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

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. Prepare the Tender Data Sheet (TDS) for a three span $150m$ prestressed concrete Highway Bridge to be constructed over the river Buriganga. Include at least five items. Consider the following: **(10)**

       - Estimated Project Cost : BDT 30 crore

       - Project Completion Time : 2 years

2. Prepare a Bill of Quantities (BOQ) for only the superstructure elements, i.e. deck and girder of the abovementioned bridge. **(10)**

3. Prepare the Technical Specifications of a Generator to be used in a rural library building. Consider the following: **(10)**

       - Building is three storied and plan area is $20m \times 30m$.

       - Natural lighting and ventilation. Air-conditioning and elevators are not present.

4. **(a)** Differentiate between: **(5)**

       (i) Act & Regulation

       (ii) Tender Security & Performance Security

   (b) Mention the role of the Tender Evaluation Committee. **(5)**

5. 'Litigation shall only be used as a last resort' – justify the following statement and criticize the effectiveness of Arbitration as a dispute resolution method. **(10)**

6. Read the following case report carefully, as you have to assess the situation with explanation from engineering ethical point of view.

   (a) Tom, a licensed civil engineer, is in charge of quality control of materials in a large multispan **(15)** bridge project which is to be designed and then constructed. Tom's company has been using ready mix cement from 'X cement company' for several years in all of their projects. During his previous experience Tom had noted that a new type of cement (from 'Y cement company') is superior to the cement they are currently using. This cement has better compressive strength and improved durability in corrosive environment. Tom convinced the project manager to replace cement X and procure cement Y for all future bridge projects.

   After the procurement of cement Y, a representative of 'Y cement company' visited Tom and invited him on a very nice fishing trip to South America. Tom had not known the salesman, Jim, prior to the visit. He also had no direct purchasing responsibilities; he had just wanted the new cement for its improved performance.

   Should Tom accept the fishing trip? Decide why or why not.

   (b) After the procurement of cement Y, the representative of 'Y cement company' came by and **(5)** introduced himself and gave Tom a plastic pen worth about five dollars.

   Should Tom accept this gift? Decide why or why not.

7. Answer **any three questions** from the following. **(3×10=30)**

   (a) Read the following case study carefully:

   Mr. X, a renowned researcher possesses clear concepts regarding the theories of his research area. When he presents his works in conferences, he provides accurate facts and figures. He has great influence on his students and colleagues, who find his actions very convincing. Moreover, Mr. X speaks in a warm and friendly tone to all.

   What traits of an effective communicator does Mr. X possess?

   (b) Mr. X of **Question 7(a)** also does not lose his temper, does not accuse and does not charge anyone without concrete evidence. Which quality of 7C's for effective communication does he possess?

   Briefly explain the other issues the message sender should consider to achieve the characteristics of this 'C'.

   (c) Describe the chronology of procedures for solicited major proposals.

   (d) What is a memorandum? Explain different types of informational memorandum reports with necessary examples.

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

Course Title: Structural Engineering V   Credit Hours: 2.0   Course Code: CE 415
Time: 2 hours   •   Full Marks: 100

[Answer any 4 (four) of the following 5 (five) questions]

1.a) A simply supported prestressed-concrete rectangular beam 500 mm by 750 mm has a span of 20 **(15)** m and is loaded by a uniform load of 50 kN/m including its self weight. The prestressing tendon is located as shown in Figure 1(a) and it produces an effective prestress of 1590 kN. Analyze the beam using first concept of prestressing (elastic material concept) to get extreme fiber stresses at section A-A located 5m away from the left support .

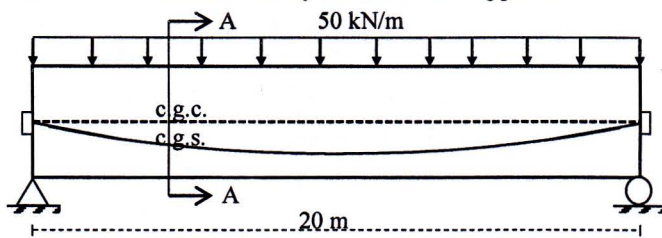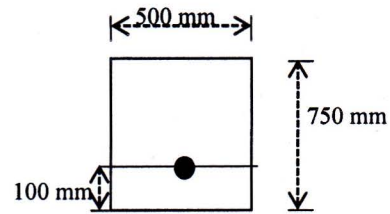Figure 1 (a)

Figure 1 (b): Mid-Section

b) What are the basic differences between the internal couple of a prestressed and a reinforced beam **(5)** section?

c) Briefly discuss the different stages of loading in prestressed concrete. **(5)**

2.a) Identify and estimate total losses for the beam shown in Figure 2(a) according to ACI-ASCE **(20)** committee 423 method. Mid-span section of the beam is shown in Figure 2(b).
Self weight of the beam, w_{sw}= 6.75 kN/m; f_i= 1397 MPa. Additional superimposed load, w_s= 14.6 kN/m when erected at 30 days and sustained for 3 years.
Given: f_{ci}'= 32 MPa; f_c'= 42 MPa; E_{ci} =26000 MPa; E_c= 30000 MPa; f_{pu}= 1862 MPa; A_{ps} = 1975 mm²; K_{es} =1; K_{re} =138 MPa; J= 0.15; C= 1.45; Relative humidity 75%;
E_s= 200000 MPa; V/S= 3.

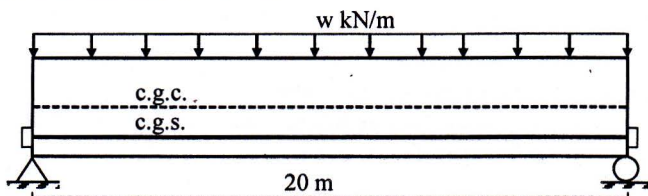
Figure 2(a)

Figure 2(b)
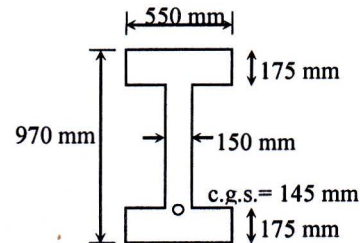
b) Describe briefly the different sources which cause lossess of prestress in a prestressed concrete **(5)** member.

3.a) An I-shaped beam is prestressed with A_{ps} =1750 mm² as prestressing steel with an effective **(10)** stress, f_{se}= 1100 MPa. The c.g.s of the strands is 115 mm above the bottom of the beam as shown in the Figure 3(a). Material properties are: f_{pu} = 1862 MPa, f_c'= 48 MPa. Calculate the ultimate resisting moment of the section for design following the ACI Code.
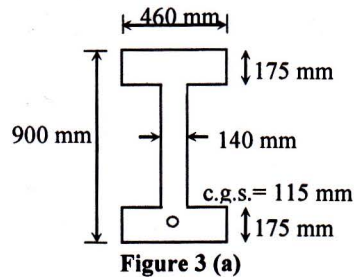
Figure 3 (a)

b) A posttensioned bonded concrete beam has a cross section of 350 mm by 500 mm. The **(15)** prestressing tendon is located as shown in the Figure 3(b) and it produces an effective prestress of 1050 kN. Analyze the beam to get the live load P in kN/m that can be allowed for (i) zero tensile stress at the bottom fibers of midspan of beam (ii) cracking at the bottom fibers of midspan where the modulus of rupture is 4.2 MPa. Ignore self weight of the beam.

Figure 3 (b)

Figure 3(c) : Mid Section
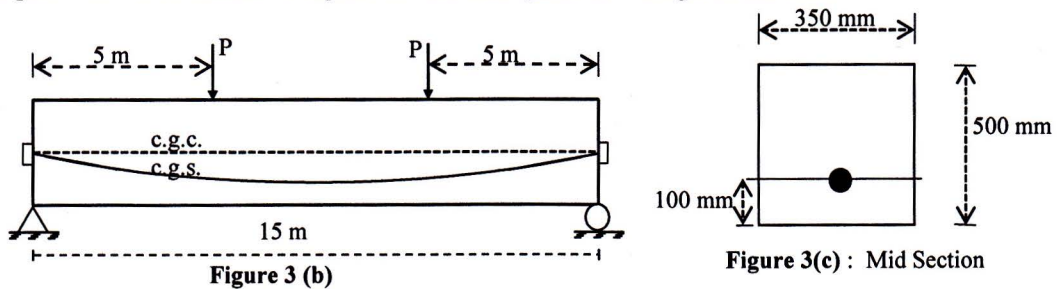
4.a) Make a preliminary design for the prestressed concrete beam to resist a total moment of 435 kN- **(10)** m. Assume the depth of the beam is 920 mm. The effective prestress of tendon is 860 MPa, allowable stress for concrete under working load is -11 MPa.
Given: M_G= 285 kN-m.

b) Make final design for the preliminary section obtained in question **4(a)** considering no tension in **(15)** concrete. Given: f_t= -11 MPa; f_b= -12.5 MPa; f_o= 1035 MPa.

5.a) A post tensioned concrete beam has curved tendons which were tensioned from left end, shown **(15)** in Figure 5. Calculate the percentage loss of pre-stress due to friction, from one end to other end (A to F) of the beam. The average length effect is 0.00061 per feet and coefficient of friction between the cable and the duct is 0.35.

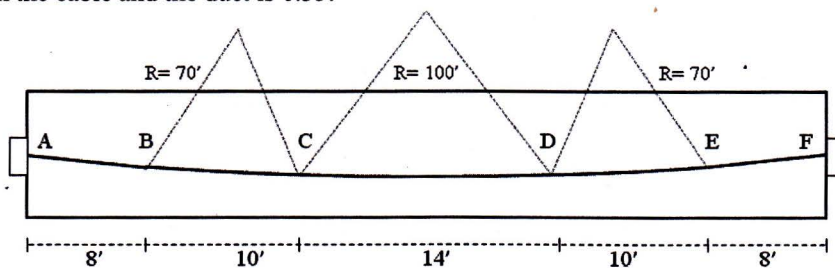**Figure 5**

b) Draw the stress distribution in concrete with the increment of superimposed load in prestressed **(10)** concrete.

List of formulae:

$$\# f_c = -\frac{F}{A} \pm \frac{Fey}{I} \pm \frac{My}{I} \qquad \#SH = 8.2 \times 10^{-6} K_{sh} E_s \left(1 - 0.06\frac{V}{S}\right)(100 - RH)$$

$$\# RE = [K_{re} - J(SH + CR + ES]C \qquad \# f_{ps} = f_{pu}\left\{1 - 0.5\rho_p\left(\frac{f_{pu}}{f'_c}\right)\right\} \qquad \# \rho_p = \frac{A_{ps}}{bd}$$

$$\# a = \frac{A_{ps} f_{ps}}{0.85 f'_c b} \qquad \# \omega_p = \frac{\rho_p f_{ps}}{f'_c} \le 0.30 \qquad \# M_u = \phi A_{ps} f_{ps}\left(d - \frac{a}{2}\right)$$

$$\# A_{pf} = \frac{\{0.85 f'_c (b - b_w) h_f\}}{f_{ps}} \qquad \# \omega_{pw} = \frac{\rho_w f_{ps}}{f'_c} \le 0.30$$

$$\# M_u = \phi\left[A_{pf} f_{ps}\left(d - \frac{h_f}{2}\right) + A_{pw} f_{ps}\left(d - \frac{a}{2}\right)\right]$$

$$\# F = \frac{M_T}{0.65h} \text{ ; if } M_G \text{ is greater than 20\% of } M_T$$

$$\# F = \frac{M_L}{0.5h} \text{; if } M_G \text{ is less than 20\% of } M_T, M_L = M_T - M_G$$

$$\# A_c = \frac{F_o h}{f_b c_t} \quad \# A_c = \frac{Fh}{f_t c_b} \quad \# A_c = \frac{F_o}{f_b}\left(1 + \frac{e - \left(M_G/F_0\right)}{k_t}\right) \quad \# A_c = \frac{F_o h}{f_b c_t - f'_t c_b}$$

$$\# A_c = \frac{Fh}{f_t c_b - f'_b c_t} \quad \# F = \frac{M_T - f'_b A k_t}{e + k_t} \quad \# k = \frac{r^2}{c}$$

$$\# V_{ci} = 0.05\sqrt{f'_c} b_w d + V_d + V_i \frac{M_{cr}}{M_{max}}$$

$$\# M_{cr} = \left(I/y_b\right)\left(0.5\sqrt{f'_c} + f_{pe} - f_d\right) \qquad \# V_{ci} = 0.05 b_w d \sqrt{f'_c} + V_i M_{cr}/M_{max}$$

$$\# M_{cr} = \left(I/y_b\right)\left(0.5\sqrt{f'_c} + f_{pe}\right) \qquad \# f_{pe} = \frac{F}{A} + \frac{Fey_b}{I}$$

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 any **Five (05)** out of **Seven (07)** questions
Each question has equal mark

1. (a) How are the steel shapes classified based on 'process of forming'? Compare between them with **(5)**
   rough sketches.

   (b) From the following table, select the lightest unequal-leg angle tension member (which is 15 feet **(15)**
   long), to resist a service dead load of 25 kips and a service live load of 75 kips. Use A36 steel (F_u= 58
   ksi). The tension member shall be connected to a gusset plate using 6 nos. 3/4- inch dia. bolts with
   standard holes in two rows as shown in the following figure. **Neglect block shear failure** mode and
   follow **AISC-LRFD** principle.

   Assume U=0.8 and check preferable $L/r \le 300$.

Shape	A_g (in^2)	r_x (in)	r_y (in)	r_z (in)
L6×4×5/8	5.86	1.89	1.13	0.859
L6×4×9/16	5.31	1.90	1.14	0.861
L6×4×1/2	4.75	1.91	1.14	0.864
L6×4×7/16	4.18	1.92	1.15	0.867

   5 spacings @ 2" = 10"

   2.5"

   D = 25 kips
   L= 75 kips
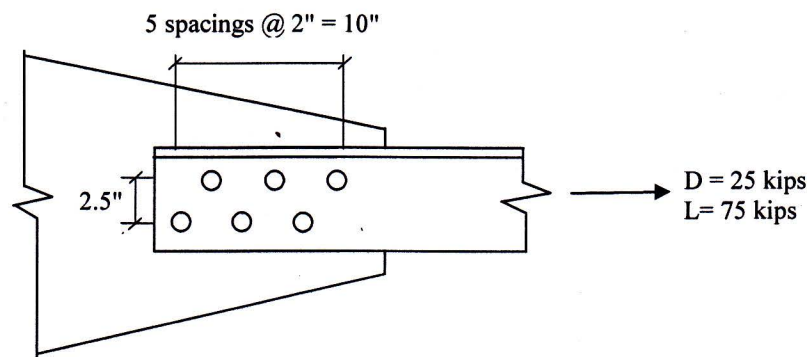
2. (a) Explain the following terms (draw rough sketch where necessary): **(5)**

   i.   Non-compact section

   ii.   Shear buckling of web

(b) Use **AISC-LRFD** approach to determine the maximum uniformly distributed load W that can act on a **(15)** simply supported span of 24 ft. Lateral supports exist only at the ends of the span. The service load is 75% live load and 25% dead load. The section is W24×84 of F_y = 50 ksi steel.

Assume that, moment gradient factor C_b = 1.0

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

3. (a) What is residual stress? What are the sources of residual stress? Describe with neat sketches. **(5)**

   (b) Determine the design load P for the bolted connection shown in the following figure. Consider **(15)** bearing and shear strength of bolts only. All bolts are ¾ inch. dia. and A490 (F_{by} = 130 ksi, F_{bu} = 150 ksi).

   All plates are made of A36 steel (F_u= 58 ksi). Use **AISC-ASD** approach.
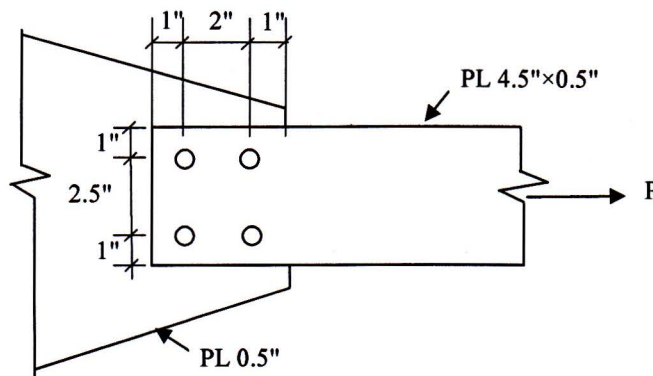

4. (a) Differentiate between butt joint and lap joint (with rough sketches). **(6)**

   What are the advantages of lap joint over butt joint?

   (b) Use the elastic vector method to compute the ultimate load (in kips/inch) on the E70XX weld **(14)** configuration shown for the bracket in the following figure. Assume the plate thickness does not affect the result.
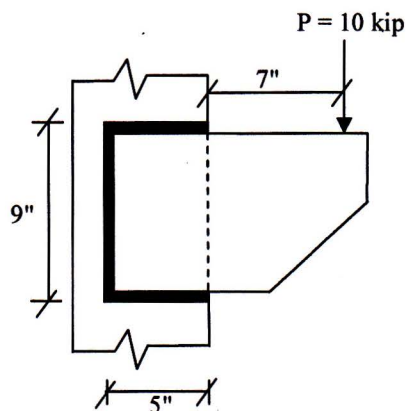
5. (a) State the assumptions for using the alignment chart to determine effective length factors of columns **(6)** in a frame.

(b) Determine effective length for columns of the frame shown in the following figure. **(14)** Given that, $I_{column} = 716$ in^4 and $I_{beam} = 833$ in^4.
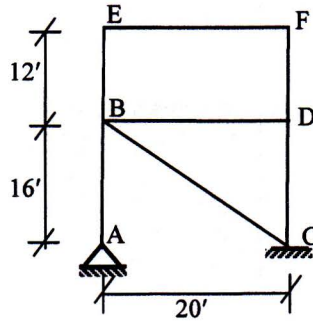

6. (a) Differentiate between overall buckling and local buckling (with rough sketch). **(2)**

(b) Write short notes on short column, intermediate column and long column. How does failure of a short **(4)** column differ from that of a long column?

(c) Determine the allowable compressive load carrying capacity of the column shown in following figure. **(14)** The column consists of W10×45 section with A992 ($F_y = 50$ ksi) steel, and is assumed to be pinned at top and bottom that allows rotation in any direction. Also the column has weak direction support (braced) at mid-height so that lateral deflection is prevented in x direction. Use **AISC-ASD** approach. Given that, $A_g = 13.3$ in.^{2}, $r_x = 4.32$ in., $r_y = 2.01$ in.

Weak axis buckling   Strong axis buckling
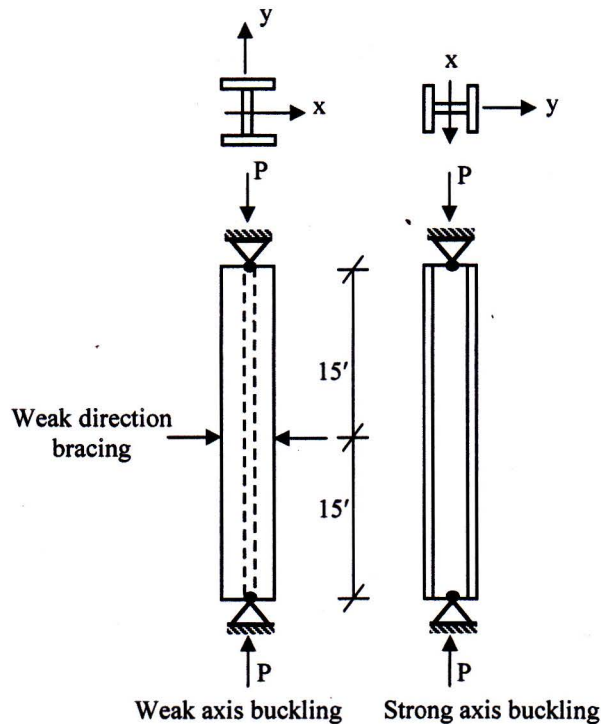
7. (a) Following figures show a beam failed under two point loading test in a laboratory. Discuss the failure **(8)** mechanism of the beam.

Distinguish between this mode of failure and simple bending with neat sketches.

Front view   Longitudinal section
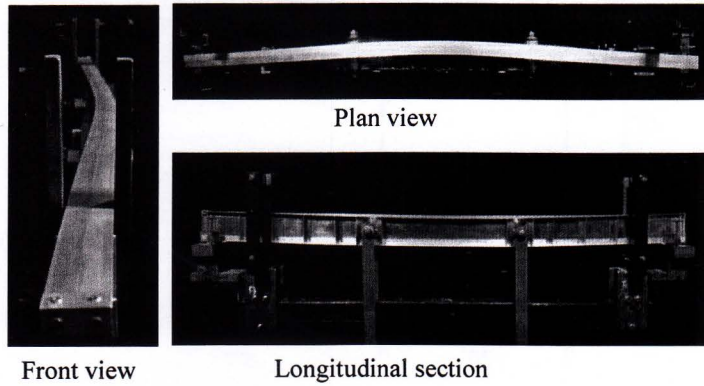
(b) Compute moment gradient factor C_b for segments AB, BC and CD of the beam in the following **(6)** figure. The beam has lateral supports only at support points A and D; and its cross-section is doubly symmetric.
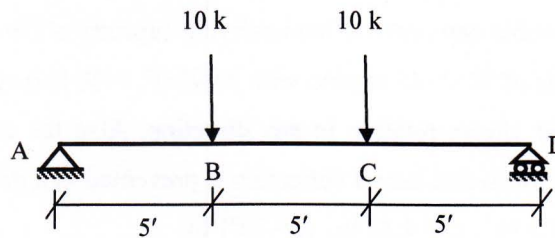
(c) Write a short note on shape factor. **(6)**

Compute shape factor for a rectangular cross-section with width b and depth h about its strong axis.

Annexure-1

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

$$R_n = 1.2L_c t F_u \leq 2.4 F_u dt \text{ (bearing)}$$

Annexure-2

Factored uniformly distributed load $W_u = 1.2 \times (0.25W) + 1.6 \times (0.75W)$

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

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

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

Beam LTB formulae:

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

$$L_r = 1.95 r_{ts}\frac{E}{0.7F_y}\sqrt{\frac{Jc}{S_x h_0}}\sqrt{1 + \sqrt{1 + 6.76\left(\frac{0.7F_y}{E}\frac{S_x h_0}{Jc}\right)^2}} \quad (c=1 \text{ for doubly symmetric section})$$

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2}\sqrt{1 + 0.078\frac{Jc}{S_x h_0}\left(\frac{L_b}{r_{ts}}\right)^2} \quad (c=1 \text{ for this section})$$

Section properties of W24×84:

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)
24.1	0.47	9.02	0.77	196	224	1.95	2.37	23.3	3.70

Annexure-3

Alignment Chart

(a) Sidesway prevented (Braced frame)

(a) Sidesway not prevented (Unbraced frame)
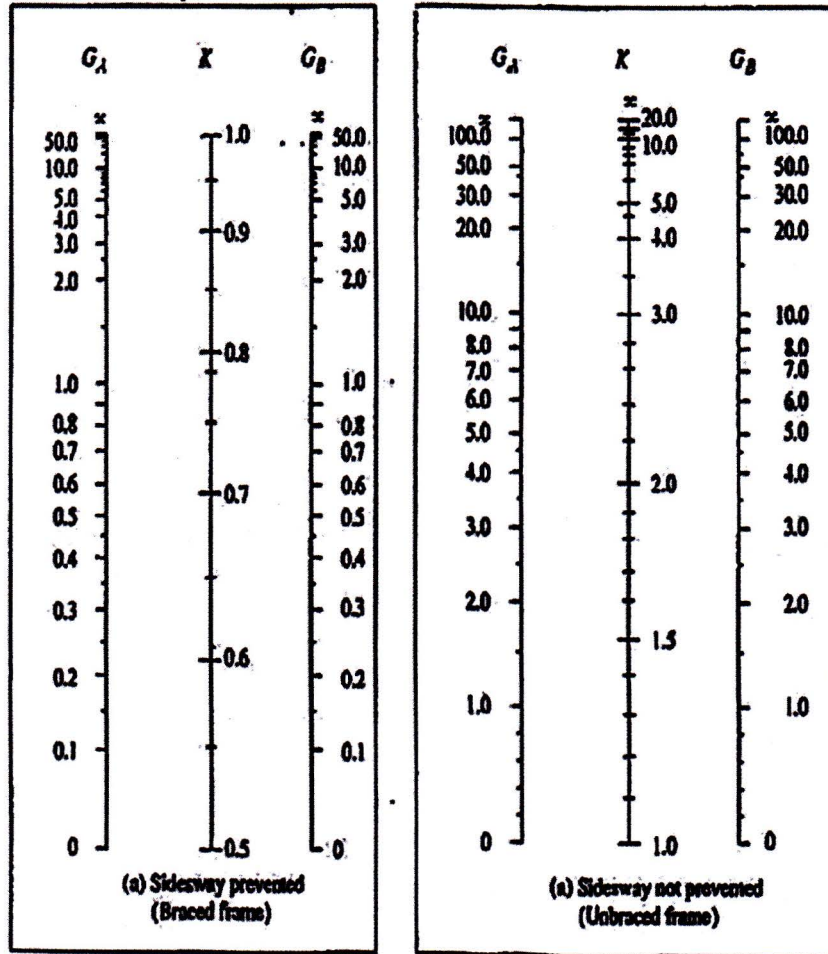
Annexure-4

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

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

Annexure-5

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

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018 (Set 1)
Program: B. Sc. Engineering (Civil)

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 2 (Two) of the following 3 questions]

1. For the construction practices shown in Figs. 1(a)~1(d), write briefly on the possible deficiency and their likely effect on the seismic resistance of the structures being built.

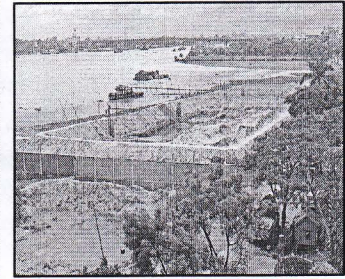Fig. 1(a): Column Steel Reinforcement   Fig. 1(b): Bamboo-Reinforced Concrete   Fig. 1(c): Multistoried Mud House   Fig. 1(d): Construction on Filled River

2. To evaluate seismic resistance of structures shown in Figs. 2(a)~2(d), write briefly on
   (i) Most likely deficiency you should primarily investigate for each
   (ii) Most effective design measure you would recommend if the structures are found deficient in (i).
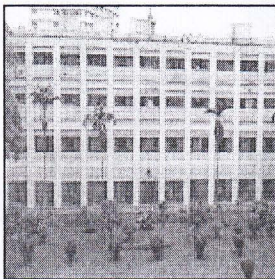

Fig. 2(a): Secretariat Bldg (RC Beam-Column Frame)   Fig. 2(b): Chittagong City Center (Proposed 51-St Steel Frame)   Fig. 2(c): Parliament Bhaban (RC Wall Structure)   Fig. 2(d): Shat-Gambuj Mosque (Historic Brick Masonry)
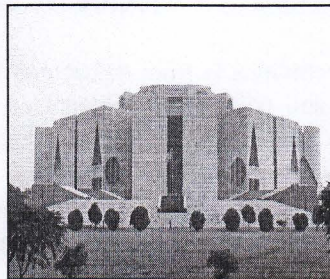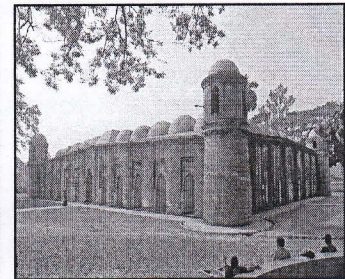
3. For the structures damaged in earthquakes as shown in Figs. 3(a)~3(d), write briefly on
   (i) Most likely reason for their structural damage
   (ii) Most effective measure that could have minimized such damages.

Fig. 3(a): Bent Rail (Assam 1897)   Fig. 3(b): Destroyed Brick Bldg (Assam 1897)   Fig. 3(c): Tilted RC Bldg (Chittagong 2016)   Fig. 3(d): Damaged RC Bldg (Chittagong 2003)

PART B

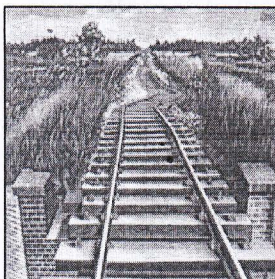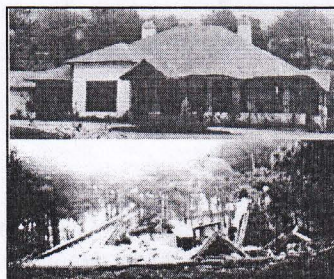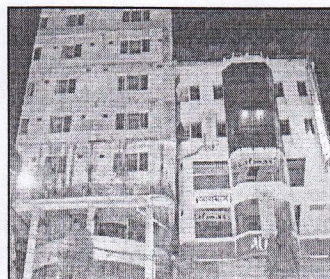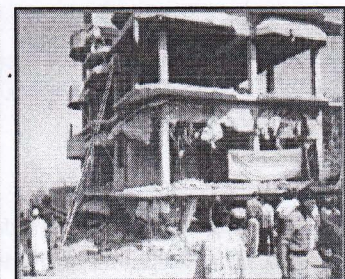[Given: $f_c' = [3 + (\text{Roll No.} /100)]$, ksi, $f_y = 15f_c'$, $E_c = 1000f_c'$, $E_{Masonry} = E_c/2$, $E_s = 29000$ ksi for all questions]

4. The 10-storied RC structure 'UAP-1' shown in Fig. 4(a) consists of (24″ × 24″) columns (with 12-#9 bars) at ground floor and additional brick walls at the other floors.

   It is represented by two models as in Fig. 4(b).

   Model-1 is the conventional structural model, neglecting effect of infill wall assuming distributed load of 3 k/ft over beam lengths.

   Model-2 assumes the structure to be a SDOF system, lumping all loads as structural weight.

   (i) For both Model-1 and Model-2, calculate Time period, elastic base shear force and storey force using the BNBC 93 earthquake response spectrum for Dhaka ($S = 1.5$, $\xi = 5\%$).

   (ii) Also calculate the Yield Reduction Factor (R_y) for each model, if $\mu = 8.0$.

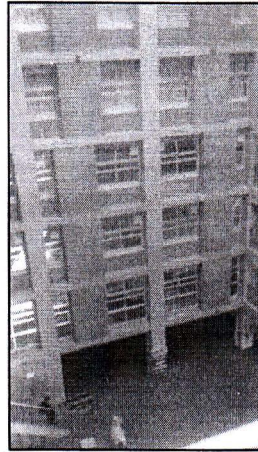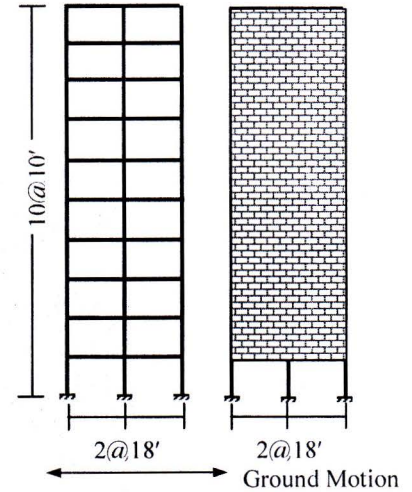   (iii) Specify the column hoops for moderate seismic detailing.

Fig. 4(a): UAP-1

Fig. 4(b): Model-1, 2

10@10′ 2@18′ 2@18′ Ground Motion

5. The 7″-thick flat plate area shown in Fig. 5(a) (for Model-1 of UAP-1, described in Question 4) is supported on (24″ × 24″) RC columns.

   Assume axial force on columns is from distributed load of 3 k/ft over slab lengths, and unbalanced moment on columns from the column BMD (for earthquake) shown in Fig. 5(b).

   Calculate the
   (i) Maximum shear stress (including direct shear and torsional shear) in the slab around the central column,

   (ii) Longitudinal reinforcements within the 'Concealed Beam' area.

Fig. 5(a): Flat Plate   Fig. 5(b): Column BMD

150 k′   −150 k′   150 k′   −150 k′
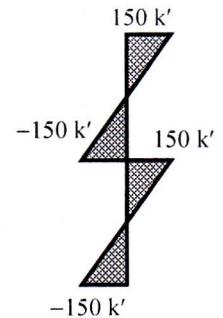
6. Fig. 6 shows the member sections for Model-1 of 'UAP-1' described in Question 4 [shown in Fig. 4(b)] if it is made of steel instead of RC. Calculate the

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

   (ii) Determine the requirement of joint continuity plate and its possible thickness (t_{cp}) at exterior joint and interior joint.

0.45″   8.0″   0.28″   4.5″   Beam

0.90″   7.1″   0.55″   9.0″   Column
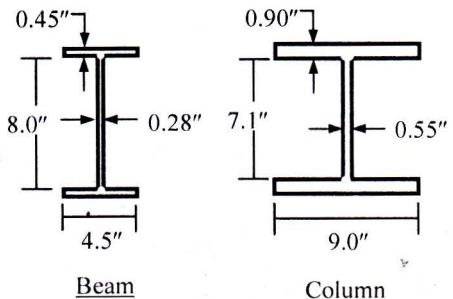
Fig. 6

7. Each column for Model-2 of 'UAP-1' [Fig. 4(b)] mentioned in Question 4 is supported on a massless Base Isolation spring with Shear Modulus = 150 psi, Bearing Area = 15 ft², Height = 12″.

   (i) Calculate lateral stiffness of the entire Base Isolation system (three columns)

   (ii) Determine the first natural frequency and modal shape of the system.

   (iii) Use the proposed new BNBC (for soil *SB* and $\xi = 5\%$) to calculate base shear (for design earthquake in Zone 2) and elastic peak deformations for 1st mode of vibration of the system.

8. The RC frame 'UAP-2' shown in Fig. 7(a) consists of three (24″ × 24″) columns and (36′ × 4′) size 5″-thick brick wall. It is represented by the model in Fig. 7(b), where beam *abc* carries weight of 3 k/ft. Determine the first natural frequency and modal shape of the

   (i) SDOF frame, assuming the frame is also fixed at *def*

   (ii) 2-DOF frame, considering stiffness of the brickwall *defghi*, as well as the columns.
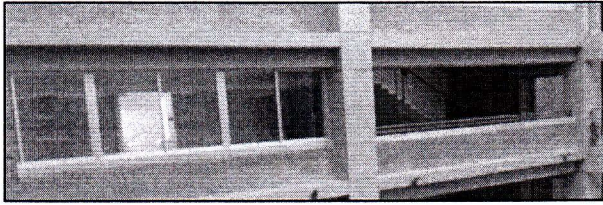
Fig. 7(a): UAP-2
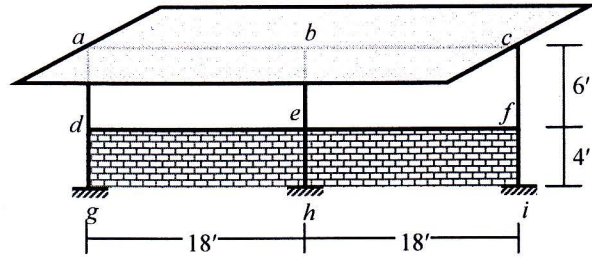
Fig. 7(b)

9. Fig. 8(a) is floor plan of a past UAP-CE campus, a 4-storied brick masonry structure shown in Fig. 8(b).

   (i) Neglect the openings of all walls to calculate wall shear stresses, when subjected to seismic base shear $V_b = 20$ k [Given: $H_{Wall} = 10′$, $t_{Wall} = 10″$].

   (ii) Check Wall-6 shown in Fig. 8(c) for opening sizes and thickness.
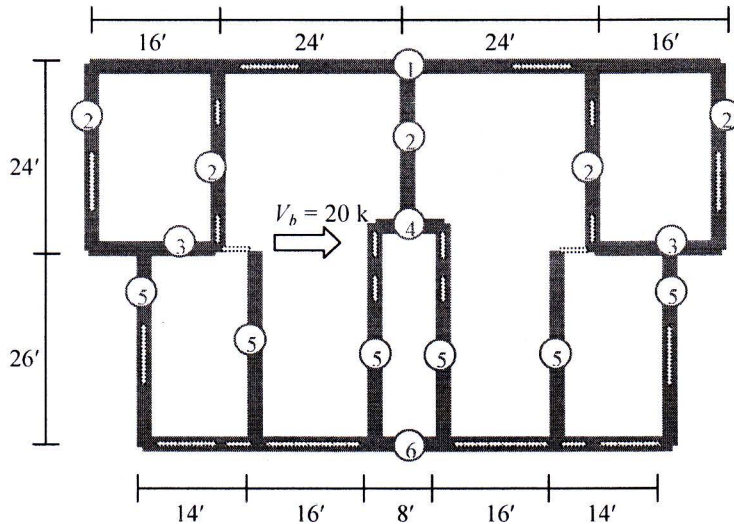
Fig. 8(a): Bldg Floor Plan
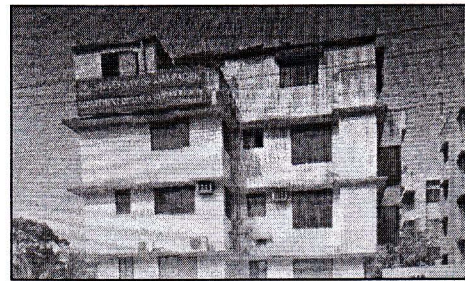
Fig. 8(b): Bldg Elevation
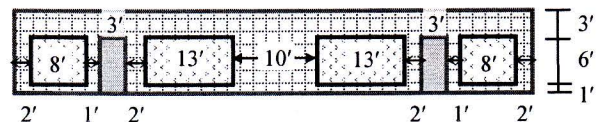
Fig. 8(c): Wall-6

10. An earthquake of Moment Magnitude 9.0 originates from a fault at Epicenter E (Shaheed Romizuddin Cantt. College, shown in Google Map of Fig. 9) and propagates over a rupture area of width 100 km and depth 700 km through underlying rock having shear modulus 100 GPa. Calculate the

    (i) Average displacement of the fault plane,   (ii) Energy released during the earthquake,

    (iii) PGA at Farmgate area (F), 10 km from E [using Milne and Davenport (1969)].
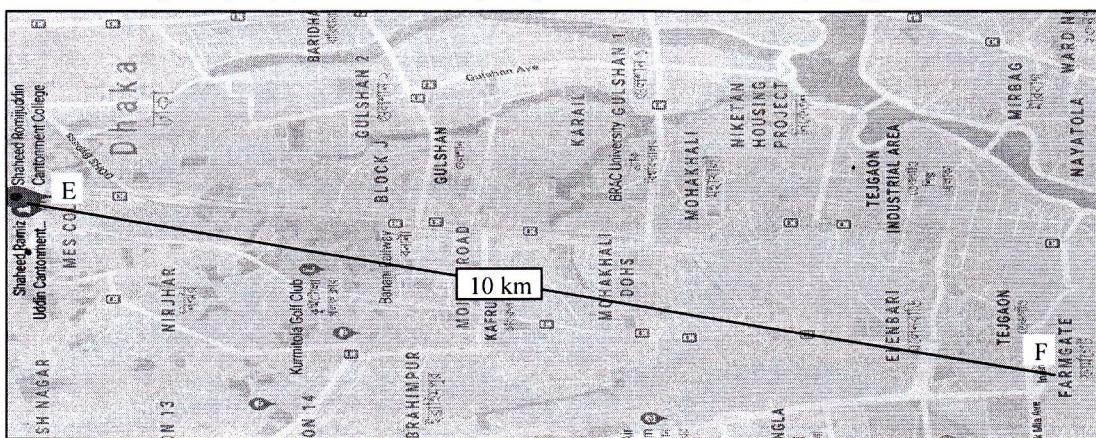
Fig. 9: Google Map showing Epicenter and Farmgate area

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

Course Title: Structural Engineering X (Concrete Technology) Course Code: CE 425
Time: 2 hours   Full Marks: 100 (8x10+20)

Answer all questions

Question 1:

Write the advantages of using blended cement. Explain the pozzolanic reaction of fly [4+6 =10] ash and discuss the impacts of this reaction in concrete properties.

Question 2:

Calculate the Bogue compound contents (C_2S, C_3S, C_3A, and C_4AF) of the following Portland cements (A, B, and C). Which of these cements is likely to be high heat cement and which one will give the higher strength of concrete? Justify with proper explanation.   [10]

Bulk Oxide Content	Percentage in Cement		
	A	B	C
CaO	68.2	61	64.2
SiO_2	22.4	25	20.7
Al_2O_3	4.6	4	3.9
Fe_2O_3	0.3	3	5.3
MgO	1.3	1.1	1.4
SO_3	2.4	2.5	2
K_2O	0.3	0.2	0.4
Na_2O	0.3	0.3	0.5
LOI	0.2	2.9	1.6

Question 3:

Describe the main difference between boom concrete pump and line pump/trailer-mounted concrete pump. Based on your knowledge, explain what makes concrete pumpable.   [5+5=10]

Or

List causes of segregation of concrete and the effects on concrete performance due to [5+5=10] segregation.

Question 4:

a. Based on your understanding, illustrate the difference between ready-mixed concrete and normal concrete.   [5+5 =10]

b. Describe what are the necessary precautions should be taken to avoid retempering.

Question 5:

a. "The purpose of air entrainment in concrete is to protect concrete from cracks due to freezing and thawing cycles". Do you agree or disagree with this statement? Justify your answer with a schematic diagram.

b. One of the commonly used accelerating admixtures is calcium chloride. What will be the disadvantage of using this type of admixture in concrete used for the construction of reinforced concrete structures?

[7+3=10]

Question 6:

Identify why Ultra-High Performance Concrete (UHPC) has higher resistance to freezing thaw than normal strength concrete. List the benefits of using UHPC.

[6+4=10]

Question 7:

Illustrate the main purposes of Non-destructive Tests. Report what are the main factors that affect the rebound number during assessing the concrete strength via rebound hammer.

[5+5=10]

Question 8:

a. Apply the knowledge to explain the mechanisms of pore pressure spalling.

[5]

b. "An effective way for reducing concrete sensitivity to spalling is the addition of polypropylene fiber in concrete", explain why?

[5]

Question 9:

a. A bridge will be constructed to connect Munshiganj to Shariatpur and Madaripur, linking the south-west of the country, to northern and eastern regions of Bangladesh. To this aim, three concrete (X, Y, and Z) has been selected and durability test such as water absorption capacity is performed on cylindrical specimen (150 mm in diameter and 70 mm long) in the Engineering Materials Lab at UAP. The test data are given below:

[15]

Concrete	Mass of dry specimen [gm]	Mass of wet specimen [gm]		
	0 min	1 hour	2 hour	4 hour
X	1450	1458	1461	1466
Y	1440	1445	1447	1452
Z	1420	1423	1425	1429

Calculate water absorption coefficient of concretes and draw the evolution of water absorption coefficient as a function of time. Based on the durability test results, propose a suitable concrete for the bridge construction with proper explanation.

b. Give an explanation of how corrosion of steel reinforcement occurs in concrete.

Or

Provide an overview of deterioration of concrete due to carbonation.

[5]

Or

[5]

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 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. Please note that all questions are NOT of equal value.
Assume data if not available.

1. (a) When a waste is termed "hazardous"? Draw the hierarchy of priorities in hazardous waste management. **[5+5]**

   (b) Explain the functional elements of solid waste management system with figure. **[10]**
   OR
   Explain 4Rs in MSW management.

2. (a) Differentiate between "primary recycling" and "secondary recycling" in reuse and recycling of MSW **[5]**
   OR
   Differentiate between "separation materials" and "conversion materials" in materials recycling processes.

   (b) A cannery (where food/fruits are canned) receives on a given day: **[10]**
   i) 12 tons of raw produce
   ii) 5 tons of cans
   iii) 0.5 tons of cartons
   iv) 0.3 tons of miscellaneous materials.
   As a result of internal activity
   i. 10 tons of product are produced, remainder discharged to a disposal facility
   ii. 4 tons of cans are stored, remainder used
   iii) 3% of cans used are damaged and incinerated, remainder used.
   iv) 75% of miscellaneous materials become paper waste and incinerated, remainder is disposed of.
   Determine the generation rate of wastes.

   OR
   2500 kg/h of municipal solid waste with 10 percent glass is applied to a rotary screen for the removal of glass prior to shredding. Weight of underflow is 500 kg/h and weight of glass in screen underflow = 200 kg/h, determine the recovery efficiency and effectiveness of the screen.

3. (a) Explain the recycling pattern for urban solid waste in Bangladesh with figure. **[5]**

   (b) Distinguish between hauled-container and stationary-container systems during collection phases of solid waste management. **[10]**

4. (a) Explain with figure the mechanism of anaerobic digestion of solid waste with appropriate chemical reactions. **[15]**

(b) Estimate the total gas (theoretical) that could be produced from the organic fraction of MSW under anaerobic conditions using the given data below:
Chemical formula without water= $C_{60}H_{94.3}O_{37.8}N$.
Total weight of organic material in 100 lb of solid wastes is equal to 58 lb including moisture. [10]

5. (a) Draw the process flow diagram for MSW composting facilities. [5]

(b) Write short notes on "Vermicomposting" OR "Barrel composting". [5]

(c) Barrels of 60 gal (US) capacity are to be used for a barrel composting plant for a community of 500 people in Gazipur. The plant will operate throughout the year. The average temperature measured within the waste is 43° C. The composition of solid waste in a 100kg sample is given in following table. The targeted loss of volume is 50 per cent and the average density of the waste is 450 kg/m³. The waste generation rate of Gazipur is 0.4 kg/capita/day. Compute the number of barrels required in barrel composting plant.
OR
Using the following table, calculate the oxygen requirement of organic wastes for composting considering the structural formula $C_1H_{2.4}O_{0.9}N_{0.02}$. [15]

Component	Wet mass, kg	Dry mass, kg	Composition, Kg					
			C	H	O	N	S	ASH
Food Waste	45	18	13	0.5	2.5	0.5	0.03	1.47
Paper	22	15	5.5	1.3	6.4	0.71	0.09	1.0
Cardboard	8	7.5	3.1	0.31	3.2	0.06	0.03	0.8
Plastics	5	4.9	3.3	0.35	1.1	-	-	0.15
Garden trimming	15	5	1.7	0.65	1.85	0.25	0.01	0.54
Wood	5	4	2.1	0.21	1.35	0.2	-	0.14
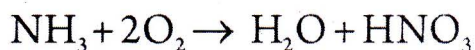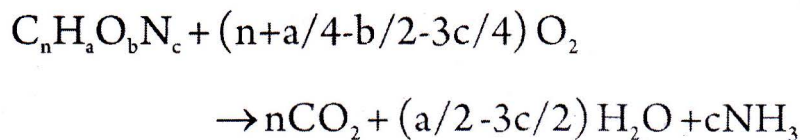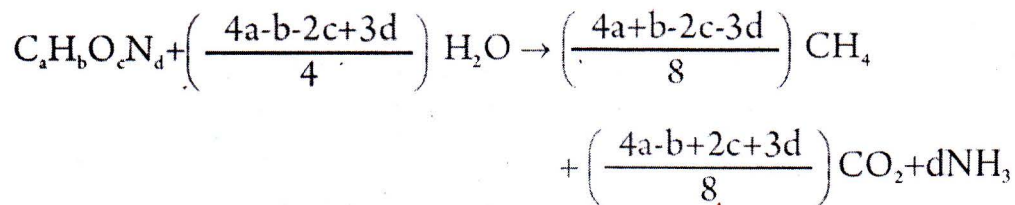
$$C_aH_bO_cN_d + \left(\frac{4a-b-2c+3d}{4}\right)H_2O \rightarrow \left(\frac{4a+b-2c-3d}{8}\right)CH_4$$

$$+ \left(\frac{4a-b+2c+3d}{8}\right)CO_2 + dNH_3$$

$$C_nH_aO_bN_c + (n+a/4-b/2-3c/4)O_2$$

$$\rightarrow nCO_2 + (a/2-3c/2)H_2O + cNH_3$$

$$NH_3 + 2O_2 \rightarrow H_2O + HNO_3$$

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

Course Title: Environmental Engineering IV

Course Code: CE 433

Time- 2 hours

Full marks: 100

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

1. (a) What are the health effects of Particulate Matter? Discuss the deposition mechanisms of particulates in human body. (10)

OR

Discuss the formation and health effects of Carbon monoxide. Write a short note on typical diurnal variation of NO, NO_2 and O_3 in the atmosphere.

(b) The following air quality data have been recorded at the Continuous Monitoring Stations/Systems (CAMS) in Dhaka on April 26, 2018. (7)
$PM_{2.5} = 70\ \mu g/m^3$ (24 hr)
$PM_{10} = 170\ \mu g/m^3$ (24 hr)
$CO = 20$ ppm (8 hr)
$O_3 = 0.095$ ppm (8 hr)
Employ the method of AQI estimation and prepare an AQI report for the day.

(c) Identify the five major physical processes that are simulated in air quality dispersion modeling. (3)

2. (a) Discuss the purposes that are accomplished through air quality models. (6)

OR

What is the goal of diffusion models (such as Gaussian Plume model)? What are the assumptions of the "Point Source Gaussian Plume Model"?

(b) A stack emitting 65 g/s of SO_2 has an effective stack height of 155 m. The wind speed is 4.5 m/s at 10 m, and atmosphere is adiabatic with Stability class D. Calculate the ground level SO_2 concentration: (11)
    i)   Directly downwind at a distance of 2.5 km
    ii)   At a point downwind where SO_2 is maximum
    iii)   At a point located 2 km downwind and 0.1 km off the downwind axis.

(c)   Define "Maximum mixing depth" for an air pollutant.   (3)

3 (a)   Compare the conditions in atmosphere (ambient vs adiabatic lapse rates) when you   (7) evaluate the following plumes from stacks in an industrial area (show in drawing): i) Lofting; ii) Fumigating; iii) coning. Identify which type of plume creates adverse effects and which one helps to reduce exposure for nearby community?

(b)   Choose two from each category that you will apply to reduce pollution after listing   (5) down the names of control devices for particulate contaminants and gaseous contaminants (no description required).

OR

The equation for complete combustion of gasoline can be given by:
$C_7H_{13} + 10.25\ O_2 + 38.5\ N_2 \rightarrow 7CO_2 + 6.5\ H_2O + 38.5\ N_2$
Estimate the air to fuel ratio for this complete combustion considering that the air is made up of only O_2 and N_2. What is the significance of this stoichiometric ratio?
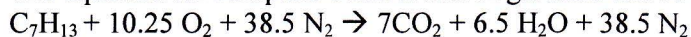
(c)   A power plant has a 100 m stack with an inside radius of 1m. The exhaust gases leave   (8) the stack with an exit velocity of 10 m/s at a temp. of 220°C. Ambient temp is 6°C, winds at the effective stack height are estimated to be 5 m/s, surface wind speed is 3 m/s, and it is a cloudy summer day (Stability class C). Calculate the effective height of this stack.

4 (a)   Illustrate the effect of air to fuel ratio on pollution with figure.   (6)

OR

Point out how the coupling of exhaust gas recirculation (EGR) with a thermal reactor can reduce emissions of all three pollutants, CO, HC and NO_x.

(b)   Define CBOD and NBOD with a figure. The ultimate CBOD (L_0) in a river due to   (5+6) discharge of wastewater is 24.6 mg/L at 25°C. The deoxygenation and the reaeration constants at 20°C are 0.23/day and 0.4/day respectively. If the time required (t_c) for dissolved oxygen to reach at its minimum is 2.45 days, compute the critical DO or DO_{min}. (Equations attached)

(c)   What are the limiting nutrients for algal growth? It was found in a sample from a lake   (3) that N/P>15. Which one is the limiting nutrient between these two nutrients?

5 (a)   Explain the simple phosphorus model for lakes with a sketch.   (5)

(b)   Briefly illustrate the layers in a stratified lake using figure. Which type of lake becomes   (5) more vulnerable to summer stratification?

Show in a schematic, the zones of pollution and the change in aquatic ecology in a stream by wastewater disposal.

(c) Consider a lake with 200×10^6 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 0.45 m^3/s and its phosphorus concentration is 10.0 mg/L (= 10.0 g/m^3). The lake is also fed by a stream having 30 m^3/s of flow with no phosphorus. If the phosphorus settling rate is estimated to be 10 m/year,

    (a) Calculate the average phosphorus concentration in the lake.

    (b) Analyze what level of phosphorus removal at the treatment plant would be required to keep the average lake concentration below 0.010 mg/L?

              (10)

Given Formula:

$$I_P = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}}(C_P - BP_{Lo}) + I_{Lo} \;\; ;$$

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

$$u = u_0(\frac{z}{z_0})^p$$

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

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

$$C(x, 0) = \frac{2Q_L}{\sqrt{(2\Pi)}u\sigma_z}$$

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

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

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

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

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

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

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

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

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

$$P = \frac{S}{Q + \upsilon_s \cdot A}$$

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

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.

$$F = gr^2 v_s\left(1 - \frac{T_a}{T_s}\right) \qquad ; \qquad \Delta h = \frac{1.6 F^{1/3} x_f^{2/3}}{u}$$

$$x_f = 120\,F^{0.4} \quad \text{if } F \geq 55\ m^4/s^3 \qquad : \qquad x_f = 50\,F^{5/8} \quad \text{if } F < 55\ m^4/s^3$$

TABLE 7.7 WIND PROFILE EXPONENT p FOR ROUGH TERRAIN[a]

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

[a] For smooth terrain, multiply p by 0.6; see Table 7.8 for further descriptions of the stability classifications used here.

Source: Peterson (1978).

best ← A, B

Neutral → C, D

worst ← E, F

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

Course Title: Environmental Engineering - VII   Course Code: CE 439
Time: 2 hours   Full Marks: 100

There are Five (5) questions. <u>Answer any Four (4)</u>   **(4 X 25 = 100)**

1. (a) Elaborate briefly, the three core values inherent in the overall EIA process for EIA to be an effective tool to safeguard the environment. **[6]**

   (b) Prepare a neat "EIA Process Flowchart" and indicate important stages where public consultations/ involvement is crucial. **[10]**

   (c) What are the important objectives of public consultations/ involvement in EIA? **[9]**

2. (a) Explain with examples the various dimensions of "Impacts" that require clear understanding before conducting EIA. Why socio-political dimension of impacts is of great concern? **[7+3]**

   (b) Differentiate using diagrams and with examples the terms indirect, cumulative and interactive impacts. **[9]**

   (c) When are "impacts" considered to be potentially significant? **[6]**

3. (a) Environmental baseline studies are usually considered to refer to a description of some aspects of the physical, biological and social environments that could be affected by the development project under consideration. How appropriate or vague is this definition? What would be a more operative definition? **[6+4]**

   (b) Explain the role of base line studies in EIA. **[7]**

   (c) What are the purposes of scoping in EIA? What consequences might happen if scoping is not done or inadequately done? **[4+4]**

4. (a) "Mitigation should not be reactionary responses to environmental impacts that exceed statutory limits or that are unacceptable to nearby sensitive receivers, but rather it should function as a critical design tool for the development as it progresses." – Briefly explain. **[7]**

   (b) What are the important steps that should be considered in incorporating mitigation measures to reduce the scale of impacts to acceptable levels? **[8]**

   (c) What are the purposes of environmental monitoring? Explain the differences between "baseline monitoring", "impact monitoring" and "compliance monitoring". **[4+6]**

5. (a) What are the three major steps involved in "Environmental Evaluation System"? Briefly explain the procedure of environmental evaluation system of development projects. **[6+6]**

   (b) What is a value function curve? Discuss with a suitable example how the value function curves for environmental parameters are developed and used in EES? **[3+10]**

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

Course Title: GIS and Remote Sensing
Time: 2.00 Hours

Course Code: CE 531
Full Marks: 70

Section A
Answer the following questions.
[Marks distribution:6*1+4*2.5=16]

1.   Answer the following questions.[Not more than one sentence].   **[6*1=6]**

    (a)   Which format of GIS data is essential for terrain analysis?

    (b)   In a situation you are not being able to perform the spatial analysis tools, what sort of action you have to take to do so?

    (c)   You know that CLIP is one of the Geo-processing tools. but why cannot do it for raster formatted GIS data? What function you have to use for doing clipping in case the file format is in raster version?

    (d)   You are intended to complete the clipping for your raster formatted file. After checking the environmental settings still, you are not getting a result for your particular area. what option you need to check before doing the clipping in case you want to get the result exactly in your study zone?

    (e)   Write down the path which may lead you towards saving a new shape file.

    (f)   In which menu bar you will get the option Export map?

2.   Answer the following questions.   **[2.5*4=10]**

    (a)   What are questions can be solved through GIS.

    (b)   Why it is essential to study GIS as an Environmental Engineer?

    (c)   What do you understand by DEM file? What are the information you can extract from the DEM version of raster data?

    (d)   After the image is geo-referenced, each pixel has a real world coordinate value assigned to it. What is Geo-referencing? How to do that?

1

3. (a) Geo-reference the image of Charghat upazila and then convert the file as Google earth format. **[4+1]**

   (b) Digitize the geo-referenced image of Charghat district boundary along with its water bodies, wide rivers, national highways, railways network. Calculate the total area of water bodies. Which one has more length coverage, railways network or national highways? **[4+1+1]**

   (c) You have been provided with the satellite image of Ganges river for two different years. Find out the river bank shifting. **[3+4]**

4. (a) You have been provided with the DEM file of Bangladesh. Now you are being asked to prepare a contour map of Dhaka district. From the contour mapping find out the area having the highest elevation. **[4+3]**

   (b) Prepare a flood map for the monsoon period of the year 1998.Needed files are provided in the exam folder. Write down the necessary steps required for preparing the flood map in the examination paper. **[3+3+3+2]**

5. (a) Water ways shape file is given. Calculate the total length of different types of water ways. Show a graphical plot, which water ways has minimum coverage throughout the whole country? **[3+2+3]**

   (b) From the point shape file select Bangladesh Television Center Dhaka HQ. Select the places which are within 1500 m from Bangladesh Television Center Dhaka HQ. Are there any schools situated in the selected area? **[1+2+3]**

   (c) Find out the soil pattern of Rangamati. khagrachori, Bandorban. **[2+2]**

6. (a) A shape file consists of CO_2 concentration variation for the different District of the whole Bangladesh. Prepare a map showing the CO_2 concentration. What is the name of this kind of mapping procedure? **[3+1]**

   (b) Calculate the water quality index value for the given wasa connections of Mirpur area You have been given the quality rating value for the parameters pH, TDS , Hardness.
   You need to use the equation ,$WQI=\sum q_n*w_n$. To calculate the water quality index, Given $[w_{n(pH)}=0.22, w_{n(TDS)}=0.004, w_{n(Hardness)}=0.006]$.Write down the necessary steps required for preparing the flood map in the examination paper. **[4+3+2]**

   (c) Prepare a contour map of the index value. Classify the contour map with different color maintaining the contour interval. **[3+2]**

7. (a) Create DEM (Digital Elevation Model) map using inverse distance weighting (IDW) method, using the given elevation points provided as excel format. Display the DEMs you have created. **[4+1]**

   (b) Derive the slope gradient from the DEM you have been given. Improve the display; change the number of classes to 15. What type of raster operation is the calculation of slope gradient? **[3+2]**

   (c) What is the total area of the particular zone of Shajahanpur area which is located nearby the Shajahanpur colony road . In which ward this area is located? Classify the land according to their using purpose. Write the building number which has maximum storied and being used as a mixed purpose. Are the building used for public or private facilities? **[2+2+0.5+0.5+1+1+1]**