University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering X | Course Code: CE 425
Time: 1 hour | Credit Hour: 2.0 | Full Marks: 20

Question 1: [4]

Explain the hydration of four main compounds of cement and their effects on strength development of concrete.

Question 2: [4]

Discuss the working mechanism of Superplasticizer in fresh concrete.

Question 3: [4]

Distinguish the features between ready-mix concrete and site-mix concrete.

Question 4: [3+5]

A cement with a Silica ratio of 2.65, Alumina ratio of 1.55, Hydraulic modulus of 2.0 and Lime saturation factor of 0.95 is selected. Determine the missing oxide percentages and comment of the properties of cement in terms of strength, heat of hydration, setting time.

Oxides	Content (%)
Cao	?
SiO_2	22.0
Al_2O_3	7.25
Fe_2O_3	?
SO_3	?

Given:

$$\text{Silica ratio: } \frac{\%\ SiO_2}{\%\ Al_2O_3 + \%\ Fe_2O_3}$$

$$\text{Hydraulic Modulus} = \frac{\%\ CaO}{\%\ SiO_2 + \%\ Al_2O_3 + \%\ Fe_2O_3}$$

$$\text{Alumina modulus: } \frac{\%\ Al_2O_3}{\%\ Fe_2O_3}$$

$$\text{Lime Saturation Factor : } \frac{\%CaO - 0.7\ (\%SO_3)}{2.8(\%SiO_2) + 1.2(\%\ Al_2O_3) + 0.65(\%Fe_2O_3)}$$

University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination Spring 2024
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering III — Course Code: CE 431
Time- 1 hour — Full marks: 40

Answer all the questions (*20 +20 = 40*). [Assume reasonable data if any]

1. (a) Discuss the physical properties of solid waste mentioning the importance of each with respect to the usage and reutilization potential of solid waste. (10)

(b) Analyze the summary table for the chemical components of a solid waste sample given below to determine the approximate chemical formulas **without sulfur**. Also calculate the energy content of the waste using Dulong's formula mentioned below: (10)

Dulong's Formula:

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

Component	Moisture	Carbon	Hydrogen	Oxygen	Nitrogen	Sulfur	Ash
Mass (kg)	22.58	52.20	5.56	40.00	0.47	0.26	5.14
Molar Mass (kg/mol)	-	12.00	1.00	16.00	14.00	32.00	-

2. (a) Provide examples of source reduction, and on-site processing mentioning the resources saved or benefits realized. (5)

(b) Discuss the comparative scenario between the "direct haul" and "transfer station" system waste collection based on economic point of view. (5)

OR

For a city with a high generation rate of solid waste, explain which collection system will be beneficial among hauled and stationary system.

(c) Using the data for the energy values given in the table, make an estimate of the energy of the remaining solid waste if 45% of cardboard, 45% of the paper, 25% rubber, 15% food waste and 50% of plastics is recovered by the homeowner. Estimate the % (decrease or increase) change in total energy per unit weight of waste after recovery based on 100 kg of waste. (10)

Constituent	Food waste	Paper	Newsprint	Card board	rubber	Plastics
Weight (%)	32.5	35	12	6	5.5	9
Total Energy, (kJ)	628,615	527,520	88,305	61,460	20,688	78,573

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Spring 2024
Program: BSc.in Civil Engineering

Course Title: Irrigation and Flood Control | Course Code: CE 461
Time 1 Hour | Credit Hour :3 | Total Marks: 20
There are 3 (three) questions. Answer all the questions. Assume any missing data.

1a. Name some important factors that affect irrigation planning and development. 2

1b. Define the following: i) Permanent Wilting Point, ii) Potential Evapotranspiration, iii). Effective Rainfall 3

2a. Develop the relationship between Delta and the Duty of a crop 3

2b. Determine Evapotranspiration, Consumptive Irrigation Requirement, and Field Irrigation Requirement for wheat from the following Table. Consider water application efficiency 70%, crop factor 0.75. Use Blaney-Criddle Equation. 4

Month	Average Monthly Temperature (^{0}C)	Monthly Sunshine Hour (%)	Average Useful Rainfall (cm)
November	18.0	7.20	1.70
December	15.0	7.15	1.42
January	13.5	7.30	3.01
February	14.5	7.10	2.25

3a. Identify the number of days after which you will supply water to the soil to ensure sufficient irrigation of the given crop if the field capacity of the soil is 28%, Permanent wilting point is 15%, the Dry density of the soil is 1.3 gm/cc, Effective depth of root zone is 0.7 m and Daily consumptive use of water for the given crop is 15 mm. 4
Assume readily available moisture is 80 % of available moisture.

3b. The time required to irrigate a strip of 0.04 hectares of land is 50 minutes from a tube well with a discharge of 0.02 cumec. Determine the average flow depth on the field if the soil infiltration capacity is 6 cm/hr. Also, determine the maximum area that may be irrigated from the tube well. 4

University of Asia Pacific
Department of Civil Engineering
Midterm Examination – Spring 2024
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering II | Course Code: CE 451
Time: 1 hour | Credit Hour: 3:00 | Full Marks: 60

1. a) Draw the layers of flexible pavements. (5.0)
   b) List the ideal characteristics of aggregates for use in road construction. (5.0)
   c) Differentiate between cutback bitumen and bitumen emulsion. (5.0)
   d) Discuss the significance of (i) Water content test of bitumen and (ii) Bitumen adhesion test of aggregates. (5.0)

2. The following results were obtained by a sieve analysis. Classify the soil according to the AASHTO classification system and calculate the group index. Discuss whether this material is suitable in its natural state for use as a subbase material. (10.0)

Table 1: Mechanical Analysis

Sieve No.	Percent Finer	Plasticity Test
4	97	LL = 50%
10	93	PL = 30%
40	88	
100	78	
200	35	

3. a) Determine the optimum asphalt content for highway pavement supporting ESAL = 2 x 10^7. Table 2 shows data obtained from the Marshall test. The total volume of the test specimen was 540 cm^3. Compare the stability, flow and percent voids in total mix of the paving mixture containing the optimum asphalt content with the requirements for Marshall mix design of highway pavement specified in Table 3. (27.0)

Table 2: Marshall Method

Asphalt %	Weight of the specimen in Air (gm)	Weight of specimen in Water (gm)	Stability (lb)	Flow (in)	Maximum Specific Gravity
4.0	1582	856	1700	13	3.10
4.5	1430	1054	1650	18	4.50
5.0	1370	689	1570	22	2.30

   b) Do you think this mixture is suitable for the construction of highway pavement according to the specified limits given in Table 3? Justify your answer with proper explanation. (3.0)

Table 3: Suggested Test Limits for Marshall Test

(a) Maximum and Minimum Values

Marshall Method Mix Criteria	*Light Traffic* $ESAL < 10^4$	*Medium Traffic* $10^4 < ESAL < 10^6$	*Heavy Traffic* $ESAL > 10^6$
Compaction (No. of blows each end of Specimen)	35	50	75
Stability *N* (lb)	3336 (750)	5338 (1200)	8006 (1800)
Flow, 0.25 mm (0.1 in.)	8 to 18	8 to 16	8 to 14
Air Voids (%)	10 to 20	15 to 25	22 to 30

Table 4: Correction Factors for Marshall Stability Values

Volume of specimen in cm^3	Approximate Thickness of Specimen in mm	Correction Factors
457-470	57.1	1.19
471-482	58.7	1.14
483-495	60.3	1.09
496-508	61.9	1.04
509-522	63.5	1.00
523-535	65.1	0.96
536-546	66.7	0.93
547-559	68.3	0.89
560-573	69.9	0.86

Table 5: AASHTO Classification of Soils and Soil Aggregate Mixtures

General Classification	*Granular Materials (35% or Less Passing No. 200)*							*Silt-Clay Materials (More than 35% Passing No. 200)*			
	A-1			*A-2*							*A-7*
Group Classification	*A-1-a*	*A-1-b*	*A-3*	*A-2-4*	*A-2-5*	*A-2-6*	*A-2-7*	*A-4*	*A-5*	*A-6*	*A-7-5, A-7-6*
Sieve analysis Percent passing											
No. 10	−50 max.	–	–	–	–	–	–	–	–	–	
No. 40	30 max.	50 max.	51 min.	–	–	–	–	–	–	–	–
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing No. 40:											
Liquid limit	–		–	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		N.P.	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.*
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General rating as subgrade	Excellent to good							Fair to poor			

***Plasticity index of A-7-5 subgroup ≤ LL − 30. Plasticity index of A-7-6 subgroup > LL − 30.**

Formula

$$G_{sb} = \frac{P_{ca} + P_{fa} + P_{mf}}{\frac{P_{ca}}{G_{bca}} + \frac{P_{fa}}{G_{bfa}} + \frac{P_{mf}}{G_{bmf}}} \qquad VMA = 100 - \frac{G_{mb}P_s}{G_{sb}} \qquad P_a = 100\,\frac{G_{mm} - G_{mb}}{G_{mm}}$$

$$G = (F-35)[0.2 + 0.005\,(LL - 40)] + [(0.01)\,(F - 15)\,(PI - 10)]$$

University of Asia Pacific
Department of Civil Engineering
Mid Term Examination (Spring 2024)
Program: B. Sc. Engineering (Civil)

Course Title: Professional Practices and Communication | Course Code: CE 403
Time: 1 hour | Credit Hours: 2.00 | Full Marks: 40

(There are FOUR questions. You must answer all the questions.)

1. **a)** Suppose you are a member of a Tender Evaluation Committee (TEC). You have received a tender which does not contain a detailed price schedule. Explain your course of action regarding this tender document and justify your action. **[6]**

   b) Explain the necessity of "Contract Wording" while writing a contract. **[4]**

2. Briefly discuss about the "Bill of Quantities" section in a tender document. Show the typical tabular format of a BoQ. **[10]**

3. **a)** Explain the Scope-Schedule-Budget triangular relationship. **[5]**

   b) List all the phases of a project cycle. Briefly discuss the closing phase of a project cycle. **[1+4]**

4. **a)** Define Arbitrator and Adjudicator. Briefly discuss about the differences between arbitration and adjudication processes. **[2+3]**

   b) Define "Enforceable" and "Unenforceable" contracts. Explain how to write the "Introduction" of a project proposal? **[2+3]**

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Spring 2024

Course # CE 441 — Course Title: Geotechnical Engineering II
Full Marks: 40 — Time: 1 hour

Answer to all questions

1. (a) A geotechnical subsurface exploration is to be conducted at a site. Give two points each regarding selection of location and number of boreholes. 4

   (b) Compare on the extent and significant depth up to which exploration is generally intended from the perspective of geotechnical engineering with other types of exploration as such in the field of agronomy and petroleum engineering. 6

2. (a) Mention drilling type and summarize logging for a geotechnical subsurface exploration. 3

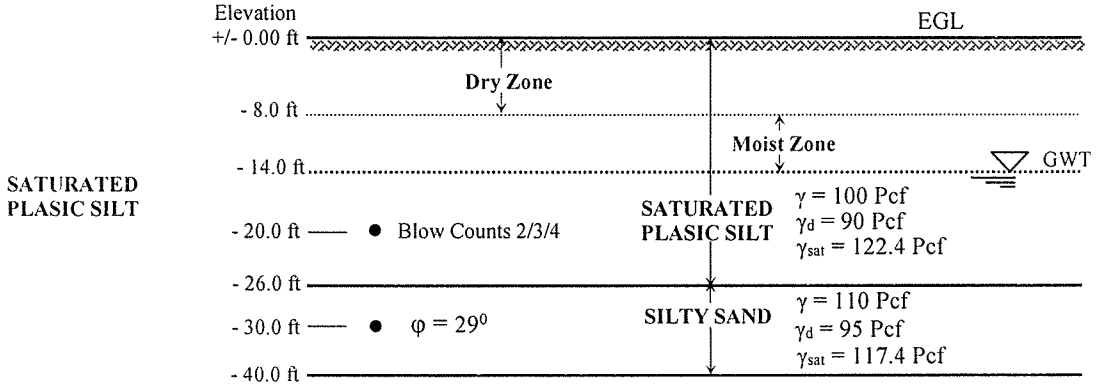
   (b) Consider the following scenario for an existing two-storied building already constructed 15-years ago at a site at Dhanmondi area of Dhaka City: 7

   - A footing of the building was constructed without performing any geotechnical analysis having a dimension of 8 ft x 10 ft
   - Estimated applied column load on this footing for existing condition, P_{app} = 160 kips
   - Estimated ultimate bearing capacity as determined from geotechnical analysis performed for long-term condition for this site, (q_u) = 10,000 psf.

   Assess the actual factor of safety of the foundation for existing condition and comment on your result. Also estimate the amount of extra load that can be applied on this footing while maintaining a required factor of safety of 2.5

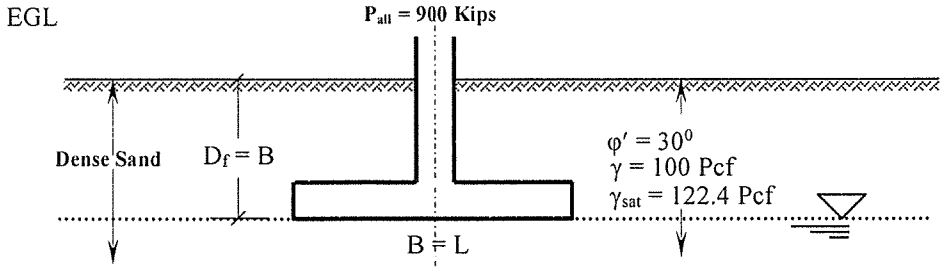
3. Information regarding a geotechnical site investigation conducted at a site at Chandpur is provided below. Estimate the Field SPT value at a depth of 30 feet below EGL. Use Appendix as necessary. Also determine the angle of internal friction or cohesion, as applicable at corresponding depth. 10

   Notes: *Use hammer efficiency of 50%; SPT was conducted without liner*



4. (a) Draw a neat sketch showing local shear failure in medium stiff/dense soil (no description is required. 2

   (b) Using Terzaghi's bearing capacity equation (TBCE), determine the size of the square footing. Use F. S. = 3. Also determine the allowable bearing capacity in this case. 8



University of Asia Pacific
Department of Civil Engineering
Midterm Examination Spring 2024
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering III | Course Code: CE 411
Time: 1 hour | Credit Hour: 3.0 | Full Marks: 40 (= 4 × 10)

ANSWER ALL QUESTIONS. Any missing data can be assumed reasonably.

1. Use stiffness method to calculate deflections of joints *c* and *d* of the grid system ***abcdef*** loaded as shown in ***Fig.1***
[Given: EI = 45×10^3 k-ft^2 and GJ = 4.8×10^3 k-ft^2].

2. Use stiffness method (neglecting axial deformations) to calculate deflection at joint *f*, rotations of joints *c* and *e* of the frame ***abcdef*** loaded as shown in ***Fig.2***
[Given: EI = 40×10^3 k-ft^2]

3. Identify zero-force members of the truss loaded as shown in ***Fig.3***. Determine the displacements of joint *c* and *g*. Also calculate axial force of member ***ch.***
[Given: EA/L =1000 k/ft].

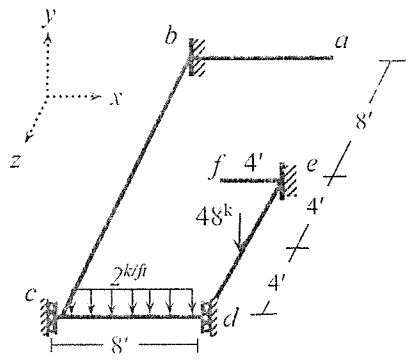


Fig.1

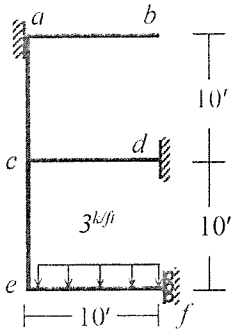


Fig.2

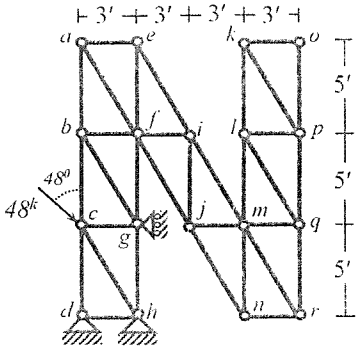


Fig.3

4. Ignore zero-force members of the space truss ***abcdefgh*** shown in ***Fig.4*** and apply boundary conditions to formulate stiffness matrix and load vector. A force X_c= 48^k is applied on joint *c* in *x* direction. Joint *a* is restrained in *z* direction by a roller support.
[Given: S_x = 1100 k/ft, Nodal Coordinates (ft) are *a*(0,4,-10), *b*(10,4,-10), *c*(0,4,0), *d*(10,4,0), *e*(0,0,0), *f*(10,0,0), *g*(10,0,-10) and *h*(0,0,-10)].

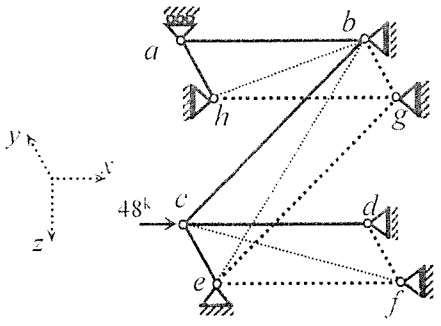


Fig.4

List of Useful Formulae for CE 411

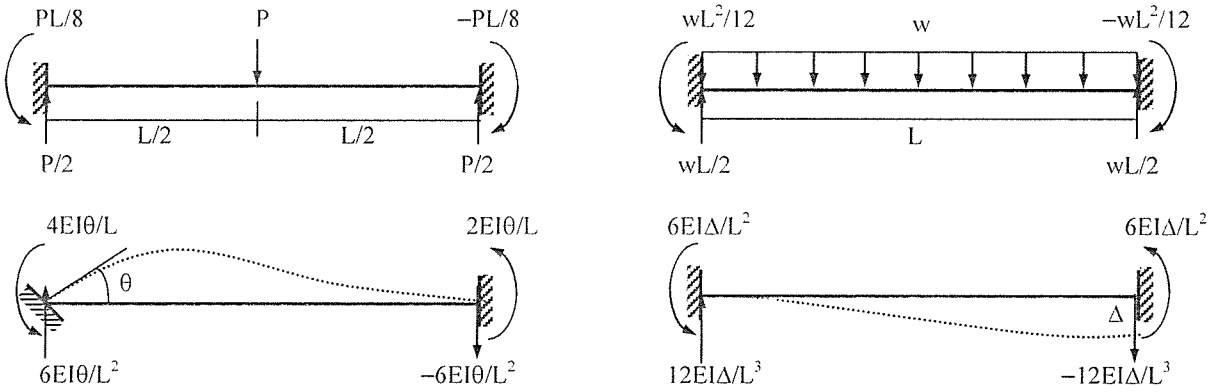
* The stiffness matrix $\mathbf{K}_m^G$ of a 2D truss member in the global axis system is given by

$$\mathbf{K}_m^G = S_x \begin{pmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{pmatrix}$$

and Truss member force, $P_{AB} = S_x [(u_B - u_A)\, C + (v_B - v_A)\, S]$

[where $C = \cos\theta$, $S = \sin\theta$]

Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings



* The stiffness matrix of a 3D truss member in the global axes system [using $C_x = \cos\alpha$, $C_y = \cos\beta$, $C_z = \cos\gamma$] is

$$\mathbf{K}_m^G = S_x \begin{pmatrix} C_x^2 & C_xC_y & C_xC_z & -C_x^2 & -C_xC_y & -C_xC_z \\ C_yC_x & C_y^2 & C_yC_z & -C_yC_x & -C_y^2 & -C_yC_z \\ C_zC_x & C_zC_y & C_z^2 & -C_zC_x & -C_zC_y & -C_z^2 \\ -C_x^2 & -C_xC_y & -C_xC_z & C_x^2 & C_xC_y & C_xC_z \\ -C_yC_x & -C_y^2 & -C_yC_z & C_yC_x & C_y^2 & C_yC_z \\ -C_zC_x & -C_zC_y & -C_z^2 & C_zC_x & C_zC_y & C_z^2 \end{pmatrix}$$

$C_x = L_x/L$, $C_y = L_y/L$, $C_z = L_z/L$
where $L = \sqrt{[L_x^2 + L_y^2 + L_z^2]}$

* Member force $P_{AB} = S_x [(u_B - u_A)\, C_x + (v_B - v_A)\, C_y + (w_B - w_A)\, C_z]$

* Ignoring axial deformations, the matrices $\mathbf{K}_m^L$ and $\mathbf{G}_m^L$ of a frame member in the local axis system are

$$\mathbf{K}_m^L = \begin{pmatrix} S_1 & S_2 & -S_1 & S_2 \\ S_2 & S_3 & -S_2 & S_4 \\ -S_1 & -S_2 & S_1 & -S_2 \\ S_2 & S_4 & -S_2 & S_3 \end{pmatrix} \qquad \mathbf{G}_m^L = (P/30L) \begin{pmatrix} 36 & 3L & -36 & 3L \\ 3L & 4L^2 & -3L & -L^2 \\ -36 & -3L & 36 & -3L \\ 3L & -L^2 & -3L & 4L^2 \end{pmatrix}$$

where $S_1 = 12EI/L^3$, $S_2 = 6EI/L^2$, $S_3 = 4EI/L$, $S_4 = 2EI/L$

*The general form of the stiffness matrix for any member of a 2-dimensional frame is

$$\mathbf{K}_m^G = \begin{pmatrix} S_xC^2+S_1S^2 & (S_x-S_1)CS & -S_2S & -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & -S_2S \\ (S_x-S_1)CS & S_xS^2+S_1C^2 & S_2C & -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & S_2C \\ S_2S & S_2C & S_3 & S_2S & -S_2C & S_4 \\ -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & S_2S & S_xC^2+S_1S^2 & (S_x-S_1)CS & S_2S \\ -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & -S_2C & (S_x-S_1)CS & (S_xS^2+S_1C^2) & -S_2C \\ -S_2S & S_2C & S_4 & S_2S & -S_2C & S_3 \end{pmatrix}$$