Course Title: GIS and Remote Sensing   Course Code: CE 531
Time: 2.00 Hours   Full Marks: 100

Section A
Answer the following questions.
[Marks distribution: 10×1+4×2.5=20]

I.   Answer the following multiple choice questions.   [10*1=10]

(a)   Map makers use GIS to

(i)   store geographic information
(ii)   use geographic information
(iii) view geographic information
(iv)   store, use and view geographic information

(b)   Information in GIS is entered and stored as

(i)   panels
(ii)   layers
(iii) single panel
(iv)   dual-panel

(c)   User can use GIS to make

(i)   complex analyses only
(ii)   display maps only
(iii) complex analyses and display maps
(iv)   none of these

(d)   Pieces of information that provide a description of features in GIS are

(i)   Attributes
(ii)   locations
(iii) vector data
(iv)   maps

(e)   What are the two general data formats used in GIS?

(i)   Vector and raster
(ii)   Points and lines
(iii) Features and attributes
(iv)   Digital and paper maps

I

(f) How are neighborhoods represented in GIS?
   (i)   Polygons
   (ii) Lines
   (iii) Points
   (iv) Locations

(g) Which of the following is true?
   (i)   Raster data are situated in real word
   (ii) TIN Model are situated in real word
   (iii) Digital Elevation Model are situated in real
   (iv) Vector data are situated in real word

(h) The smaller the cell size for the raster layer
   (i)   The lower the resolution and the more detailed the map.
   (ii) The lower the resolution and without the detailed
   (iii) The higher the resolution and without the detailed
   (iv) The higher the resolution and the more detailed the map.

(i) GIS deals with which kind of data
   (i)   Numeric data
   (ii) Binary data
   (iii) Spatial data
   (iv) Complex data

(j) Successful spatial analysis needs
   (i)   Appropriate software
   (ii) Appropriate hardware
   (iii) Competent user
   (iv) All of the above

2.   Answer the following questions. |2.5×4=10|
   (a) Discuss briefly "Hardware" or "People" as one component of GIS.
   (b) Why it is essential to study GIS as an Environmental Engineer?
   (c) List four of the advantages of GIS.
   (d) Discuss briefly Data "Information" as one component of GIS.

2

3. (a) Extract DEM file of Chittagong district from USGS website.   [9]
   (b) Prepare contour map of the Chittagong district and classify the contour map with   [6]
       different color maintaining the contour interval. Find out the location having the
       highest elevation.
   (c) Derive the slope gradient from the DEM file you have extracted. Improve the display;   [5]
       change the number of classes to 15.

4.   Prepare flood maps for the monsoon period of the year 1998 and 2012. Needed files   [9+9+2]
       are provided in the exam folder. Write down the necessary steps required for
       preparing the flood map and the visible changes of inundation level in the examination
       paper.

5. (a) Convert the Google earth formatted file to into a file which will be available under   [5]
       projected co-ordinate system.
   (b) You have been provided with the satellite image of the existing water bodies of Dhaka   [15]
       district for two different years. Measure the changes.[Hint :you can calculate the total
       area of the water bodies for two different years and can compare by using digitization
       tools]

6.   Calculate the water quality index map for the given WASA connections of   [15+5]
       Dhanmondi area. You have been given the quality rating value for the parameters pH,
       TDS, Hardness, B●D, EC as vector formatted file.
       You need to use the equation, $WQI=\sum q_n * w_n$. To calculate the water quality index,
       Given $[w_{n(pH)}=0.22, w_{n(TDS)}=0.004, w_{n(Hardness)}=0.006, w_{n(BOD)}=0.004, w_{n(EC)}=0.12]$. Write
       down the necessary steps required for preparing the flood map in the examination
       paper.

7. (a) Select the name of the Thana where railway station exists. Needed files are provided   [6]
       in the exam folder.

   (b) Classify the different types of road in Malibag area and find out the total coverage   [7]
       (perimeter) of the individual categories. Needed files are provided in the exam folder.

   (c) Categories the different types of location from the places shape file and find out the   [7]
       total area coverage of each type. Needed files are provided in the exam folder.

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B. Sc. Engineering (Civil)

Course Title: Professional Practices & Communication	Course Code: CE 403
Time: 2 hours	Full Marks: 100

[Assume Reasonable Values for Any Missing Data]

PART– A
Answer the following questions.

1. Do you believe the existing procurement practices in Bangladesh are preventing the citizens from getting the best value for their money? Justify your position and suggest ways of improvement if you have any. **(10)**

2. Prepare the Tender Data Sheet (TDS) for a ten storied reinforced concrete hospital building. Consider the estimated project cost to be BDT 30 crore and project duration to be 30 months. **(10)**

3. Prepare the technical specification for concrete works of a mat foundation of a building. Include the following details (if necessary): **(10)**

   - Safety, health and ergonomic consideration   - Materials
   - Storage of materials   - Concrete mix ratio
   - Formwork   - Placing of reinforcement
   - Handling and placing of concrete   - Surface finish and joints
   - Testing and assurance for compliance   - Curing

4. Justify the effectiveness of arbitration as a dispute resolution method and mention the points to consider when selecting an arbitrator. **(10)**

5. Different stakeholders (e.g. ALLIANCE, The Bangladesh ACCORD, National Tripartite Plan of Action, Bangladesh Industrial Police, Department of Inspection for Factories and Establishments, National Parliament and Civil Society) took different initiatives and proposed different measures to ensure the safety of industrial workers following the collapse of Rana Plaza in April 2013.

   (a) Identify different health and safety measures that can be practiced on-site to reduce the impacts of incidents/accidents in the workplace for both the following cases: **(5)**

        (i) Garments factories

        (ii) Construction sites

   (b) Demonstrate the necessity and lacking in workplace culture of prevention and awareness towards health and safety issues at construction projects from Bangladesh context. **(5)**

6. Read the following case report carefully, as you have to assess the situation with logical explanations.

   Engineer A is employed as the City Engineer for a medium-sized city, and is the only licensed professional engineer (and also a civil engineer) in a position of responsibility within the city government. This city has several large food-processing plants that discharge large amounts of waste into the wastewater system during canning season. Engineer A is responsible for the wastewater treatment plant and reports to **City Administrator B** about its operation.

   Engineer A tells Administrator B that the wastewater treatment plant is not capable of handling potential overflow during the rainy season and offers several possible solutions. Mr. B replies that they will face the problem when it happens.

   Engineer A privately notifies other city officials about the wastewater treatment plant problem, but Mr. B removes the responsibility for the sanitation system from Mr. A and gives it to Mr. C, a technician who is normally under Mr. A's supervision. Mr. B instructs **technician C** to report directly to him and confirms this arrangement with a memo, which is copied to engineer A. Mr. A is also placed on probation. He is warned that if he discusses the matter further, he will be terminated.

   Engineer A continues to work for the government as City Engineer; he assumes no responsibility for the wastewater treatment plant, but continues to advise technician C without Mr. B's knowledge. During the monsoon, heavy storms occur in the city. It becomes clear to those involved that if the wastewater treatment plant's waste water is not released into the local river, the ponds will overflow and dump all of the waste into the river. Everyone realizes that Engineer A was right all along.

   (a) Assess Engineer A's actions from engineering ethical point of view. If you were in his position, how would you respond to this situation in case of such conflicts? **(15)**

   (b) Assess Engineer A's actions from the aspects of 'Environment and sustainability'. **(10)**

   (c) Justify City Administrator B's decision when Engineer A disregarded his command in terms of engineering ethical aspects. **(10)**

7. By a group of undergraduate thesis students, two titles were shortlisted for a research project as stated below: **(15)**

   Title 1: Environmental impact assessment of innovative structures for sustainable and eco-friendly construction.

   Title 2: Environmental impact assessment of innovative structures for sustainable and eco-friendly construction through introduction of perforated SIFCON and FRP.

   Evaluate the titles and choose the better one. Defend your choice with logical judgments.

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University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2018
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering X (Concrete Technology)   Course Code: CE 425
Time: 2 hours   Full Marks: 100

Answer all questions

Question 1:

Sketch the schematic diagram of the structure of hydrated silicates of cement.   [10]
Based on your understanding, explain the form of water held in hydrated cement
paste.

Question 2:

A Reinforced Concrete (RC) road will be constructed which is sensitive to thermal   [6+5+4
expansion. To this aim, three types of cement (A, B and C) have been chosen and   = 15]
technical data sheets are collected to pre-investigate the performance of cement in
order to find suitable concrete for that construction. The chemical constituent of
cement (A, B, and C) is given in Table 1.

Table 1: Chemical constituent of cement (A, B, and C)

Bulk Oxide Content	Percentage in Cement		
	A	B	C
CaO	60	67	60
SiO_2	17	25	20
Al_2O_3	7	5	12
Fe_2O_3	3	4.5	3.3
MgO	1.3	1.4	1.1
SO_3	0.1	0.2	0.1
K_2O	0.5	0.4	0.2
Na_2O	0.6	0.5	0.3
LOI	2.9	1.5	2.3

(i) Calculate the silica modulus and Bogue compound contents of three cement.

(ii) From Bogue analysis, find the cements that will provide higher heat and higher
strength of concrete. Based on the knowledge of cement chemistry, make comments on
the mechanical and durability performance of concrete if the RC road is made with
those three cements.

(iii) Based on the silica modulus and Bogue analysis, propose a suitable cement for the
RC road construction and justify your selection.

Question 3:

a. Using schematic diagram, discuss the mechanism for successful pumping of   [5+5 =10]
    concrete.
b. Apply the knowledge to explain the difference between transit mixed ready mix
    and volumetric mixed ready mix.

Question 4:

A concrete retaining wall is constructed to holding back earth, see **Figure 1**. The following necessary data are provided for the concrete retaining wall. |8+2+5 =15|
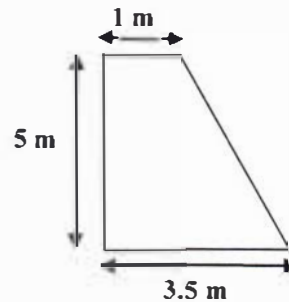
Given data:
For wall element: $C_1 = 1.0$ and $C_2 = 0.45$
Density of concrete = 2550 kg/m^3
Concrete temperature at placement = 10°C
Uniform volume supply rate of 18 m^3/h

End elevation = 10 m long

Figure 1: Retaining wall

(i) Calculating the concrete lateral pressure at every 1.0 m height of a mass concrete retaining wall.
(ii) Draw the pressure envelope for formwork design.
(iii) Based on the knowledge, explain the factors that affect the concrete pressure on formwork.

Question 5:

a. "Addition of air entraining admixture in concrete prevent the formation of cracks due to freezing and thawing cycles". Explain the statement using the schematic diagram and proper mechanism. |6+4=10|

b. Why the silica fume is known as super-pozzolan?

Question 6:

a. Sketch the schematic diagram of the failure mode of normal and high strength concrete in compression and explain how the Interfacial Transition Zone (ITZ) play an important role in the failure mode of concrete. |6+4=10|

b. Illustrate how does the autogenous healing process work.

Question 7:

Identify the mechanisms involved in concrete deterioration by corrosion of embedded steel. |10|

Or

Describe the deterioration of concrete due to carbonation. Explain the measurement of carbonation depth of concrete.

Question 8:

Fire spalling of concrete is a complex phenomenon, which might occur due to pressure build-up in the pores, thermal and external load-induced stresses. In order to avoid fire spalling, three concrete (A, B and C) has been selected and durability* tests such as gas permeability, porosity, and water absorption capacity are performed at elevated temperature. It is noted that among three concrete, one of them contain a certain percentage of polypropylene fibers. Part of the test data are given below:

[20]

Concrete	T [°C]	Mass of dry test specimen [gm]	Apparent mass of immersed test specimen [gm]	Mass of soaked test specimen [gm]
A	100	232	145	243
	200	186	117	196
	400	207	131	221
B	100	240	146	250
	200	241	117	266
	400	239	132	276
C	100	231	145	244
	200	227	117	246
	400	217	134	234

Calculate the apparent porosity of three concrete. The apparent porosity of three concrete A, B and C at 20°C are, respectively, 9, 7 and 11%. Draw the evolution of apparent porosity as a function of temperature (T = 20, 100, 200 and 400°C). Based on the durability test result, propose a suitable concrete which can avoid/minimize the risk of fire spalling. Explain with proper mechanism how and why the proposed concrete is less sensitive to fire spalling.

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering III   Course Code: CE 431

Time: 2 hours   Full marks: 100

Answer all the questions from question no. 1-5. (5 X 20 = 100)
(Assume any missing data)

1. (a)   Show the flow chart of anaerobic digestion process of organic municipal solid waste.   (5)
OR

Why is the energy recovery rate higher in anaerobic digestion than the recovery from landfill?

(b)   Propose a recycling plan to implement in your community in a flow chart. Also mention the factors to consider while planning the recycling scheme.   (8)

(c)   Discuss with examples how you can implement the concepts of source reduction, on-site processing and storage at your home.   (7)

2. (a)   List down the environmental factors affecting both anaerobic digestion and composting.   (4)

(b)   With examples, explain the difference between resource recovery by material separation and resource recovery by material conversion. **OR**   (6)
Compare the suitability of the methods "anaerobic digestion" and "composting" for waste treatment with respect to cost, energy and management options.

(c)   Estimate the theoretical volume of Methane (CH_4), Carbon-di-oxide (CO_2) and Ammonia (NH_3) that would be expected from anaerobic digestion of per ton of waste having the composition $C_{60}H_{194.3}O_{37.8}N$. Also estimate the percentage composition (volume fractions of each gas) of the resulting gas mixture. The density of CH_4, CO_2 and NH_3 at standard temperature and pressure (STP) are 0.7167 kg/m^3, 1.9783 kg/m^3 and 0.696 kg/m^3 respectively.   (10)

3. (a)   Compare 'preventive maintenance' versus 'breakdown maintenance' of collection vehicles.   (3)

(b)   Mention the advantages and the disadvantages of sanitary landfill. **OR**   (7)
Sketch the profiles of gases that are generated along the different stages of digestion in a landfill.

(c)   A transfer station was built with an installation cost of 5,00,000 BDT with yearly   (10)

operational cost being 50,000 BDT. The transfer station is meant to handle 500 tons/day operating 7 days a week. To be operated to and from the transfer station, a tractor-trailor was bought with 1,00,000 BDT which will require 10,000 BDT for yearly operation and maintenance. The truck carries 50 tons/trip. A driver appointed would require 4,000 BDT per month including benefits. The capital cost of the building and transfer trucks are to be amortized over a 20 year period using a 10% discount factor. Suppose it takes 45 minutes to make a one-way trip from the transfer station to the disposal site and 5 round trips per day are made. Find the total cost of transfer station and hauling cost in BDT per ton.

4. (a) Differentiate between putrescible and non-putrescible categories of solid waste with examples of household waste. Provide a brief description on any two physical OR chemical properties of solid waste. (4+6)

(b) A Municipal Solid Waste sample of 100 kg was collected to analyze the physical properties. Estimate the overall moisture content, total and overall energy contents of the waste. (10)

Component	% by Mass	Moisture Content(%)	Energy Content (KJ/Kg)
Paper	31.5	4.2	16900
Plastics	10.2	2.3	31300
Wood	4.6	18.7	19800
Textiles	8.8	9.5	18100
Leather	7.6	10.2	16800
Rubber	5.2	1.9	23400
Metals	12.1	1.3	27000
Food waste	13.6	82	4200
Miscellaneous	6.4	3.4	600

5. (a) List the problems associated with hazardous waste treatment and disposal. Briefly discuss how you would attempt to solve the problems in Bangladesh. (10)
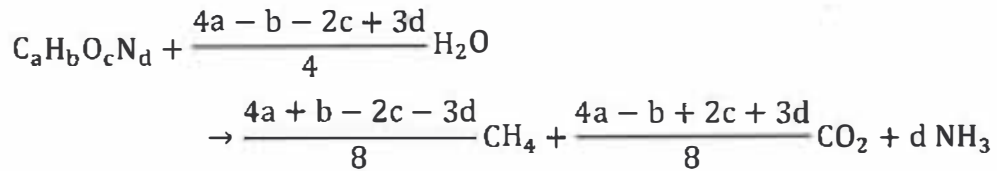
OR

Define "Life Cycle Assessment". If you want to establish an industry, what are the factors you should consider for effective recycle, reuse, collection and disposal of industrial waste?

(b) The following four soil layers are laid between the base of a landfill and the underlying aquifer. How long will it take for leachates to migrate to the aquifer? (10)

Layers of soil	Depth (m)	Porosity (%)	Permeability (m/s)
Layer A	5.0	45	2.5×10^{-8}
Layer B	2.0	42	1.9×10^{-7}
Layer C	3.0	40	5.3×10^{-6}
Layer D	1.0	35	3.8×10^{-5}

Given Formulae:

Energy Content (KJ/Kg) = 338.2C + 1430 (H-O/8) + 95.4S

$$C_aH_bO_cN_d + \frac{4a - b - 2c + 3d}{4} H_2O$$
$$\rightarrow \frac{4a + b - 2c - 3d}{8} CH_4 + \frac{4a - b + 2c + 3d}{8} CO_2 + d\, NH_3$$

$$CRF = \left[\frac{i(1+i)^n}{(1+i)^n - 1}\right] \quad A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

Where, A = Annual cost (BDT/yr)
         P = Purchase price, (BDT)
         i = interest rate, discount rate (yr^{-1})
         n = amortization period (yr)
      CRF = Capital Recovery factor

Average interstitial velocity, $v_p = k/\alpha$

Equivalent permeability, $K_e = \dfrac{\sum d_i}{\sum \dfrac{d_i}{k_i}}$

$$M = \left(\frac{w - d}{w}\right) x100$$

Course Title: Structural Engineering V (Prestressed Concrete)   Course Code: CE 415
Time: 2 (Two) hours   Full Marks: 100

Answer all questions
Assume reasonable values for any missing data. Symbols used have their usual meanings.
[Use E_c 30,000 N/mm^2, E_s 200,000 N/mm^2, f_c' 40 N/mm^2]

QUESTION 1 [10 MARKS]

a. In terms of durability pre-stress concrete would be better than reinforced concrete, explain the statement through comparative study of both methods. [4]
b. Derive the equation $[F_2 = F_1 e^{-\mu\alpha - KL}]$ to calculate loss of pre-stressing due to friction. [4]
c. Differentiate the basic design concepts between Pre-stress Concrete and Reinforced Concrete. [2]

QUESTION 2 [20 MARKS]

A simply supported pre-stressed concrete floor slab of office building (shown in **Figure 1**) is carrying 2.4 kN/m live load and 8 kN/m dead load due to random wall and finishes (excluding slab self weight). The width and thickness of slab is 1000 mm and 300 mm respectively. A curved tendon is provided with an eccentricity of 100 mm below the centroid of the slab section. The initial pre-stressing force (Fi) would be applied on the slab to ensure full pre-stressing condition of slab (zero stress at bottom of slab under service loading condition).
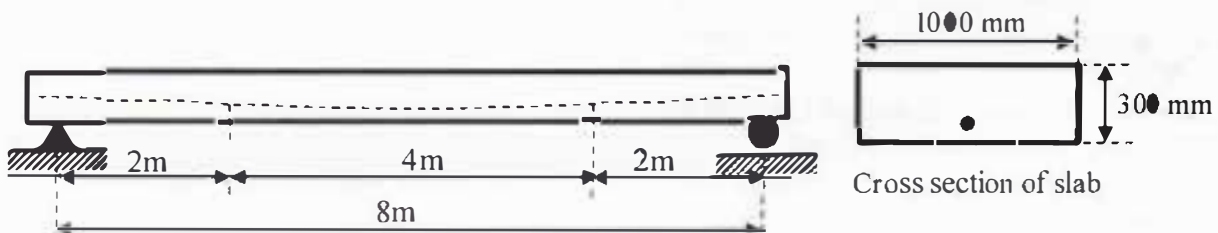

Figure 1. Pre-cast post tension floor slab

a. Calculate loss of pre-stress due to elastic shortening of the slab for pre-tension prestressing system, assume 10% pre-stressing force will be reduced just after transfer of force ($F_0 = 0.9F_i$). [10]
b. Calculate loss of pre-stress due to elastic shortening of the slab for post-tension prestressing system. Assume cross sectional area of each tendon is 195 mm^2 and allowable tensile stress of tendon is 1100 N/mm^2. [10]

QUESTION 3 [30 MARKS]

A simply supported 8 meter span post tension pre-stressed concrete bridge girder is carrying 30 kN/m live load and 40 kN/m dead load from deck slab. The section of the girder is 250 mm x 800 mm. An eccentric curved tendon is provided which is 300 mm below from the centroid of the beam (mid-span).

a. Analyze the girder to obtain the minimum initial pre-stressing force (no tension at bottom of mid span of beam) at service loading condition and check stresses of pre-stressing tendon and concrete (top and bottom) at mid span of beam because of initial pre-stressing force when the beam is subjected to force at transfer and at working load conditions. [20]

b. Analyze the girder to obtain maximum allowable live load for just to cause crack at bottom of mid-span of beam due to same initial pre-stressing force at working loading condition of **Question 3(a)** [modulus of rupture $f_r = 0.62\sqrt{f_c'}$ in psi where f_c' is in psi, f_c' is 40 MPa]. [10]

QUESTION 4 [10 MARKS]

Analyze the beam of **Question 3** for maximum deflections due to initial pre-stressing force and loads when the beam is subjected to force at transfer and at working loading conditions. The loss of pre-stressing is 20%. Assume required data for analysis [$\Delta = \frac{5wL^4}{384EI}$]. [10]

QUESTION 5 [30 MARKS]

A simply supported 8 meter span pre-stressed concrete bridge girder (I section) is subjected to mid-span sagging moment (M_L) of 450 kN-m due to moving load and self weight of deck slab. An eccentric curved tendon is provided which is located at centre of bottom flange of girder (75 mm above from bottom of girder). The girder is required to design at condition of "no tension in concrete".

[Thicknesses of flange and web of I section are 150 mm, allowable stress of pre-stressing tendon is 1100 N/mm², total loss is 20%, assume required data to design].

a. Design the girder using preliminary design method to obtain section and required cross-sectional area of pre-stressing tendon. [15]

b. Finalize the design using elastic design method to obtain section of girder and cross-sectional area of pre-stressing tendon. [15]

University of Asia Pacific
Department of Civil Engineering
## Final Examination Fall 2018
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering VI (Design of Steel Structures)   Course Code: CE 417
Time: 2 hours   Full Marks: 5×20=100

[Assume Reasonable Values for Any Missing Data]
Answer all the questions
Each question has equal mark

1. (a) Define residual stress. Draw a typical hot rolled W-section and show the residual stress diagrams at **(5)** flanges and web.

    (b) Investigate the tension capacity of the plate PL 8×5/8 attached to a gusset plate with eight bolts as **(15)** shown in **Figure 1**. Consider **all the limit states** and assume uniform tension stress. The material is A36 (F_u= 58 ksi) and bolts are 7/8- inch diameter with standard holes. Follow **AISC-LRFD** approach. See **Annexure-1.**

Figure 1
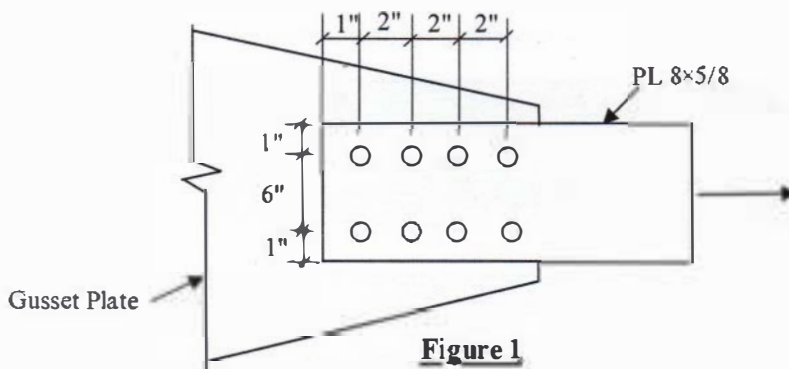
2. (a) Differentiate between groove weld and fillet weld (with rough sketches). **(5)**

    (b) Determine the maximum uniformly distributed load w that can act on a simply supported span of 15 ft **(15)** beam. Lateral supports exist at midspan and at the ends of the span. The service load is 80% live load and 20% dead load. The section is W21×62 of F_y = 50 ksi steel. Use **AISC-LRFD** approach. See **Annexure-2.**

    Note: Beam self-weight is not negligible and hence it must be accounted for.

    Assume that, moment gradient factor C_b = 1.0

3. (a) What are the advantages of structural bolts over rivets? Justify the reasons why rivets are obsolete for **(5)** modern joint construction.

(b)   Determine the number of 3/4-in dia. A325 bolts (F_y=90 ksi, F_u= 120 ksi) in standard holes required to   **(15)**
develop the full strength of A36 (F_u= 58 ksi) steel plates shown in **Figure 2.** Assume the portion of
double lap splice is a bearing type connection with **threads excluded from the shear planes** and a
double row of bolts is used. Show neat sketch of the designed bolted connection. Use **AISC-LRFD**
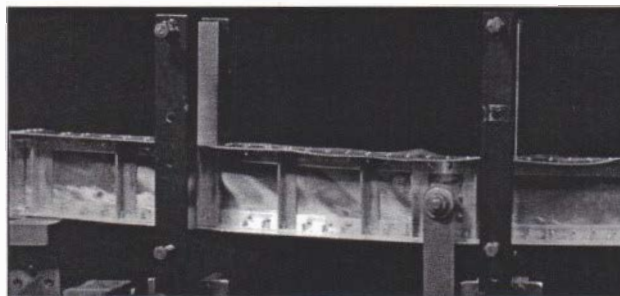method and **ignore block shear mode.** See **Annexure-3.**
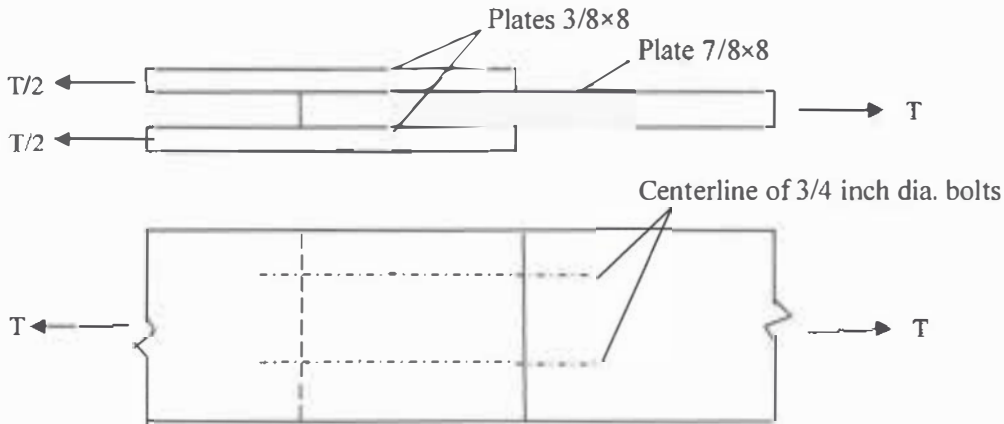
Figure 2

4.   (a)   **Figure 3** shows a beam failed under two point loading test in a laboratory. Discuss the failure   **(5)**
mechanism of the beam. What is the governing parameter for this mode of failure?

Plan view

Longitudinal section
Figure 3

(b)   Select the lightest W section (from **Table 1**) of A992 steel (F_y = 50 ksi) to serve as a column of 20 ft   **(15)**
length to carry an axial compression load of 100 kip dead load and 200 kip live load in a braced frame
structure. The column is assumed to be fixed at top and bottom. Use **AISC-ASD** approach. See
Annexure-4.

Table 1

Shape	A_g (in^2)	r_x (in)	r_v (in)
W 14×68	20.0	6.01	2.46
W 14×61	17.9	5.98	2.45
W 14×53	15.6	5.89	1.92

5. (a) Define 'serviceability of beams'. How is serviceability of a structural component different from its **(5)** strength?

(b) Select the lightest W section (from **Table 2**) to carry a uniform dead load of 0.8 kip/ft and a live load **(15)** of 1.8 kip/ft on a simply supported span of 25 ft. Assume that the sections are compact and adequate lateral support is provided.

The live load deflection is limited to L/360. Use A572 Grade 50 steel and follow **AISC-ASD** approach. See **Annexure-5.**

Note: Check both strength and serviceability criteria. Beam self-weight is not negligible and hence it must be accounted for.

Table 2

Shape	I_x (in^4)	I_y (in^4)	Z_x (in^3)	Z_v (in^3)
W 14×68	722	121	115	36.9
W 14×61	640	107	102	32.8
W 14×53	541	57.7	87.1	22.0

Annexure-1

Block shear capacity: Nominal strength

$R_n = 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$ (shear yielding – tension rupture)

$R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt}$ (shear fracture – tension rupture)

Annexure-2

$$C_b = \frac{12.5M_{max}}{2.5M_{max} + 3M_A + 4M_B + 3M_C}R_m \leq 3.0$$

Factored uniformly distributed load $W_u = 1.2 \times (0.2W) + 1.6 \times (0.8W)$

Design moment, $\emptyset_b M_n = \frac{W_u L^2}{8} + \frac{W_{self\,weight}L^2}{8}$

For compactness of web; $\lambda_p \leq 3.76\sqrt{\frac{E}{F_y}}$

For compactness of flange; $\lambda_p \leq 0.38\sqrt{\frac{E}{F_y}}$

Beam LTB formulae:

$$\frac{L_p}{r_y} = 1.76\sqrt{\frac{E}{F_y}}$$

$$L_r = 1.95r_{ts}\frac{E}{0.7F_y}\sqrt{\frac{Jc}{S_xh_0}}\sqrt{1 + \sqrt{1 + 6.76(\frac{0.7F_y}{E}\frac{S_xh_0}{Jc})^2}}$$ (c=1 for doubly symmetric section)

$$F_{cr} = \frac{C_b\pi^2 E}{(\frac{L_b}{r_{ts}})^2}\sqrt{1 + 0.078\frac{Jc}{S_xh_0}(\frac{L_b}{r_{ts}})^2}$$ (c=1 for this section)

Section properties of W21×62:

d (in)	t_w (in)	b_f (in)	t_f(in)	S_x (in³)	Z_x (in³)	r_y (in)	r_{ts} (in)	h_0 (in)	J (in⁴)
21.0	0.400	8.24	0.615	127	144	1.77	2.15	20.4	1.83

Annexure-3

Nominal strength, $R_n = F_{nv}mA_b$ (shear)

$\qquad\qquad\qquad R_n = 1.2L_etF_u \leq 2.4 F_udt$ (bearing)

Annexure-4

$F_{cr} = [0.658^{F_y/F_e}]F_y$ for $\frac{kL}{r} \leq 4.71\sqrt{\frac{E}{F_y}}$

$F_{cr} = 0.877 F_e$ for $\frac{kL}{r} > 4.71\sqrt{\frac{E}{F_y}}$

Annexure-5

Δ (at midspan) $= \frac{5}{384}\frac{wL^4}{EI}$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2018
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering IV   Course Code: CE 433
Time- 2 hours   Full marks: 100

There are five questions. Answer all the questions. (5 X 20 = 100)
(Assume any missing data)

1. (a) Explain "Primary air pollutants" vs "Secondary air pollutants".   (6)

OR

Explain "Gaseous air pollutants" vs "Particulate air pollutants".

(b) The following air quality data have been recorded at the Continuous Monitoring   (14)
Stations/Systems (CAMS) in Dhaka on April 26, 2018.
$PM_{2.5} = 100 \ \mu g/m^3$ (24 hr)
$PM_{10} = 200 \ \mu g/m^3$ (24 hr)
$CO = 50$ ppm (8 hr)
$O_3 = 0.095$ ppm (8 hr)
$SO_2 = 20$ ppm (24 hr)
Employ the method of AQI estimation and prepare an AQI report for the day.

2. (a) Compare the profiles of adiabatic and environmental lapse rates during stable, neutral,   (8)
and unstable atmospheric conditions using figures. Also show the resulting plumes
types for the mentioned conditions.

OR

Considering fumigating plumes, lofting plume and inversion layers, show and discuss
how comparison of lapse rates can help predicting the gaseous emission from a stack.

(b) A stack emitting 70 g/s of CO has an effective stack height of 150 m. The wind speed is   (12)
4 m/s at 10 m and it is a clear summer day (Stability class B). Estimate the ground level
CO concentration directly downwind at a distance of 3 km. Also estimate the
concentration at a point downwind where CO concentration is maximum.

3 (a) What are the main approaches for vehicular pollution control   (6)

OR

List down the control devices for particulate contaminants and gaseous contaminants.

(b)   Calculate the minimum size of particle that will be removed with 100% efficiency from   (9)
       a settling chamber under the following conditions:
       - Air: Horizontal velocity 0.3 m/s
       - Temperature: 77°C
       - Particle: Sp Gr 2.0
       - Chamber: Length = 7.5 m
       - Height = 1.5 m
At 77°C of air, μ = 2.1 X 10^{-5} kg/m.s
Calculate the fractional efficiency of 20 μm particles in the above settling chamber.

OR

Suppose the ambient atmospheric temp profile of an area is given by the following
equation: Λ(°C) = 30 – 0.005z, when, z = altitude in m.
If maximum surface temperature is 34°C and average wind speed is 4.9 m/s, estimate
the ventilation coefficient and comment on the pollution potential.

(c)   Mention any five options (wedges) that you can adopt to reduce the emission of carbon   (5)
       di oxide (stabilization triangle).

4 (a) Discuss the effect of air/fuel ratio on fuel power, economy and pollution with schematic   (6)
       diagram.

OR

Provide oxidation and reduction reactions in a "2-way" and a "3-way" catalytic
converters.

(b)   What are the components that have to be considered to develop a simple phosphorus   (5+6)
       model in a lake (show in a figure)? Derive the equation for estimating phosphorus
       concentration in a lake using the model.

OR

What are the limiting nutrients and when is each of them limiting? Based on limiting
nutrients, how can you check if a lake is susceptible to eutrophication or not?

(c)   State the effects of "Thermal Pollution" in a water body.   (3)

5 (a) A municipal wastewater treatment plant discharges 0.17 m^3/s of treated effluent having   (20)
       BOD_5 of 40.0 mg/L and DO of 2 mg/L into a stream that has a flow of 0.50 m^3/s and a
       BOD_5 of 3 mg/L and DO of 8 mg/L. The temperature of the river is 25°C. The
       deoxygenation constant k_d is 0.23/day at 20°C. The stream has a depth of 2.6 m and the
       average stream velocity is 0.2 m/s.
           a.   Find the critical distance downstream at which DO is a minimum.
           b.   Find the minimum DO.

Given Formulae:

$$I_P = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}}(C_P - BP_{Lo}) + I_{Lo} \; ; \quad dp_* = \left(\frac{18\mu v_h H}{g\rho_p L}\right)^{1/2} \qquad \eta = \frac{L.\,g.\,dp^2 \rho_p}{H.v_h.\,18\mu}$$

Ventilation coefficient (m^2/s) = Maximum mixing depth * average wind speed within mixing depth

$$\sigma_y = a.x^{0.894} \; ; \quad \sigma_z = c.x^d + f$$

$$c_{max} = \frac{Q}{u}\left(\frac{C_u}{Q}\right)_{max}$$

$$C(x,0,0) = \frac{Q}{\pi u \sigma_y \sigma_z}\exp\left(\frac{-H^2}{2\sigma_z^2}\right)$$

$$BOD_m . V_m = BOD_w. V_w + BOD_d. V_d \qquad\qquad BOD_t = L_0(1 - e^{-kt}) \qquad L_t = L_0 e^{-kt}$$

$$D = \frac{k_d L_0}{k_r - k_d}\left(e^{-k_d t} - e^{-k_r t}\right) + D_0 e^{-k_r t}$$

$$k_r = \frac{3.9u^{1/2}}{H^{3/2}} \qquad\qquad t_c = \frac{1}{k_r - k_d}\ln\left[\frac{k_r}{k_d}\left(1 - \frac{D_0[k_r - k_d]}{k_d . L_0}\right)\right]$$

$$D_c = \frac{k_d}{k_r}L_0 e^{-k_r t_c}$$

$$DO_{(sat)} = 14.62 - 0.39\,T + 0.007714\,T^2 - 0.0000646\,T^3$$

$$k_{d\,(at\,T°C)} = k_{20°C} . (1.047)^{T-20}, \quad k_{r\,(at\,T°C)} = k_{r20°C} . (1.024)^{T-20}$$

$$DO_{min} = DO_{sat} - D_c \; ; \quad D_0 = DO_{sat} - DO_{mix} \; ; \quad DO(x) = DO_{sat} - D(x)$$

$$P = \frac{S}{Q + v_s . A}$$

$$k_{d\,(at\,T°C)} = k_{20°C} . (1.047)^{T-20}, \quad k_{r(at\,T°C)} = k_{r20°C} . (1.024)^{T-20}$$

Breakpoints								
O_3 (ppm) 8-hr	O_3 (ppm) 1-hr (i)	$PM_{2.5}$ ($\mu g/m^3$) 24-hr	PM_{10} ($\mu g/m^3$) 24-hr	CO (ppm) 8-hr	SO_2 (ppm) 24-hr	SO_2 (ppm) Annual	AQI	Category
0.000-0.064	---	0.0-15.4	0-54	0.0-4.4	0.000-0.034	(ii)	0-50	Good
0.065-0.084	---	15.5-40.4	55-54	4.5-9.4	0.035-0.144	(ii)	51-100	Moderate
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	Unhealthy for sensitive group
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	Unhealthy
0.125-0.374	0.205-0.404	150.5-250.4	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300	Very unhealthy
(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	Hazardous
(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	Hazardous

(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 is reported

(ii) NO_2 has no short term air quality standard and can generate an AQI only above 200

(iii) 8-hr O_3 values do not define higher AQI values (≥ 301). AQI values of 301 or higher are calculated with 1-hr O_3 concentrations.
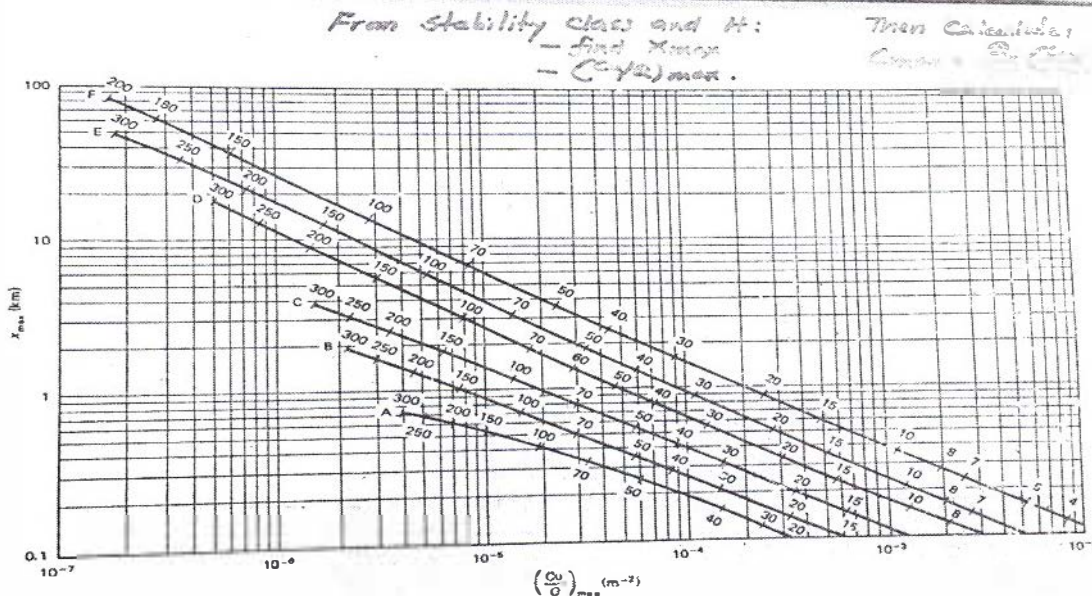

Figure 7.30   To determine the peak downwind plume concentration, enter the graph at the appropriate stability classification and effective stack height (numbers above the lines, m meters) and then move across to find the distance to the peak, and down, to find a parameter from which the peak concentration can be found (Turner, 1970).

Table 4 Constants in empirical relationships for σ_y and σ_z

Stability class	$x \leq 1$ km				$x \geq 1$ km		
	a	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	0.911	0	61	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

Course Title: Structural Engineering IX   Credit Hours: 2.0   Course Code: CE 423
    (Earthquake Resistant Design and Retrofitting)
Time: 2 hours   Full Marks: 70 (= 7 × 10)

PART A
[Answer any 5 (Five) of the following 7 questions]

[Given: $f_c' = [3.6 + (\text{Roll No. }/360)]$, ksi, $f_y = 15f_c'$, $E_c = 1000f_c'$, $E_{Masonry} = E_c/2$, $E_s = 29000$ ksi for all questions]

1. Fig. 1 shows the floor plan of a 4-storied brick masonry building in Dhaka (with 9′ high stories and 6″-thick RC slabs), where the dark lines represent brick walls.

   For the earthquake direction as shown

   (i) Determine the
   - Lateral stiffness of in-plane solid walls
   - Location ($\bar{x}$) of base shear $V_b = (36 + \text{Roll No}/36)$ kips, considering weight of walls as well as the slab
   - Maximum shear stress in the solid walls, considering direct shear and torsional shear.

   (ii) Check the adequacy of thickness of walls ABC, DEF, GHI for out-of-plane conditions
   [Given: $E_{Masonry} = 2000$ ksi, $t_{Wall} = 10″$].
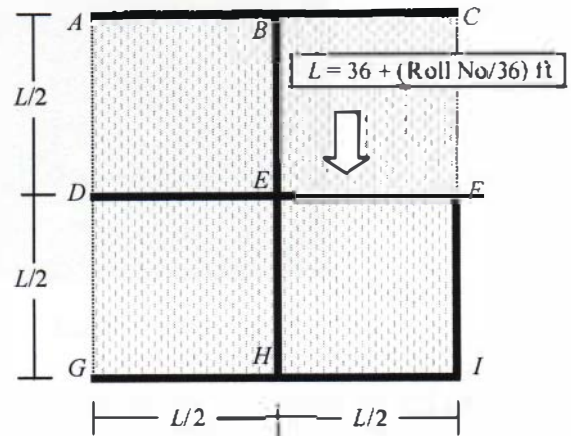

$L = 36 + (\text{Roll No}/36)$ ft

Fig. 1

2. Fig. 1 shows the floor plan of a 36-storied steel frame (with 9′ high columns), where the dark lines represent beams and all joints ($A \sim I$) represent columns.

   For beam load $w_u = 3.6$ k/ft and member sections shown in Fig. 2, with $B_b = [9 + (\text{Roll No}./36)]$ in and $B_c = 2B_b$, determine the

   (i) Appropriate dimensions of Reduced Beam Section (RBS)

   (ii) Horizontal shear force (V_{pz}) as well as nominal shear strength (R_v) in the panel zone of beam-column joint E.
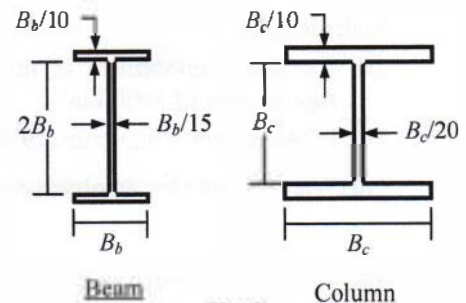

Beam   Column
Fig. 2

3. Fig. 1 shows the floor plan of a 36-storied RC frame (with 9′ high columns), where the dark lines represent beams and all joints ($A \sim I$) represent columns. All beams are uniformly loaded at $w_u = 3.6$ k/ft.

   (i) Given: $h = 36 + (\text{Roll No}/36)$ in, use the Kent-Park Model to calculate the Ductility Factor ($= \varepsilon_{50c}/\varepsilon_0$) of the ($h \times h$) RC column 'E' (with steel ratio = 3.6%, clear cover = 1.5″) if rectangular ties are provided to satisfy major seismic detailing provision.

   (ii) Calculate the ultimate moment capacity of the column 'E' and check whether it yields in flexure before it fails in shear.

4. Fig. 3 shows test arrangement of a 6"-thick flat plate (carrying uniformly distributed self-weight of 0.15 ksf) having a floor area of (5' × 3'), and subjected to two equal and opposite loads (F_0).

It is supported on a 4'-high interior RC column of (7" × 7") section, which has been retrofitted by two 3"-thick RC wing walls, as shown in Fig. 4.

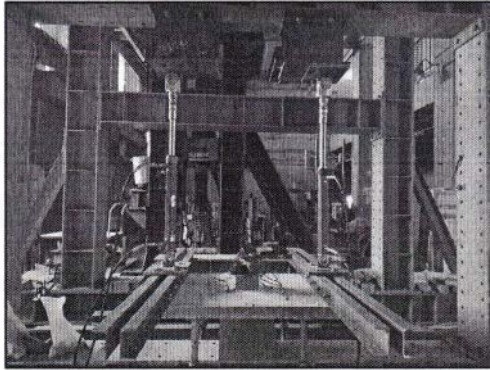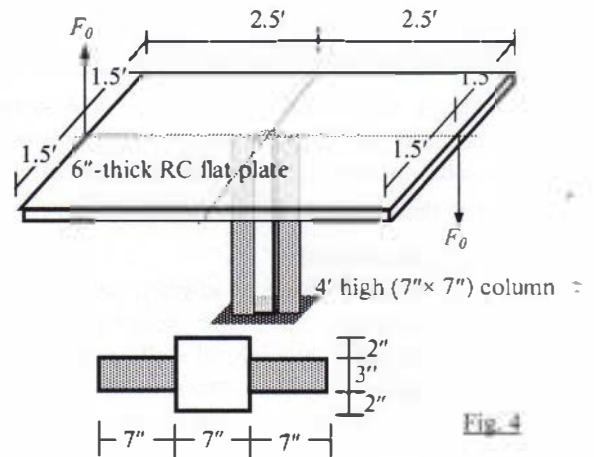Considering 1" drift due to earthquake, determine the allowable vertical forces (F_0) the 6"-thick RC flat plate can survive.

Fig. 3

Fig. 4

5. Fig. 5 shows the location of a possible 'Mega' earthquake (of Moment Magnitude 9.0) that may originate at Tripura (at Hypocentral distance of 220 km from Dhaka) from rock with shear modulus 70 GPa, Poisson's Ratio 0.10 and density 2000 kg/m^3.

Calculate the

(i) Average displacement of the fault plane over a rupture area of 5000 km^2

(ii) PGA [Esteva-Villaverde (1974)] at Dhaka

(iii) Warning time for an observer at Dhaka.

Fig. 5: New megathrust fault-line

6. Fig. 6 shows the changed forms of a 20'-high tree in Winter and Spring.
Average diameter of the tree's trunk is 15", while its weight (assumed concentrated at the top) is 1000 lbs in winter and 2000 lbs in spring.

Calculate the

(i) Natural frequency of the tree in Winter and Spring

(ii) Use BNBC 2015 to calculate the elastic base shear working on the tree in Winter and Spring

[Assume Modulus of elasticity of tree E_t = 2000 ksi, and that it is in Dhaka, on soil SA].
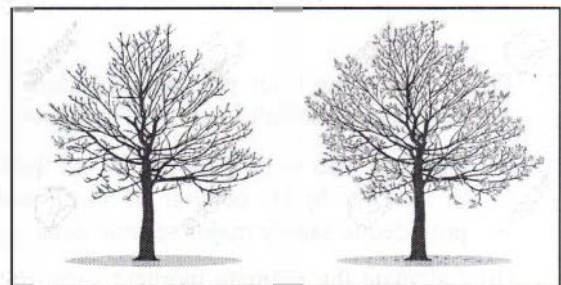

Fig. 6: Tree in (a) Winter, (b) Spring

7. The tree (in Spring) shown in Fig. 6 (b) (described in Question 6) is supported on very soft soil (with G_{Soil} = 1 k/ft^2) so that the foundation stiffness k_{Soil} = $8G_{Soil} R/(2-v)$ [where R = Radius of foundation = Radius of tree trunk, v = Poisson's ratio = 0.2] is also small, but it works almost like a Base-Isolator.

Calculate the (i) Natural frequencies,

(ii) Modal shapes of the foundation-tree system.

PART B

8. Explain briefly OR draw appropriate sketches (with proper labels) to show
   (i) Details of two seismic safety measures for the reading space of the UAP-CE Department.
   (ii) Two possible ways to retrofit the soft storey supporting UAP City Campus.
   (iii) What to do if an earthquake hits while you are at (a) ground floor, (b) 6th floor of UAP Campus.
   (iv) Two possible retrofit schemes to apply if new tests find UAP Campus is built on very soft soil.

9. To evaluate seismic resistance of structures (in Bangladesh) shown in Figs. 7(a)~7(d), write briefly on
   (i) Most likely deficiency you should primarily investigate for each
   (ii) Most effective retrofit measure you would recommend if the structures are found deficient in (i).

Fig. 7(a): Jatiyo Smriti Shoudho (RC)

Fig. 7(b): BBank (Tall RC Bldg)

Fig. 7(c): Geo Steel BD (Steel Bldg)

Fig. 7(d): Ahsan Manzil (Historic Brick Masonry)

10. For structures shown in Figs. 8(a)~8(d) damaged in earthquakes (outside Bangladesh), write briefly on
    (i) Most likely reason for their structural damage
    (ii) Most effective measure that could have prevented such damages.
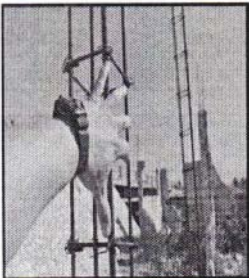

Fig. 8(a): Column Damage (Haiti 2010)

Fig. 8(b): Building Tilt (Nepal 2015)

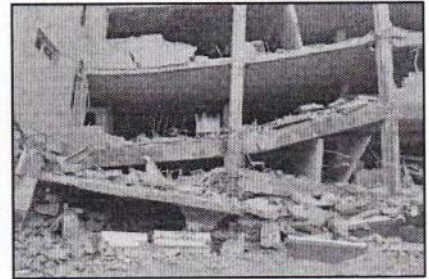Fig. 8(c): Flat slab Building (Mexico 1985)

Fig. 8(d): RC Building (Haiti 2010)

Course Title: Environmental Engineering - VII	Course Code: CE 439
Time: 02 hours	Full Marks: 100

There are Five (5) questions. <u>Answer any Four (4) questions.</u>

Question 1 [Marks: 15+10]

Explain with examples the various dimensions of "Impacts" that require clear understanding before conducting EIA. Explain with examples the terms indirect, cumulative and interactive impacts.

Question 2 [Marks: 6+12+7]

What are the three major steps involved in "Environmental Evaluation System"? Briefly explain the procedure of environmental evaluation system of development projects. Briefly explain the procedure of developing a graded impact matrix.

Question 3 [Marks: 4+12+9]

Why are mitigation measures important in EIA? Explain with suitable examples the practical hierarchy that should be followed for mitigation of impacts. What impact mitigation strategies are commonly adopted to reduce the scale and significance of impacts to an acceptable level?

Question 4 [Marks: 6+10+9]

Why 'environmental monitoring' is considered an important tool for the safeguard of the environment? What are the purposes of environmental monitoring in the context of EIA? Distinguish between 'baseline monitoring', 'mitigation monitoring' and 'compliance monitoring'.

Question 5 [Marks: 10+6+9]

Prepare a neat EIA process flowchart indicating the points where public involvement/ consultations is important. Who are the key stakeholders for consultations during an EIA study? What are the important objectives of public involvement/ stakeholders' consultation in EIA?