacts, proposed mitigation measures, institutional responsibilities and costs. Represent in a tabulated form by considering construction and operation phases only. 16 CO3 PO6
  
- 7. (a) Sketch a process with 3Ps in SEA. Describe 3Ps for evaluating environmental impacts in SEA. How does issues of 'why' and 'if' are strategic? Explain with a diagram. 8 CO3 PO6
  
- (b) Sketch a social assessment process cycle in SIA. What types of social impacts can be addressed while conducting SIA? Describe briefly. 8 CO3 PO6



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

Midterm Examination  
Course Number: CEE 4835  
Course Title: Environmental Modeling

Summer Semester: 2021–2022  
Full Marks: 150  
Time: 3 Hours

There are 7 (seven) questions. You can answer any 6 (six) questions. Marks of each question and corresponding CO and PO are written in the brackets. The figures in the right margin indicate marks. The symbols have their usual meanings.

- |                                                                                                                                                                                                                                                                                                                                             | Full Mark | CO  | PO  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|-----|
| (1) a) Figure 1 shows a river that receives wastewater from a sewage treatment plant at kilometer point 0 (KP 0) and a tributary inflow at KP 40. For 80 km downstream from the treatment plant, there is a CBOD settling removal rate of $0.25 \text{ d}^{-1}$ . If the stream is at sea level, compute the following at KP '0' and '40' – |           |     |     |
| i. the concentration of BOD                                                                                                                                                                                                                                                                                                                 | [5]       | [2] | [2] |
| ii. the oxygen saturation                                                                                                                                                                                                                                                                                                                   | [5]       | [2] | [2] |
| iii. the amount of oxygen deficit                                                                                                                                                                                                                                                                                                           | [5]       | [2] | [2] |
| iv. the concentration of dissolved oxygen                                                                                                                                                                                                                                                                                                   | [5]       | [2] | [2] |

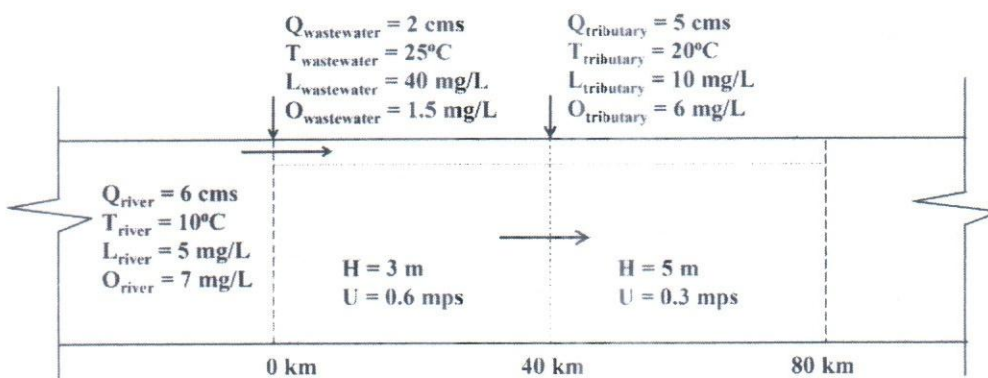


Figure 1

Necessary details are provided in Appendix for Question 1.

- b) Suppose a river receives wastewater from a sewage treatment plant. Show the effect of this sewage treatment plant effluent on the river biota through graphical representation. [5] [1] [1]

- (2) a) A point source Gaussian Plume Model for a power plant emitting CO has an effective stack height as 25 m (Figure 2). The night is overcast with surface wind speed stays less than  $2 \text{ m s}^{-1}$ . Your concern is with ground level pollution at two locations, A and B, which are 1.2 and 1.4 km directly downwind from the stack.

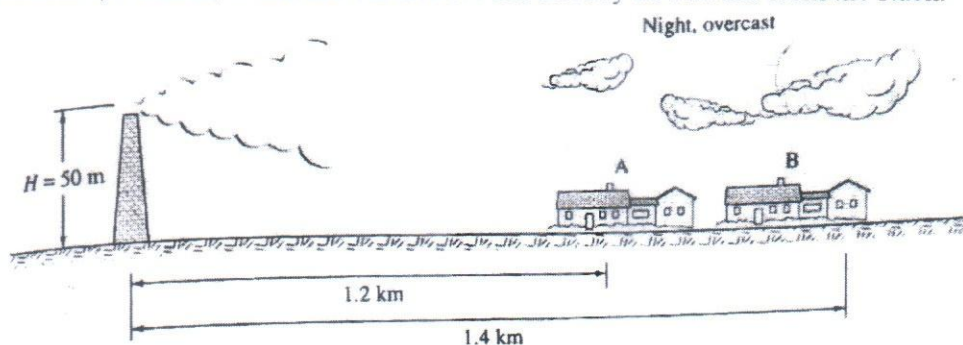


Figure 2

- At what distance will the maximum concentration of pollution occur? Which location (A or B) would have the higher level of pollution? [2.5] [2] [2]
- Suppose the sky clears up and the windspeed stays at  $6 \text{ m s}^{-1}$ . Will the location downwind at which the maximum concentration occurs move? If so, will it move closer to the stack or further way from the stack? Which house would experience the most pollution? (H remains as 25 m) [2.5] [2] [2]

Necessary details are provided in Appendix for Question 2.

- b) Suppose a bonfire emits CO at the rate of  $20 \text{ g s}^{-1}$  on a clear night when the wind is blowing at  $2 \text{ m s}^{-1}$ . If the effective stack height at the fire is 6 m, (i) what would you expect the ground level CO concentration to be at 400 m directly downwind? (ii) Estimate the maximum ground level concentration. Refer to Appendix for Question 2 for additional information. [7.5] [2] [2]
- c) A stack emits  $600 \text{ g s}^{-1}$  gas the molecular weight of which is 28 g. Maximum NO in the exhaust gas is 30 ppm. The stack has an effective height of 100 m. The windspeed is  $4 \text{ m s}^{-1}$  at 10 m height. It is a clear summer day with sun nearly overhead. Estimate the NO concentration at a point located 2 km downwind and 0.1 km off the downwind axis. [7.5] [2] [2]
- d) Explain three major atmospheric stability classes with respect to environmental and adiabatic lapse rate. [5] [1] [1]

- (3) a) A well serving an industry pumps at  $1.5 \text{ m}^3 \text{ s}^{-1}$  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 1700 m North and 600 m West; station B is 100 m south; and station C is 100 m north and 500 m west. Hydrogeologists determine that the phreatic aquifer is in an infinite flow domain, is 10 m thick, has hydraulic conductivity of  $0.025 \text{ m s}^{-1}$  and has a regional hydraulic gradient of 0.005 from north to south. In this circumstance, which of the lawyers will have a difficult time defending his client (Figure 3 is provided for your reference)? Justify your answer.

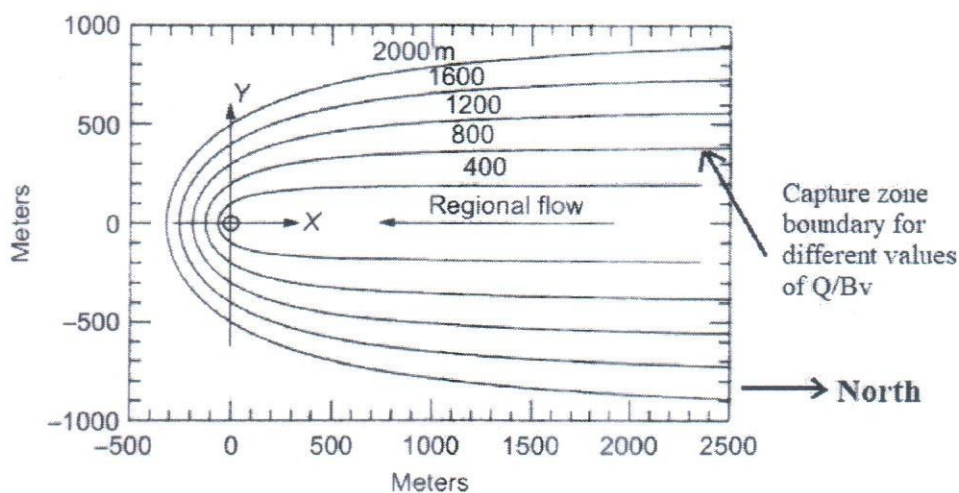


Figure 3

- b) In 2020, gasoline contamination was discovered during a routine site assessment at an urban site shown in Figure 4. It is not known how long before 2020 this contamination reached the site, assuming that it originated off-site. At the site, hydraulic conductivity is  $100 \text{ ft day}^{-1}$ , porosity is 0.3, gradient (in direction indicated) is 0.00225, and transverse dispersivity is 8 ft. Make a justified recommendation as to which gas station or stations are the likely culprits (include all assumptions): Station A was established in 2008; Station B in 2016; and Station C in 2014.

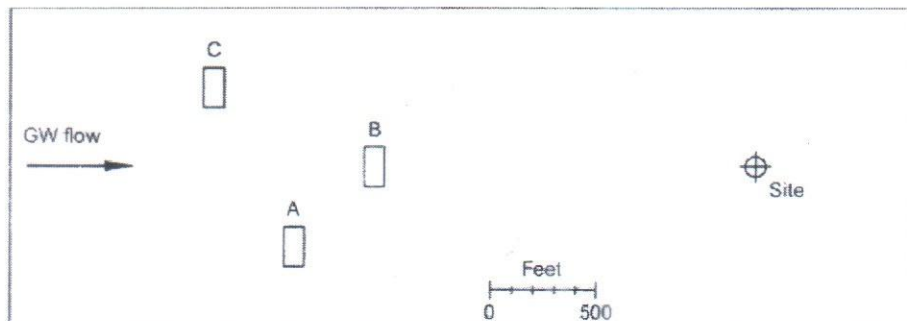


Figure 4

- c) In a sand having a median grain size of 0.1 mm and porosity of 0.25, such as might be used to pack a column for a lab-scale experiment, how high must seepage velocity be to make the mechanical dispersion coefficient equal to the effective molecular diffusion coefficient? [5] [2] [2]
- d) Why is longitudinal dispersion stronger than transverse dispersion? [2.5] [1] [1]
- e) What is meant by NAPL and DNAPL? Why removal of DNAPL and NAPL is difficult from groundwater? [2.5] [1] [1]
- (4) A total phosphorus mass balance for Dhanmondi lake ( $V = 1634 \times 10^9 \text{ m}^3$ ) can be solved at steady state for

$$P = \frac{W}{Q + vA}$$

where  $P$  = total phosphorus concentration ( $\text{mg m}^{-3}$ )  
 $W$  = total phosphorus loading ( $\text{mg yr}^{-1}$ ) = 10000 mta  
 $Q$  = outflow ( $\text{m}^3 \text{ yr}^{-1}$ ) =  $212 \times 10^9 \text{ m}^3 \text{ yr}^{-1}$   
 $v$  = an apparent settling velocity ( $\text{m yr}^{-1}$ )  
 $A$  = lake-surface area =  $19000 \times 10^6 \text{ m}^2$

- a) Apply this model to calculate the total phosphorus concentration of Dhanmondi lake in the early 2020s. Assume that the settling velocity is  $12.4 \text{ m yr}^{-1}$ . [2.5] [2] [2]
- b) Suppose you have additional data available indicating that the settling velocity can range from about 4 to  $40 \text{ m yr}^{-1}$ . Use this information and a first-order sensitivity analysis to translate this range into an uncertainty estimate for the total phosphorus prediction. Express and comment on your result in terms of condition number. [10] [2] [2]
- c) For the case from Question 4a, assume that the settling velocity (in  $\text{m yr}^{-1}$ ) follows the triangular distribution - [7.5] [2] [2]

$$f(x) = \frac{x}{4} \quad 0 \leq x < 2$$

$$f(x) = \frac{4-x}{4} \quad 2 \leq x < 4$$

Determine the phosphorus concentration using Monte Carlo uncertainty analysis. Use a random value of cumulative distribution function as 0.4.

- d) For the case from Question 4a, if the value of  $\frac{\Delta P}{P}$  is obtained as 0.25 for the uncertainty of settling velocity, what will this value represent? [2.5] [1] [1]
- e) Name different methods of sensitivity analysis used for surface water quality modeling. [2.5] [1] [1]

- (5) a) A tanker truck careens off the road and dumps 30,000 L of glucose syrup into a small mountain lake ( $V = 10000 \text{ m}^3$ , initial CBOD =  $5 \text{ g L}^{-1}$ ). If the concentration of the syrup is  $100 \text{ g glucose L}^{-1}$ , [10] [2] [2]
- Compute the grams of CBOD spilled.
  - Determine the lake's saturation concentration of oxygen ( $T = 10^\circ\text{C}$ ; chloride concentration = 10 ppt, elevation = 1100 ft). Also determine the percent saturation of oxygen.
  - Determine the oxygen concentration in the lake.

Necessary details are provided in Appendix for Question 5.

- b) A tall stack and a nearby short stack have plumes as shown in Figure 5. Which atmospheric temperature profile would be most likely to cause that pair of plumes? The solid and dotted line represent the environmental and dry adiabatic lapse rate, respectively. Justify your answer. [2.5] [2] [2]

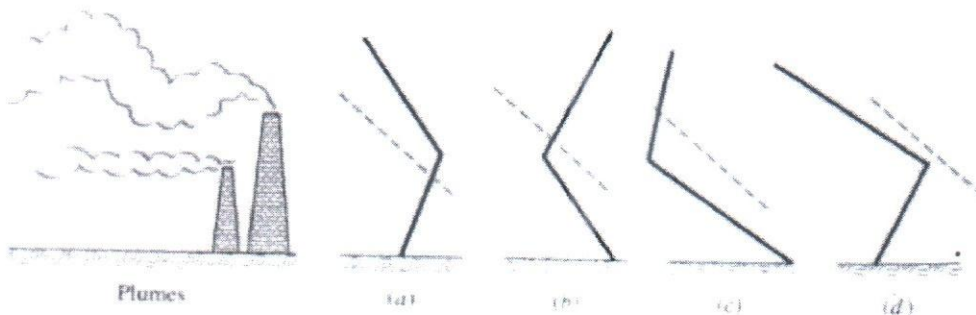


Figure 5

- c) A powerplant stands 120 m high and has an inner diameter at the top as 1.2 m. Emission gas exit the stack at  $130^\circ\text{C}$  at  $10 \text{ m s}^{-1}$  while the ambient temperature is  $10^\circ\text{C}$ . Wind speed at stack height is  $8 \text{ m s}^{-1}$ . It is a clear summer day with sun higher than  $60^\circ$  above the horizon and surface wind speed of  $6 \text{ m s}^{-1}$ , estimate the effective stack height of the powerplant. Refer to Appendix for Question 5 for necessary details. [7.5] [2] [2]
- d) Define temperature inversion and mixing depth. [5] [1] [1]
- (6) a) A pond with a single inflow stream has the following characteristics:  
 Mean depth = 4 m  
 Surface area =  $2 \times 10^5 \text{ m}^2$   
 Water residence time = 3 weeks  
 Inflow BOD concentration =  $5 \text{ mg L}^{-1}$

BOD decays at a rate of  $0.18 \text{ d}^{-1}$  and settles at a rate of  $0.2 \text{ m d}^{-1}$ . A subdivision housing of 1800 people will discharge raw sewage into this system. Each individual contributes about  $200 \text{ gal capita}^{-1} \text{ d}^{-1}$  of wastewater and  $0.4 \text{ lb capita}^{-1} \text{ d}^{-1}$  of biochemical oxygen demand (BOD).

- i. Determine the BOD concentration of the wastewater in  $\text{mg L}^{-1}$ . [2] [2] [2]
- ii. Calculate the assimilation factor for the pond prior to building the subdivision. Which of the purging mechanisms are most effective? List them in decreasing order of effectiveness. [3.5] [2] [2]
- iii. Determine the steady-state concentration for the lake with and without the installation of subdivision. [7] [2] [2]

b) A lake has the following characteristics:

Volume =  $60,000 \text{ m}^3$

Mean depth = 3 m

Inflow = outflow =  $8000 \text{ m}^3 \text{ d}^{-1}$

Temperature =  $20 \text{ }^\circ\text{C}$

The lake receives the input of a pollutant from three sources: a factory discharge of  $75 \text{ kg d}^{-1}$ , a flux from the atmosphere of  $1 \text{ g m}^{-2} \text{ d}^{-1}$ , and the inflow stream that has a concentration of  $20 \text{ mg L}^{-1}$ . If the pollutant decays at the rate of  $0.3 \text{ d}^{-1}$  at  $20^\circ\text{C}$  ( $\theta = 1.05$ ),

- i. Compute the assimilation factor. [2.5] [2] [2]
- ii. Determine the steady-state concentration. [5] [2] [2]

c) Define residence time. Give an example of irreversible reaction related to surface water quality modeling. [5] [1] [1]

- (7) a) Use the cascade model to simulate the steady-state distribution of concentration in an elongated tank shown in Figure 6. The tank has cross-sectional area  $A_c = 20 \text{ m}^2$ , length  $L = 100 \text{ m}$ , velocity  $U = 100 \text{ m hr}^{-1}$ , and first-order reaction rate  $k = 2 \text{ hr}^{-1}$ . The inflow concentration is  $1 \text{ mg L}^{-1}$ . Use  $n = 1, 2$  and  $3$  CSTRs to approximate the concentration in tank. Plot and comment on the results. [12.5] [2] [2]

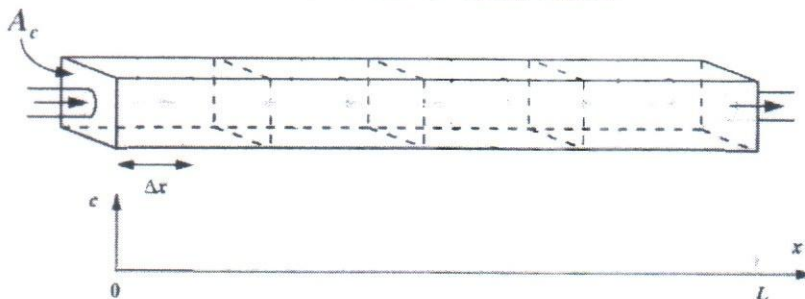


Figure 6

- b) Suppose that three lakes (Lake 1  $\rightarrow$  Lake 2  $\rightarrow$  Lake 3) connected in series have the following characteristics:

Parameters	Units	Lake 1	Lake 2	Lake 3
Loading	kg yr <sup>-1</sup>	2,000	4,000	1,000
Mean Depth	m	3	7	3
Surface Area	10 <sup>6</sup> m <sup>2</sup>	0.667	0.571	1.000
Volume	10 <sup>6</sup> m <sup>3</sup>	2	4	3
Outflow	10 <sup>6</sup> m <sup>3</sup> yr <sup>-1</sup>	1.0	1.0	1.0

If the pollutant settles at a rate of 10 m yr<sup>-1</sup> and concentration in Lake 1 is 260.76  $\mu\text{g L}^{-1}$ .

- i. Calculate the steady-state concentration in Lake 2. [5] [2] [2]
  - ii. Determine the concentration in Lake 3 due to the loading of the Lake 2. [2.5] [2] [2]
- c) Describe the two general ways in which completely mixed reactors can be connected. [5] [1] [1]

Appendix for Question 1

$$k_d = 0.3 \left( \frac{H}{2.4} \right)^{-0.434} \quad 0 \leq H \leq 2.4 \text{ m}$$

$$k_d = 0.3 \quad H > 2.4 \text{ m}$$

$$k_a = 3.93 \frac{U^{0.5}}{H^{1.5}}$$

Units:  $k_a$ (d<sup>-1</sup>),  $U$ (mps),  $H$ (m)

$$\ln o_{sf} = -139.34411 + \frac{1.575701 \times 10^5}{T_a} - \frac{6.642308 \times 10^7}{T_a^2}$$

$$+ \frac{1.243800 \times 10^{10}}{T_a^3} - \frac{8.621949 \times 10^{11}}{T_a^4}$$

Appendix for Question 2**TABLE** ATMOSPHERIC STABILITY CLASSIFICATIONS

Surface wind speed <sup>a</sup> (m/s)	Day solar insolation			Night, cloudiness <sup>e</sup>	
	Strong <sup>b</sup>	Moderate <sup>c</sup>	Slight <sup>d</sup>	Cloudy (≥4/8)	Clear (≤3/8)
<2	A	A-B <sup>f</sup>	B	E	F
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

<sup>a</sup>Surface wind speed is measured at 10 m above the ground

<sup>b</sup>Corresponds to clear summer day with sun higher than 60° above the horizon

<sup>c</sup>Corresponds to a summer day with a few broken clouds, of a clear day with sun 35-60° above horizon

<sup>d</sup>Corresponds to a fall afternoon, or a cloudy summer day, or a clear summer day with sun 15-35° above horizon

<sup>e</sup>Cloudiness is defined as the fraction of sky covered by clouds

<sup>f</sup>For A-B, B-C, or C-D conditions, average the values obtained for each



$$C(x, y, z) = \frac{Q}{2\pi\sigma_y\sigma_z\bar{u}} \exp\left[-\frac{y^2}{2\sigma_y^2}\right] \left\{ \exp\left[-\frac{(z-H)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(z+H)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(z-H-2hm)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(z-H+2hm)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(z+H-2hm)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(z+H+2hm)^2}{2\sigma_z^2}\right] \right\}$$

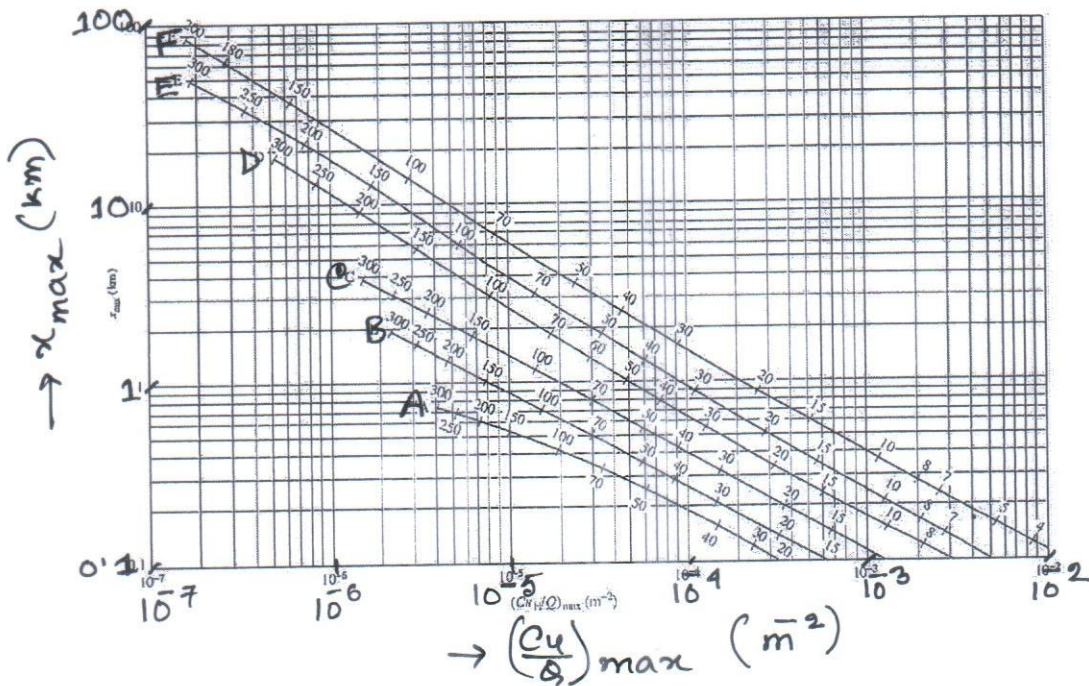


TABLE VALUES OF THE CONSTANTS,  $a$ ,  $c$ ,  $d$ , AND  $f$  FOR USE IN (7.32) AND (7.33)<sup>a</sup>

Stability	$a$	$x \leq 1$ km			$x \geq 1$ km		
		$c$	$d$	$f$	$c$	$d$	$f$
A	213	440.8	1.941	9.27	459.7	2.094	-9.6
B	156	106.6	1.149	3.3	108.2	1.098	2.0
C	104	61.0	0.911	0	61.0	0.911	0
D	68	33.2	0.725	-1.7	44.5	0.516	-13.0
E	50.5	22.8	0.678	-1.3	55.4	0.305	-34.0
F	34	14.35	0.740	-0.35	62.6	0.180	-48.6

<sup>a</sup> The computed values of  $\sigma$  will be in meters when  $x$  is given in kilometers.

$$\sigma_y = a \cdot X^{0.894}$$

$$\sigma_z = c \cdot X^d + f$$

**TABLE** WIND PROFILE EXPONENT  $p$  FOR ROUGH TERRAIN<sup>a</sup>

Stability class	Description	Exponent, $p$
A	Very unstable	0.15
B	Moderately unstable	0.15
C	Slightly unstable	0.20
D	Neutral	0.25
E	Slightly stable	0.40
F	Stable	0.60

<sup>a</sup> For smooth terrain, multiply  $p$  by 0.6; see Table 7.8 for further descriptions of the stability classifications used here.

Appendix for Question 5

$$\ln o_{ss} = \ln o_{sf} - S \left( 1.7674 \times 10^{-2} - \frac{1.0754 \times 10^1}{T_a} + \frac{2.1407 \times 10^3}{T_a^2} \right)$$

$$S = 1.80655 \times \text{Chlor}$$

$$o_{sp} = o_{s1} [1 - 0.1148 \times \text{elev}(\text{km})]$$

$$o_{sp} = o_{s1} [1 - 0.000035 \times \text{elev}(\text{ft})]$$

$$F = g r^2 v_s (1 - T_a/T_s)$$

$$\Delta h = (1.6 F^{1/3} x_f^{2/3})/u$$

$$x_f = 120 F^{0.4}, \quad F \geq 55 \text{ m}^4/\text{s}^3$$

$$x_f = 50 F^{5/8}, \quad F < 55 \text{ m}^4/\text{s}^3$$

$$\Delta h = 2.6 \left( \frac{F}{uS} \right)^{1/3}$$

$$S = \frac{g}{T_a} \left( \frac{\Delta T_a}{\Delta z} + \Gamma \right)$$

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

Semester Final Examination

8th Semester (Summer): 2020 - 2021

Course Number: CEE 4847

Full Marks: 150

Course Title: Sub-surface soil Investigation and In-Situ Testing

Time: 3 Hours

Answer the following questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable values for any data not given.

1. (a) Explain the factors affecting sample disturbance. What are the precautions to be taken in handling and transporting soil samples? Discuss shortly. (08)  
(CO1)  
(PO1)
- (b) Discuss the advantages and disadvantages of using bentonite for borehole stabilization. Also, discuss a standard method for collecting undisturbed samples from a bore hole. (08)  
(CO1)  
(PO1)
- (c) Choose the appropriate type of subsoil exploration for the following cases: (09)  
(i) Deposit of soft plastic clay (CO1)  
(ii) Loose sand deposits (PO1)  
(iii) Rock deposit
2. (a) Give a critical comparison between the standard penetration test and the static cone penetration test. (08)  
(CO1)  
(PO1)
- (b) Suppose that you are going to construct an embankment on soft ground. Discuss the planning steps you will follow for a systematic approach to monitor this work using geotechnical instrumentation. (09)  
(CO1)  
(PO1)
- (c) Explain any one method for soil characterization by using CPT data. (08)  
(CO1)  
(PO1)
3. (a) Discuss various types of SPT hammers with the help of neat sketches. (08)  
(CO1)  
(PO1)
- (b) Explain a bore log with the help of neat sketches and differentiate between the bore log and soil profile. (08)  
(CO1)  
(PO1)
- (c) A pumping test was made in pervious gravels and sands extending to a depth of 45 ft, where a bed of clay was encountered. The normal ground water level was at the ground surface. Observation wells were located at distances of 10 and 20 ft from the pumping well. At a discharge of  $825 \text{ ft}^3$  per minute from the pumping well, a steady state was attained in about 24 hr. The draw-down at a distance of 10 ft was 4.6 ft and at 20 ft was 1.15 ft. Determine the hydraulic conductivity in m/sec. (09)  
(CO2)  
(PO2)
4. (a) With the help of schematic view, discuss the step by step procedure of pressuremeter test (PMT). What limitations are overcome in PMT? Discuss briefly. (12)  
(CO1)  
(PO1)

- (b) A pressuremeter test was conducted at a site. Following are the readings at a depth of 7.5m based on BX probe. Determine pressuremeter modulus and limiting pressure at the depth of investigation. The volume of uninflated probe = 535 cm<sup>3</sup>. (13)  
(CO2)  
(PO2)

Pressure (kPa)	0	40	80	120	200	300	400	500	600	700	800	900
Volume Change (cc)	0	62	104	137	168	184	201	216	260	324	432	608

5. (a) Discuss briefly the procedure for separating end bearing and skin friction resistance from plate load tests. (08)  
(CO1)  
(PO1)
- (b) A footing of size 2.5 × 2.5 m is to be constructed at a site at a depth of 3 m below the ground surface. The water table is at the base of the foundation. The average static cone penetration resistance obtained at the site is 32 kg/cm<sup>2</sup>. The soil is cohesionless. Determine the safe bearing pressure for a settlement of 25 mm. If the settlement of foundation is allowed up to 35 mm, what will be the safe bearing capacity of the same soil. (09)  
(CO2)  
(PO2)
- (c) The field SPT value obtained at a depth of 12m below the ground surface is 22. Apply the methods of SPT correction for different situations and compute the corrected SPT value for dilatancy and overburden pressure for the following cases: (08)  
(CO2)  
(PO2)
- (i) The soil is saturated sand, and its saturated unit weight is 19.2 kN/m<sup>3</sup>.  
(ii) The soil is saturated clay and its saturated unit weight is 18.5 kN/m<sup>3</sup>.

Consider the groundwater table at a depth of 5m below the ground surface. The soil above the water table has a unit weight of 17.8 kN/m<sup>3</sup>.

6. (a) Illustrate briefly the major components of a subsoil investigation report. Also, discuss its limitations. (10)  
(CO1)  
(PO1)
- (b) A plate load test has been conducted on cohesionless soil. The load settlement data is given below. Determine the allowable bearing capacity of the foundation. The permissible settlement of the prototype foundation is 25mm and the factor of safety is 2.5. The sizes of square footings are 2.5m and 0.5m, respectively, for the prototype foundation and the model footing for plate load testing. (15)  
(CO2)  
(PO2)

Pressure on the plate (kPa)	0	50	100	150	200	250	300	350	400	500	700	1000
Settlement of the plate (mm)	0	1.2	2.4	3.7	5.2	7.0	9.0	11.5	14.2	21.0	40.0	80.0

Name of the Program: B. Sc. in Civil Engineering  
Semester: 8<sup>th</sup> Semester

Date: 06 April, 2022  
Time: 10:00 am – 01:00 pm

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

**Semester Final Examination**  
**Course Number: HUM 4851**  
**Course Title: Practice, Communication, and Professional Ethics**

**Summer Semester: 2020 - 2021**  
**Full Marks: 150**  
**Time: 3.0 Hours**

There are 7 (Seven) questions. Answer any 6 (Six) questions. Do not write on this question paper. Marks of each question and corresponding CO and PO are written in the brackets.

- 
1. (a) Explain the following statement regarding Project Evaluation- "Monitoring is about whether we are doing things correctly in the project and evaluation is about whether we are doing the right project" (7.5) (CO1) (PO11)
  - (b) Explain why the provision of Bid Security is included in the contract. Also write TWO advantages and TWO disadvantages of Bid Security. (10) (CO2) (PO06)
  - (c) Company Zed is a real estate company. It has high reputation in the sector for ensuring good quality and timely delivery. Mr. Dihwa, the Chief Technical Officer (CTO) of Zed, who happened to be a Civil Engineer, was discussing with a land owner for a potential business deal. The land owner was looking for a reputed real estate company for constructing a residential building on his land. Dihwa appraised using NPV, payback period etc. tools and found that the project would be a significantly profitable investment for his company. Upon scrutiny he also found out that the land tax for the land was due for several years. After handover from land owner, Dihwa's company would have to pay the due taxes. Dihwa then eventually will get much lower commission from his company as his commission is based on the projected profitability. Dihwa, while submitting his report, did not mention about the due tax payment issue. The company then signed a deal with the land owner. And eventually Dihwa has got his higher commission. (7.5) (CO3) (PO8)

After the official land handover from the land owner, Ms. Omta, a construction project manager was assigned to the project by Zed. Omta was Civil Engineering graduate with over 5-year experience in the construction sector. One day, while Omta was checking the laid out reinforcement of ground floor roof slab, she found out that there were some layout conflicts between the electrical duct layout and reinforcement layout. She assessed that correction of these layout conflicts would require input from both structural engineer and electrical design engineer and she has to suspend the construction work for at least 3 weeks for that. She decided to resolve the layout conflicts by herself and with her best guess, changed the electric layout to accommodate the reinforcement layout. Thus she was able to avoid the 3 weeks' construction delay.

Find out the professional ethics related instances that are mentioned in the case with reference to the appropriate code of ethics. Also briefly suggest preventive mechanism that can be employed to prevent the breach professional ethics incidences that you have identified.

2. (a) Bangladesh government is going to initiate a project to construct a multilane tunnel under a Jamuna river for both road and rail transport. The project will need detail studies including geotechnical investigation, topographic survey, traffic survey, hydrological & morphological study, financial & economical modeling, preliminary design, geometric design, detail structural design, HSES (health, safety, environmental and social) impact study, road safety audit etc. Create a list of critical success factors for this specific project to become successful. (7.5) (CO1) (PO11)
- (b) Discuss about the responsibilities of Quality Control Engineer and Quantity Surveyor in supervision work of a Bridge Construction Project. (10) (CO2) (PO06)
- (c) Explain the terms 'Collective bargaining agent' and 'Trade Union' in context of Bangladesh Labor Law. (7.5) (CO3) (PO8)
3. (a) Explain with justification whether the following statement is TRUE- "Project Evaluation always happen after the completion of the project" (7.5) (CO1) (PO11)
- (b) Explain the term 'Public Private Partnership (PPP)'? How it is different than other types of contract e.g. Admeasurement contract, Time based contract, Lump-sum contract etc.? (10) (CO2) (PO06)
- (c) Ms. Aidhw is a supply chain manager for Yenz International Ltd which a private sector company specialized in supplying read-to-eat lunch meal box for school, offices etc. Recently Yenz received a large order from a new customer. To process with the new order, Aidhw has requested quotation from several suppliers. One prospective supplier, Tyrog Ltd approached Aidhw and expressed their interest. During a meeting between representatives of Tyrog, Aidhw found out that the one of the member of the Tyrog's delegation was a childhood friend of her. Even they were not in contact for long time, Aidhw still became concerned about this relationship issue and was pondering how to properly address it. Explain how Aidhw can assess whether there is a potential for conflict of interest. Also explain how she can address any potential conflict of interest (7.5) (CO3) (PO8)
4. (a) Xen Ltd is a drug manufacturing company specializes in producing lifesaving cancer treatment related drugs. It owns the largest market share in this sector in Bangladesh. Xen was founded by Ms. Osur back in 1980s. She was a visionary entrepreneur and under her prudent leadership, Xen became a behemoth in the pharmaceutical industry. After her demise, her only son, Mr. Luky took over the job to lead the company as the managing director. He, as a young man, always tries to prove himself worthy of his parent's legacy. During December 2020, when the COVID-19 disease was spreading all over the country like bushfire, Mr. Luky was pondering to take license from an US based COVID-19 vaccine producer and start producing vaccine in his existing plant of Bangladesh. He asked his Chief Pharmacist Mr. Zay to check the feasibility of this venture. Zay assessed the existing market condition as well as the current capability of the company. He found out that there was no company which was trying to produce COVID-19 vaccine in Bangladesh at that time. So there was no issue that any competitor was going ahead of Xen by producing the vaccine. Also the exiting capability of Xen's pharmaceutical plants did not have enough provision to manufacture COVID-19 vaccine. If Xen has to establish new plant for this, then the cost will go high which will also make the investment less lucrative as the cost will largely out-weigh the benefit. Also significant time will be required to recoup the investment. Zay informed his findings to his boss, Luky. But Luky was not convinced with the report of Zay. He, then, adamantly, ordered his team to start negotiation with the US based company and subsequently to initiate the production of the vaccine in Xen's local plant." Explain all the 'Project Selection Approaches' that are mentioned in the above case scenario. Explain using relevant examples from the case. (7.5) (CO1) (PO11)
- (b) Define Specification. Write down advantages and limitations of writing specification. (10) (CO2)

- (c) Discuss the significant differences that exist between the Unitarist and Pluralist perspective in dealing with workplace relations. What is the more appropriate approach for practicing in a construction company? Justify your answer. (7.5) (CO3) (PO8) (PO06)
5. (a) A Technology university is considering to launch 'Masters in Construction Project Management' program. The University already offers 'Masters in Civil Engineering' as well as 'Masters in Business Management' programs for the students. Assess TWO strengths, TWO weaknesses, TWO opportunities and TWO threats for this endeavor of the University. (7.5) (CO1) (PO11)
- (b) Sylone is going to invite bid for construction of multistoried building. Before bidding, Sylone was thinking what kind of tools she could use to protect herself in case of any breach of contract by the contractor. Such kind of breach may include abandoning the work by the contractor, contractor's not rectifying the unacceptable part of work etc. Explain what kind of tool or measure Sylone can incorporate in the contract in this context. (10) (CO2) (PO06)
- (c) Explain the practical implications of the following ethical responsibility of ASCE code of ethics 2020 for professional Engineers – "Engineers: Continue professional development to enhance their technical and non-technical competencies." (7.5) (CO3) (PO8)
6. (a) Distinguish between 'Real time Evaluation' and 'Impact Evaluation' of project using relevant examples. (7.5) (CO1) (PO11)
- (b) "The road connecting Netrokona district with the capital suddenly washed out due to a flash-flood incident. Now, the main aim is to restore the transport link by repairing the road as soon as possible. As there is no time to prepare estimation and follow normal competitive procedures of procurement methods, the respective authority is looking for speedy procurement method as well as specialized contract type to employ for this urgent repair work." (10) (CO2) (PO06)  
There are several contract types like Admeasurement contracts, Lump-Sum contracts, Time-based contracts, Reimbursable-cost contracts, Performance-based contracts etc. Also there are several procurement methods for works like Open Tendering method (OTM), Limited Tendering method (LTM), Request for quotation method (RFQM), Direct Procurement method (DPM) etc. Choose the suitable procurement method as well as preferred contract types for the scenario described above.
- (c) Explain the practical implications of the following ethical responsibility of ASCE code of ethics 2020 for professional Engineers – "Engineers: Educate the public on the role of civil engineering in society" (7.5) (CO3) (PO8)
7. (a) Discuss the 'Operating necessity' and 'Competitive necessity' approaches to project selection. (7.5) (CO1) (PO11)
- (b) There are several methods for procurement of Intellectual services e.g. Quality & Cost Based Selection (QCBS), Least Cost Selection (LCS), Quality Based Selection (QBS), Fixed Budget Selection (FBS), and Single Source Selection (SSS) etc. Find out suitable procurement method for the scenarios mentioned below- (10) (CO2) (PO06)
- i. C&B, the largest public sector infrastructure development organization is looking for a consulting firm to design an elevated expressway which would connect east and west end to the capital city. C&B wants to select a consulting firm with good quality. C&B also wants to consider the financial aspects i.e. how much it has to pay to the consultant.
  - ii. The Govt. Revenue collection department (RCB) is going to implement a project aimed at digitizing the tax revenue collection and monitoring system. RCB will select a consulting firm to design and develop a highly complex software required for this digitization. This software is aimed to close the existing gap in tax collection system. So

RCB wants to acquire service of a high quality consulting firm. RCB is willing to pay whatever the consultant with highest quality proposes.

- iii. A bridge construction project is searching for a Consulting firm to conduct a Physical Model Study for designing river bank protection work. But there is only one firm available who are qualified to perform this kind of study.

(c) Write down the fundamental principles of ASCE code of ethics 2020.

(7.5)  
(CO3)  
(PO8)



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

Final Examination

Course No.: CEE 4853

Course Title: Public Transportation System

Summer Semester: 2020-2021

Full Marks: 150

Time: 3.0 hours

There are 8 (Eight) Questions. **Question 1, 2, 3 and 4 are compulsory.** Answer any 3 (three) from Question 5 to 8. The examination is **Open Book**. Marks of each question and corresponding CO and PO are written in the brackets. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume values as necessary.

1. Assume that you have joined as a public transport planner of BRT, Dhaka to reform the whole organization considering societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the company. Identify the objectives that you would like to set for this company. Also, give examples of the performance standards that you would like to establish for the company in the short-term, mid-term and the long-term. (15)  
CO1  
PO6
2. As a public transport planner you are given the responsibility to *assess* four services serving the same route: express bus service, premium bus service, standard bus service, and light rail transit, using TOPSIS. You will be evaluating the services based on the two criteria only. You will choose the criteria in such a way that for one higher is better and for the other one, higher is worse. You will assign weightage to the criteria using AHP method. Generate hypothetical data, show all calculation steps and rank the services from the best to the worst. (30)  
CO3  
PO3
3. Imagine you are responsible to run bus service which is currently operating only on a single route having terminals at A and B. Your service starts from both end at 6:30 AM and runs till 2:00 PM. The depot is located near one of the terminals and it takes the bus 10 min. to travel from the depot to the nearest terminal. Other relevant information will be as follows: (30)  
CO2  
PO1
 

	AM Peak Period 8:00 – 10:00	Base Period Other times
Headways	15 min.	25 min
Scheduled trip time (A to B; B to A)	35 min; 30 min	20 min; 15 min
Min. layover time	2 min	5 min

*Plan the vehicle blocks along with timetable and time-space network representation.*
4. Imagine that you are developing cost model for a bus service that IUT is going to run for it's students. *Construct* these cost models: traditional model, variable cost model and peak and off-peak period models. The service will be covered by 40 buses each having 40 seats. It will run for 7 days a week considering Saturdays and Sundays as the weekends. (30)  
CO2  
PO1
5. You have collected data for a specific time period at a public transport stop and found the headways to be 5, 8, 15, 12, 4, 10, 8, and 20. From this, *estimate* the expected waiting time and expected headway. Do not assume that variation of headway = 0. (15)  
CO2  
PO1

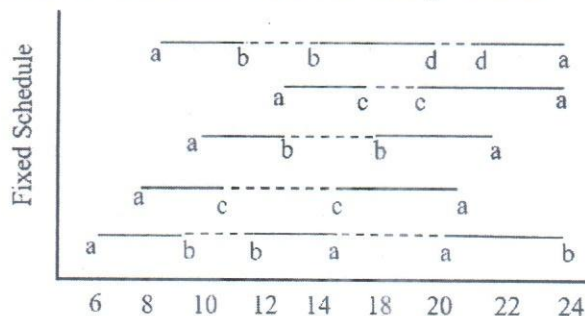
6. Estimate existing and future peak passenger flow and maximum access distance to transit line for a CBD which is crisscrossed by two MRT lines. Given data are: (15)  
CO2  
PO1

	Base year	Future year
Population density (per sq. km)	8,000	12,000
Population density decrease rate	500	800
Corridor length (km)	10	15
One-way trips per person per day	1.75	2.5
CBD bound trip %	0.3	0.4
Transit market share	0.3	0.5
Peak hour trip %	0.15	0.25

7. The utility function of a discrete choice model is given as: (15)  
 $V_{qm} = -(TT_m) - 2(Cost_m)$  CO2  
PO1

Where TT represents travel time. Discuss the weaknesses of this model. Rewrite this equation to properly represent the impacts of socio-economic and demographic influences on mode choice.

8. From the following vehicle schedule, estimate the minimum fleet size from the deficit function. Rearrange the schedule to minimize fleet size requirement. (15)  
CO2  
PO1



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Final Examination  
 Course Number: CEE 6105  
 Course Title: Theory and Design of Steel Structures

Summer Semester: 2020–2021  
 Full Marks: 150  
 Time: 3.0 Hours

There are 6 (SIX) questions. Answer ALL of them. Marks of each question are written in the brackets.

1. The member shown in Fig. 1 has lateral support at points A, B, and C. Bending is about the strong axis. The loads are service loads, and the uniform load includes the weight of the member. A992 steel is used. Determine whether the given member satisfies the appropriate AISC interaction equation of LRFD and ASD design methods. [25]  
 Note: Neglect the moment amplification.

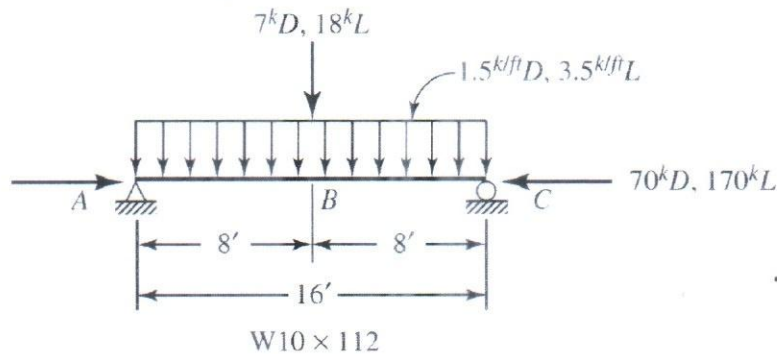


Fig. 1 for Question 1

2. The beam-column member is a part of a braced frame and subjected to the loads as shown in Fig. 2. The loads are 50% dead load and 50% live load. Bending is about the strong axis, and  $K_x = K_y = 1.0$ . Select the lightest W10 shape of A992 steel by ASD method. [25]

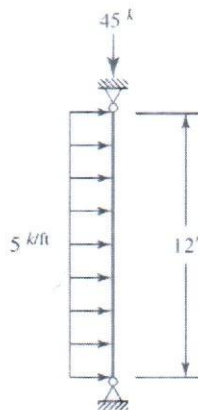


Fig. 2. for Question 2

3. The beam shown in Fig. 3 is laterally braced at A, B, C, and D. Is a W18 × 119 adequate for  $F_y = 50$  ksi? Use LRFD method for your calculation. [25]

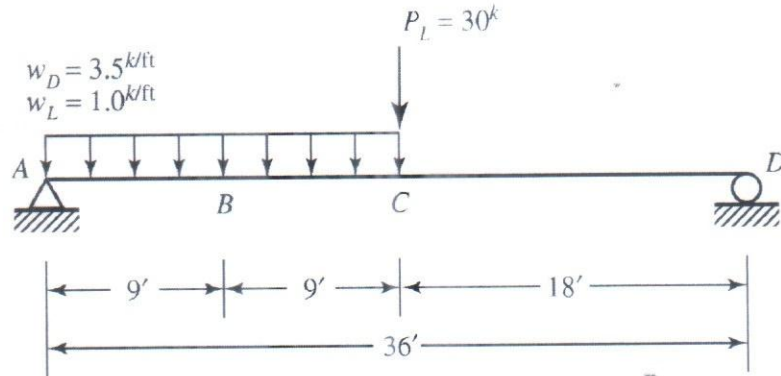


Fig. 3. for Question 3

4. A double-channel shape, 2C8 × 18.75, is used as a tension member. The channels are bolted to a 3/8-inch gusset plate with 7/8-inch diameter bolts. The tension member is A572 Grade 50 steel, and the gusset plate is A36. If LRFD is used, how much factored tensile load can be applied? Consider all limit states. [25]

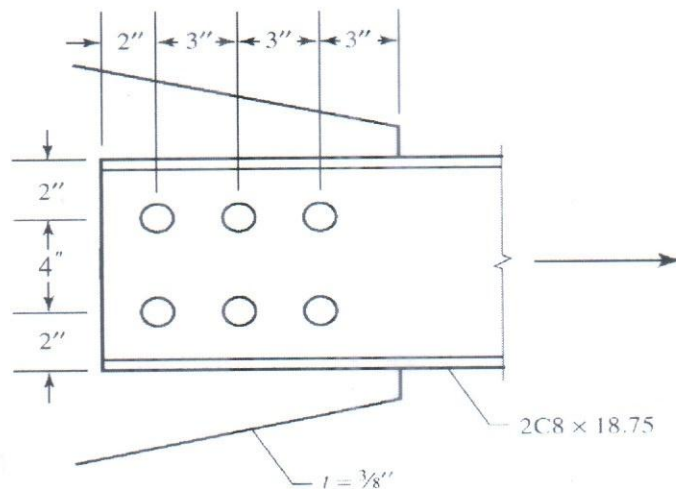


Fig. 4. for Question 4

5. Design an all-welded double angle connection between a W40×431 beam and a W14×233 column flange for beam end dead load and live load reaction of 80 kips and 200 kips, respectively. Use LRFD method. Use 70 ksi electrodes and A36 angles. [25]
6. Design an all-bolted double angle connection between a W33×291 beam and a W12×40 column flange for beam end dead load and live load reaction of 70 kips and 180 kips, respectively. Use LRFD method and A36 angles. [25]

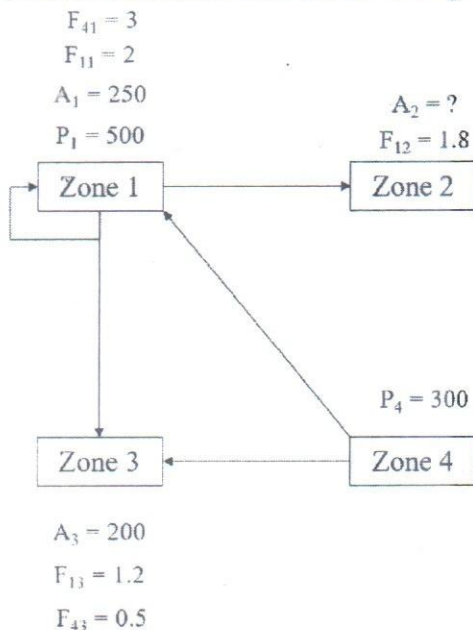
**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**  
**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

Semester Final Examination  
 Course No.: CEE 6505  
 Course Title: Transportation Planning

Summer Semester: 2020-2021  
 Full Marks: 150  
 Time: 3.0 hours

There are 4 (Four) Questions. Answer all the questions. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume any missing values. The examination is open book. Students are allowed to bring books and materials to be used during the examination.

- 1 (a) Prepare a table and present the input variables, surveys to collect data on those input variables and the outputs of a classical 4-step travel demand forecasting model. (15)
- (b) Design the questionnaires for all the major surveys conducted in a 4-step travel demand forecasting study for a city master plan project. Fill each form up with one sample data point (e.g., for household survey, the demographic and trip data of a family). (30)
2. Produce PA matrix from the following data. (15)



3. Consider the following modal-split model between two zones i and j (but we omit the zone indices to alleviate notation): (15)

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

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

Where  $t_k$  is the total travel time in mode k, and  $\theta$  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:

$t_1=12\pm 1$  min,  $t_2=17\pm 2$  min

If the estimated value for  $\theta$  is 0.1, compute a confidence interval for  $P_1$ .

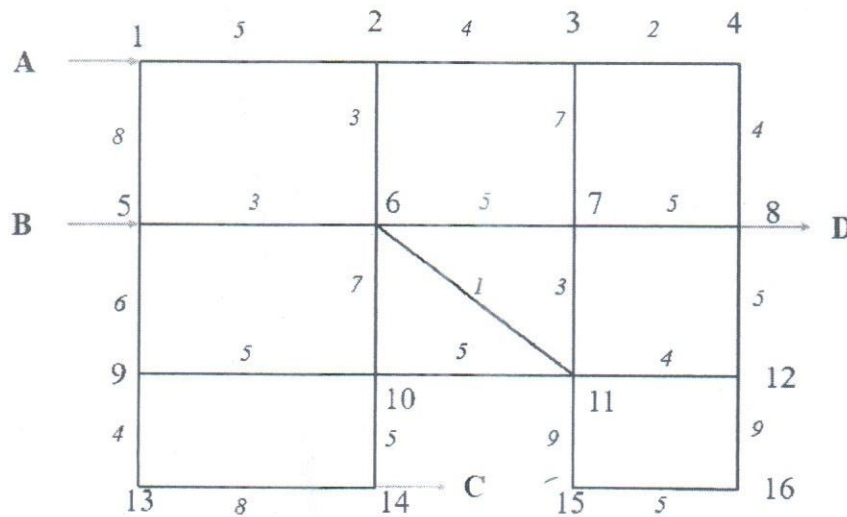
4. The 24-hr HB PA matrix from trip distribution of a study area consisting of 4 zones is given below along with the road network and associated travel time at each link (in *Italic font*). Assume that 80% of daily trips between every zonal pair originate at home and 20% if all HB trips are made during the AM peak. There are only two modes available, i.e., transit (T) and auto (C) and their corresponding utility functions and costs are also given as follows: (75)

$V_T = -0.04(\text{time}_T) - 0.004(\text{cost}_T)$ ;  $V_C = 0.3 - 0.04(\text{time}_C) - 0.004(\text{cost}_C)$

Assume that the transit routes run through the shortest paths among the OD pairs and the total travel time via transit is 20% higher than that with auto as calculated from the network below. Also, the transit cost follows flat fair of 50 Taka, i.e., for all OD pairs, the rider needs to pay 50 Taka irrespective of the distance.

PA				
	A	B	C	D
A	-	1360	1080	4510
B	2370	-	5010	1696
C	3240	1210	-	2403
D	370	800	1760	-

Auto cost				
	A	B	C	D
A	-	100	220	500
B		-	125	450
C			-	275
D				-



Complete the trip assignment (link flow) for auto only assuming auto occupancy to be 1.5 using All-or-Nothing assignment.