University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
2nd Year 1st Semester

Course Title: Principles of Accounting **Course Code: ACN 201**
Time: 2 hours **Credit Hour: 2.00** **Full Marks: 50**

[Answer any **four** questions **including question # 3** . Answer must be brief, relevant, neat and clean. Different parts of the same question (i.e. a,b,c,d) if any, must be answered consecutively.]

Question # 1: **[2+10=12]**

a) "Accounting is ingrained in our society and it is vital to our economic system." Do you agree? Explain.

b) Mr. Sharif started a delivery service, Sharif Deliveries, on June 1, 2025. The following transactions occurred during the month of June.

June 1 Shareholders invested Tk. 10,000 cash in the business in exchange for ordinary shares.
June 2 Purchased a used van for deliveries for Tk. 14,000. Sharif paid Tk. 2,000 cash and signed a note payable for the remaining balance.
June 3 Paid Tk. 500 for office rent for the month.
June 5 Performed Tk. 4,800 of services on account.
June 15 Received a cash payment of Tk. 1,250 for services provided on June 5.
June 20 Received a cash payment of Tk. 1,500 for services provided.

Required: Journalize the transactions.

Question # 2: **[12]**

Tony Masasi started his own consulting firm, Masasi Company, on June 1, 2025. The trial balance at June 30 is shown below.

MASASI COMPANY
Trial Balance
June 30, 2025

Account Number	Particulars	Debit	Credit
101	Cash	Tk. 7,150	
112	Accounts Receivable	6,000	
126	Supplies	2,000	
130	Prepaid Insurance	3,000	
157	Office Equipment	15,000	
201	Accounts Payable		4,500
209	Unearned Service Revenue		4,000
301	T. Masasi, Capital		21,750
400	Service Revinue		7,900
726	Salaries Expense	4,000	
729	Rent Expense	1,000	
		Tk. 38,150	Tk.38,150

In addition to those accounts listed on the trial balance, the chart of accounts for Masasi Company also contains the following accounts and account numbers: No. 158 Accumulated Depreciation—Office Equipment, No. 212 Salaries Payable, No. 244 Utilities Payable, No. 631 Supplies Expense, No. 711 Depreciation Expense, No. 722 Insurance Expense, and No. 732 Utilities Expense.

Other data:

i. Supplies on hand at June 30 are Tk.600.
ii. A utility bill for Tk.150 has not been recorded and will not be paid until next month.
iii. The insurance policy is for a year.
iv. Tk.2,500 of unearned service revenue has been earned at the end of the month.
v. Salaries of Tk.2,000 are accrued at June 30.
vi. The office equipment has a 5-year life with no salvage value. It is being depreciated at Tk.250 per month for 60 months.
vii. Invoices representing Tk.1,000 of services performed during the month have not been recorded as of June 30.

Instruction: Prepare the adjusting entries for the month of June.

Question # 3: [14]

Maine Department Store is located near the Village Shopping Mall. At the end of the company's calendar year on December 31, 2024, the following accounts appeared in its trial balances.

Particulars	Amounts (Tk.)	Particulars	Amounts (Tk.)
Accounts Payable	80,300	Inventory	75,000
Accounts Receivable	50,300	Mortgage Payable	80,000
Accumulated Depr.—Building	52,500	Prepaid Insurance	2,400
Accumulated Depr.—Equipment	42,900	Property Tax Expense	4,800
Building	290,000	Property Taxes Payable	4,800
Cash	23,800	Retained Earnings	64,600
Cost of Goods Sold	412,700	Salaries and Wages Expense	108,000
Depreciation Expense	23,700	Sales Commissions Expense	14,500
Dividends	24,000	Sales Commissions Payable	4,300
Equipment	110,000	Sales Returns and Allowances	8,000
Insurance Expense	7,200	Sales Revenue	724,000
Interest Expense	8,600	Share Capital	112,000
Interest Payable	5,600	Utilities Expense	12,000
Interest Revenue	4,000		

Instruction: Prepare an income statement, a retained earnings statement, and a classified statement of financial position. Tk. 16,000 of the mortgage payable is due for payment next year.

Question # 4: [2+10=12]

a) What is the main difference between variable costs and fixed costs?

b) Selected account balances for the year ended December 31 are provided below for Superior Company:

Selling and administrative salaries	Tk. 110,000
Insurance, factory	8,000
Utilities, factory	45,000
Purchases of raw materials	290,000
Indirect labor	60,000
Direct labor	?
Advertising expense	80,000
Cleaning supplies, factory	7,000
Sales commissions	50,000
Rent, factory building	120,000
Maintenance, factory	30,000

Inventory balances at the beginning and end of the year were as follows:

	Beginning of the Year	End of the Year
Raw materials	Tk. 40,000	Tk. 10,000
Work in process	?	35,000
Finished goods	50,000	?

The total manufacturing costs for the year were Tk. 683,000; the goods available for sale totaled Tk. 740,000; and the cost of goods sold totaled Tk. 660,000.

Required: Prepare a schedule of cost of goods sold for the year.

Question # 5: **[2+10=12]**

a) What is meant by the term break-even point? Name three approaches to break-even analysis. Briefly explain how each approach works.

b) Due to erratic sales of its sole product—a high-capacity battery for laptop computers—PEM, Inc., has been experiencing difficulty for some time. The company's contribution format income statement for the most recent month is given below:

Sales (19,500 units _ Tk.30 per unit)	Tk.585,000
Less variable expenses	409,500
Contribution margin	175,500
Less fixed expenses	180,000
Net operating loss	Tk. (4,500)

Required:

i. Compute the company's CM ratio and its break-even point in both units and dollars.

ii. Refer to the original data. The sales manager is convinced that a 10% reduction in the selling price, combined with an increase of Tk.60,000 in the monthly advertising budget, will cause unit sales to double. What will the new contribution format income statement look like if these changes are adopted?

iii. Refer to the original data. The Marketing Department thinks that a fancy new package for the laptop computer battery would help sales. The new package would increase packaging costs by 75 cents per unit. Assuming no other changes, how many units would have to be sold each month to earn a profit of Tk.9,750?

Question # 6: **[2+10=12]**

a) Explain the concept of capital budgeting. What are the capital budgeting techniques?

b) ACI is considering a new product line to supplement its range line. It is anticipated that the new product line will involve cash investment of Tk. 15,00,000 at time 0. After-tax cash inflows of Tk. 250,000 are expected in year 1, Tk. 300,000 in year 2, Tk. 350,000 in year 3, and Tk. 400,000 each year thereafter through year 10. Though the product line might be viable after year 10, the company prefers to be conservative and end all calculations at that time.

Required:

i. If the required rate of return is 15 percent, what is the net present value (NPV) of the project? Is it acceptable?

ii. What is its internal rate of return?

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
2nd Year 1st Semester

Course Title: Mathematics III | Course Code: MTH 201
Time: 3.00 Hours | Credit Hour: 3.00 | Full Marks: 150

Answer all the questions.

QUESTION 1 [25MARKS]

a) Using System of linear equation balance the following equation [13]

$$Fe_2O_3 + Al \rightarrow Al_2O_3 + Fe$$

b) Define Involuntary Matrix and Orthogonal Matrix. Calculate determinant of the matrix using cofactor of the second row $\begin{bmatrix} 2 & 3 & -1 & 1 \\ -3 & 2 & 0 & 3 \\ 3 & -2 & 1 & 0 \\ 3 & -2 & 1 & 4 \end{bmatrix}$. [12]

QUESTION 2 [25 MARKS]

a. Write down the formulas of moments about assumed mean and mean. Using those formulas calculate moments and kurtosis of the following data. [25]

Class	0-5	5-10	10-15	15-20	20-25
Frequency	1	2	4	2	1

QUESTION 3 [25 MARKS]

a) A 12 volt electromotive force is applied to a LR series circuit in which the inductance 1/3henry, the resistance is 10 ohms. Find the current i(t) if i(0)=0. Determine the current after long time. [13]

b) Write down the condition of exactness. Check exactness of the following equation and find its solution $x\,dx + y\,dy + \frac{xdy - ydx}{x^2+y^2} = 0$. [12]

QUESTION 4 [25 MARKS]

a) Write down the condition of probability mass and density function. The probability function of a continuous random variable X is [15]

$$f(x) = \begin{cases} \frac{2}{27}(1+x) & 2 < x < 5 \\ 0 & elsewhere \end{cases}$$

i. Verify the condition $\int_{-\infty}^{\infty} f(x)dx = 1$

ii. Find $P(3<X<4)$.

iii. Find $P(X<4)$.

b) The probability function of a discrete random variable X is [10]

X	-1	0	1
F(x)	0.2	0.3	0.5

Calculate expected value and variance.

QUESTION 5 [25 MARKS]

a) Define order and degree of ordinary differential equation. Find out the solution of the equation $(x+y)^2 \frac{dy}{dx} = 2^2$. [13]

b) Write down the format of Bernoulli's equation and solve the Bernoulli's equation [12]

$$\frac{dy}{dx} + x \sin 2y = x^3 \cos^2 y.$$

OR

a) Define ordinary differential equation. Solve the homogeneous differential equation [13]

$$\frac{dy}{dx} = \frac{y}{x} + sin\frac{y}{x}$$

b) Define linear differential equation and solve the following differential equation [12]

$$x\frac{dy}{dx} + 2y = x^2 \log x$$

QUESTION 6 [25 MARKS]

a) Define poison distribution. A car hire firm has two cars which its hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 1.5. Calculate the number of days in a year on which [13]
i. Car is not used
ii. The number of days in a year on which some demand is refused

b) Define binomial distribution. If 10% screws produced by a machine are defected. Chosen a box of 12 screws at random. Find the probability using binomial distribution that out of 12 screws [12]
i. One screw is defected
ii. None of them is defected
iii. At most two screws are defected

OR

a) State Bayes theorem. In a class of 60 students, 15 are girls, office record indicates that 80 percent of the girl students and 75 percent of the boy students got star marks in HSC. One student is randomly chosen and found to have secured star marks. Find the probability that the chosen student is a girl. [13]

b) Three bulbs are chosen at random from a lot of 15 bulbs of which 5 are defective. Find the probability that [06]
i. None are defective
ii. Exactly one is defective
iii. At least one is defective

c) What is the probability of the occurrence of a number that is odd or greater than four when a fair dice is rolled? [06]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering

Course Title: Mechanics of Solids I — Course Code: CE 211
Time: 3 hours — Credit Hour: 3.0 — Full Marks: 100 (10 x 10)

Answer all the questions

1. ***Fig.1*** shows a steel-aluminium composite cross section of a beam. Calculate the maximum stresses produced in aluminium and steel for induced bending moment of 540 kip-ft. Also draw stress diagram [Given: $E_{steel} = 30000\ ksi$, $E_{aluminium} = 10000\ ksi$].

2. For a vertical shear force (4 kips) working as shown ***Fig. 2***, compute and illustrate shear flow and determine the location of shear center for the cross section [Given: *thickness of the cross section, t = 0.1 inch*].

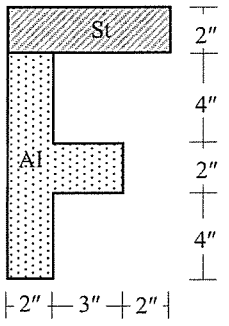


Fig.1

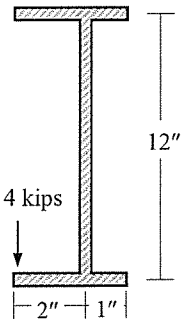


Fig.2

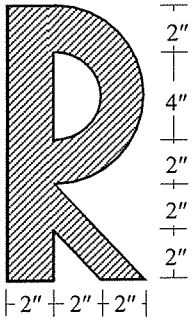


Fig.3

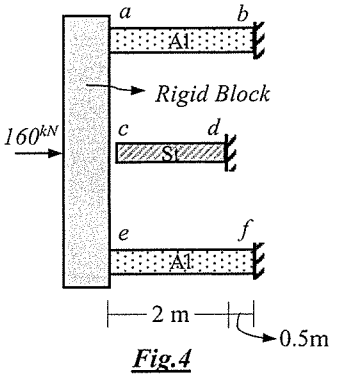


Fig.4

3. ***Fig.3*** shows a cross section of a beam. Calculate the maximum stresses for induced bending moment of M = 540 kip-ft.

4. In ***Fig.4*** a rigid block ***ae*** is attached to two rods of aluminium: ***ab*** and ***ef***, and restrained at ***b*** and ***f***, respectively. A concentrated load of 160 kN is applied at mid-point of the rigid member. There is a 4 mm gap between rigid block and steel bar: ***cd***. Calculate axial stresses developed in bars [Given: $E_{st} = 200GPa$, $E_{al} = 80\ GPa$, $A_{st} = 25 \times 25\ mm^2$, $A_{al} = 20 \times 20\ mm^2$].

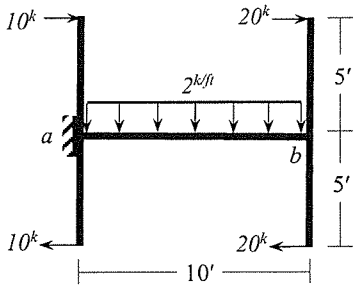


Fig.5

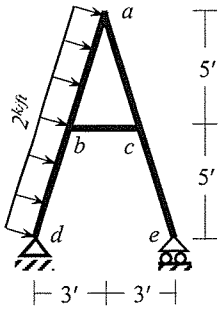


Fig.6

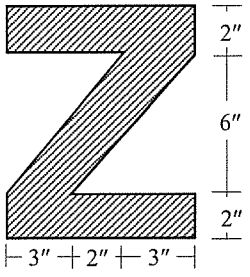


Fig.7

5. Draw axial force (AF), shear force (SF) and bending moment (BM) diagram for the member **ab** of the structure loaded as shown in ***Fig.5***.

6. Draw axial force (AF), shear force (SF) and bending moment (BM) diagram for member ***bd*** of the structure ***abcde*** loaded as shown in ***Fig.6***.

7. Calculate the maximum shear stress produced in the cross section of a beam shown in ***Fig.7 or Fig.10*** if the induced shear force is 10 kips.

8. A cylindrical steel pressure vessel (***Fig.8***) of 20″ in diameter (inside diameter) with a wall thickness of 1″ is subjected to an internal pressure of 250 psi. Calculate the tangential and longitudinal stresses and strains in the steel [Given: *Modulus of Elasticity = 30000 ksi and Poisson's Ratio = 0.25*].

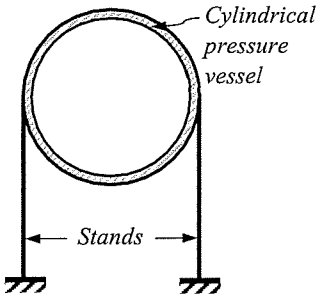


Fig.8

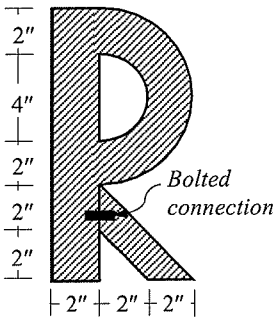


Fig.9

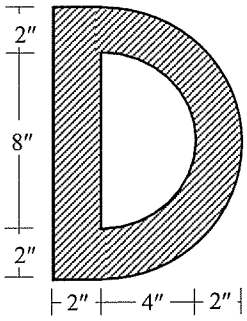


Fig.10

9. (a) Calculate the flexural shear flow at bolt level, (b) Calculate the spacing of 0.5″ bolts required at the joint shown in ***Fig.9*** to withstand the shear flow [Given: *Shear force at the section, V = 10 kips, Allowable shear stress for bolt is 20 ksi*].

10. The rectangular prism shown in ***Fig.11*** is subjected to normal force in the Y direction and is restrained in the X direction and free in Z direction. Calculate the normal stresses and strains that develop in the prism. Also determine the tensile forces in X direction and elongation in Y direction [Given: *Modulus of Elasticity = 2000 ksi and Poisson's Ratio = 0.30*].

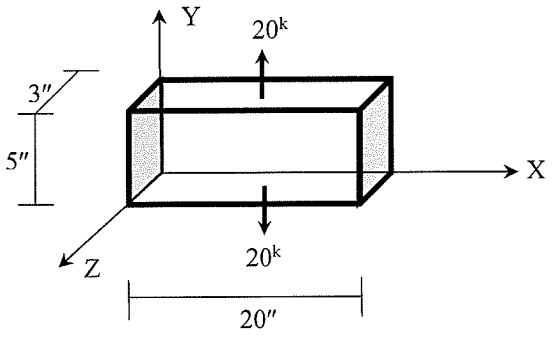


Fig.11

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
2nd Year 1st Semester

Course Title: Engineering Materials | Course Code: CE 201
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 100

[Answer all the questions. Assume value for any missing data]

PART A

QUESTION 1 [20 MARKS]

a. Aggregates from four sources having absorption capacities of 2.3%, 1.6%, 0.8% and 3.8% are blended at a ratio of 30:40:20:10 by weight, respectively. Compute the absorption capacity of the aggregate blend. **[4]**

b. Suppose urgent repair work is required for a highway. Discuss the type of concrete admixture need to be used for prompt service and clarify your discussion. **[4]**

c. Two aggregates, A and B, are to be mixed together to obtain an aggregate blend for an asphalt mixture. The grain size distribution is given below:

Table 1: Sieve Analysis of Aggrtegate

Sieve size	% Passing		
	Aggregate A	Aggregate B	Target Specification
1"	-	100	
¾"	100	94	95
1/2"	73	62	
#4	52	44	
#8	18	0	3
#16	6	-	

i. Determine the mix ratio of A and B to meet the target specification in **Table 1.** **[3]**

ii. Calculate the fineness modulus of the combined aggregate. **[9]**

QUESTION 2 [10 MARKS]

a. Determine the allowable maximum size of aggregate for construction of a building, where depth of slab is 6", clear spacing between re-bars is 1.5" and the narrowest dimension of the structure is 4". **[5]**

b. Write down the advantages of Ferrocement. **[5]**

QUESTION 3 [20 MARKS]

Design a concrete mix following the ACI 211.1 mix design method for a non-air entrained concrete to be used in a column with a specified compressive strength of 30 MPa. Maximum allowable slump of concrete is 100 mm. A superplasticizer (specific gravity 1.3) is to be used at 0.6% of the cement weight, capable of reducing water demand by approximately 20% while

maintaining workability. Additionally, a retarder (specific gravity 1.2) at a dose of 0.08% of the cement weight is to be used in the concrete mix. Table 1 to Table 4 in annexure and the following data are provided for the mix design. **[20]**

Cement: Portland Composite Cement; Specific gravity = 2.91

Coarse Aggregate:

- Maximum size: 19 mm
- Absorption capacity: 1.8%
- Moisture content: 0.8%
- Bulk specific gravity (Oven Dry): 2.85
- Unit weight (dry-rodded): 1600 kg/m^3

Fine Aggregate:

- Fineness modulus: 2.5
- Absorption capacity: 3.9%
- Moisture content: 4.5%
- Bulk specific gravity (OD): 2.55

PART B

QUESTION 4 [25 MARKS]

a. Define bulking phenomenon of sand. Explain how bulking is related to aggregate gradation. **[8]**

b. Differentiate between hydraulic and non- hydraulic lime. **[7]**

c. Draw lime-mortar cycle and explain with chemical reactions. **[10]**

QUESTION 5 [25 MARKS]

a. Explain the following relationship graphically: **[10]**

   I. Concrete strength vs age
   II. Concrete strength vs water- cement ratio

b. Name few defects of timber. **[2]**

c. Name the major constituents of paint. **[3]**

d. The strain vs time plot of a material is shown below in Figure 3. **[10]**

I. Define the type of the material whether it is elastic or plastic or elastoplastic

II. Draw the load vs time plot from the given plot for this material

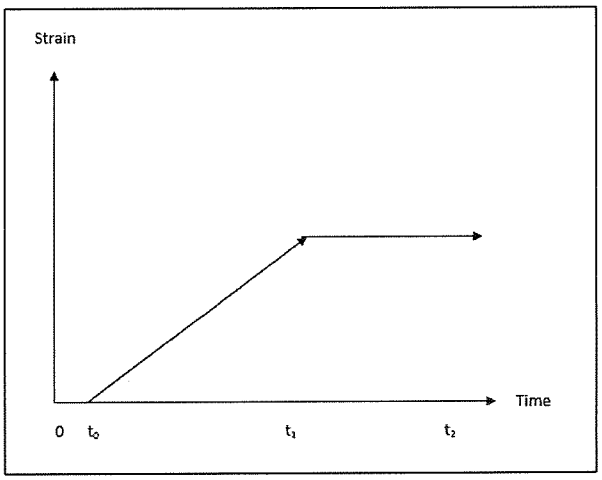


Figure 3: Strain vs Time plot

Annexure

Table 1

Slump, mm	Water, kilograms per cubic meter of concrete, for indicated sizes of aggregate*							
	9.5 mm	12.5 mm	19 mm	25 mm	37.5 mm	50 mm**	75 mm**	150 mm**
	Non-air-entrained concrete							
25 to 50	207	199	190	179	166	154	130	113
75 to 100	228	216	205	193	181	169	145	124
150 to 175	243	228	216	202	190	178	160	—
Approximate amount of entrapped air in non-air-entrained concrete, percent	3	2.5	2	1.5	1	0.5	0.3	0.2

Table 2

Compressive strength at 28 days, MPa	Water-cementitious materials ratio by mass	
	Non-air-entrained concrete	Air-entrained concrete
45	0.38	0.30
40	0.42	0.34
35	0.47	0.39
30	0.54	0.45
25	0.61	0.52
20	0.69	0.60
15	0.79	0.70

Table 3

Specified compressive strength, f'_c, MPa	Required average compressive strength, f'_{cr}, MPa
Less than 21	$f'_c + 7.0$
21 to 35	$f'_c + 8.5$
Over 35	$1.10 f'_c + 5.0$

Table 4

Nominal maximum size of aggregate, mm (in.)	Bulk volume of dry-rodded coarse aggregate per unit volume of concrete for different fineness moduli of fine aggregate*			
	2.40	2.60	2.80	3.00
9.5 (⅜)	0.50	0.48	0.46	0.44
12.5 (½)	0.59	0.57	0.55	0.53
19 (¾)	0.66	0.64	0.62	0.60
25 (1)	0.71	0.69	0.67	0.65
37.5 (1½)	0.75	0.73	0.71	0.69
50 (2)	0.78	0.76	0.74	0.72
75 (3)	0.82	0.80	0.78	0.76
150 (6)	0.87	0.85	0.83	0.81

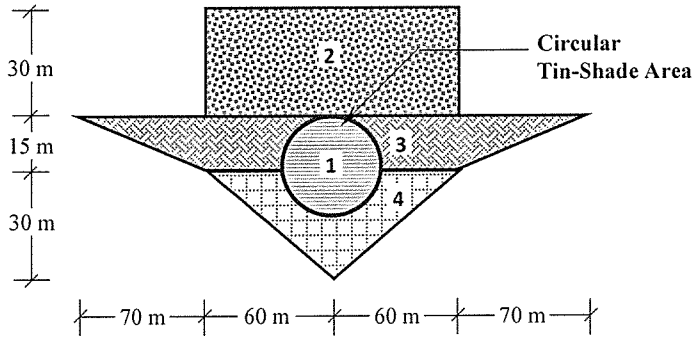
University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering

Course Title: Engineering Geology and Geomorphology (OBE) Course Code: CE 203
Time: 3 hours Credit Hour: 3.0 Full Marks: 100

(Answer all questions)

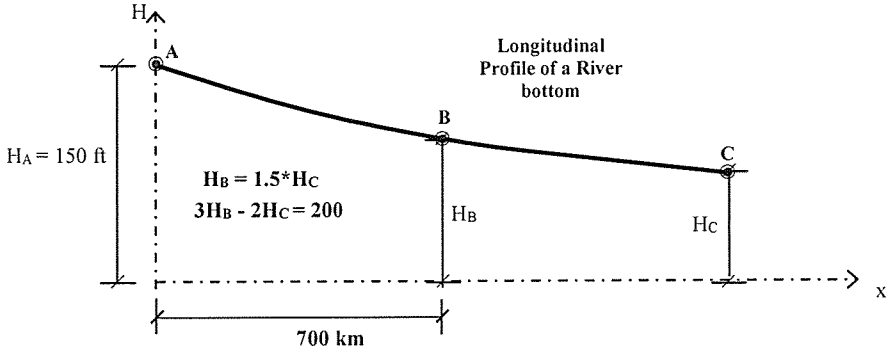
1. Define *Physical* and *Chemical weathering*. What is *Diastrophism*? [3]

2. For the drainage area shown below, calculate peak runoff in ft^3/s. Use $C_2 = (C_3 + C_4 - 0.3)$, $C_3 = (C_4 - 0.2)$ and $C_4 = 0.6$ and $I = 0.05$ in/min. [8]



3. Define *Capacity* and *Competence* of a river. What is a *Graded stream*? [3]

4. From the figure shown below, calculate the horizontal distance between locations B and C. [8]



5. Derive the relationship between the diameter of the maximum size particle a river can carry and the velocity of the river stream. What happens to the diameter if the velocity is doubled? [4]

6. Calculate Stream Frequency (SF) of a catchment area (having Drainage Density, DD = 0.05 km/km^2) from the information provided in the table below. [8]

Stream Rank	No. of Streams (Ns_i)	BR	ABR	Mean Length (Lm_i,km)	LR	ALR
1	---			---		
2	8	---	2.8	---	3.0	2.5
3	---	3		---	---	
4	---	2.5		100		

7. Define a **mineral**, stating its five essential characteristics. Explain the critical importance of a mineral's **crystalline structure** in both its identification and in determining its physical properties. [10]

8. Describe the formation process of **Igneous Rocks**. Differentiate between **Intrusive** and **Extrusive** igneous rocks based on three key criteria. [6]

9. Differentiate among the three main types of **Sedimentary rocks**. Provide a specific example for each type and briefly explain the engineering significance of two of these examples. [15]

10. Illustrate and fully explain the **Rock Cycle**. [10]

11. Two earthquakes occurred in the region and magnitude was measured by the same seismograph station.:

- **Earthquake A** measured a magnitude of 6.2 on the Richter scale.
- **Earthquake B** measured a magnitude of 4.5 on the Richter scale.

How many times greater was the maximum trace amplitude (A) of Earthquake A compared to Earthquake B? [10]

12. Discuss in depth the three processes of V-shaped valley formation. [15]

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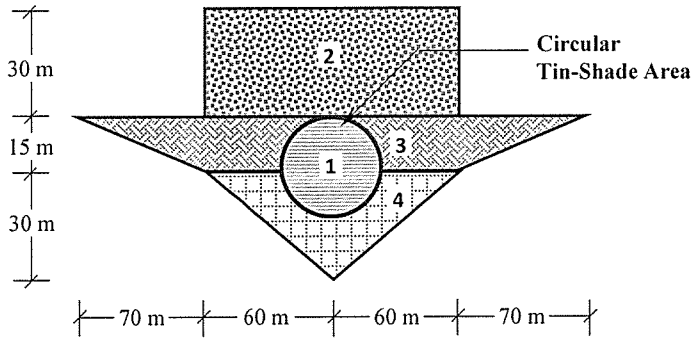
Course Title: Engineering Geology and Geomorphology (Old) Course Code: CE 203
Time: 3 hours Credit Hour: 3.0 Full Marks: 100

(Answer all questions)

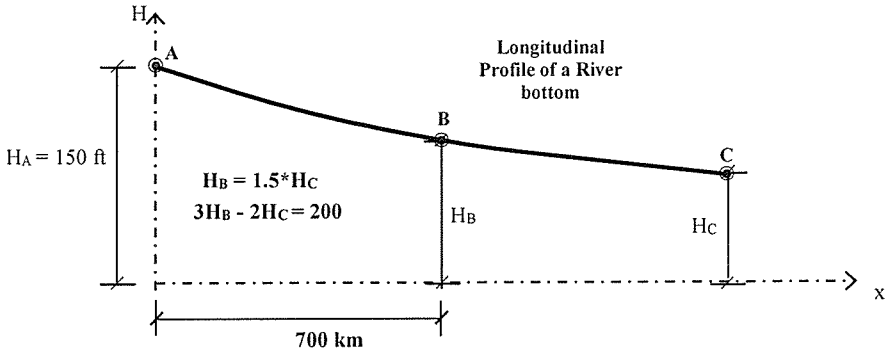
1. Define *Physical* and *Chemical weathering*. What is *Diastrophism*? [3]

2. For the drainage area shown below, calculate peak runoff in ft^3/s. Use $C_2 = (C_3 + C_4 - 0.3)$, $C_3 = (C_4 - 0.2)$ and $C_4 = 0.6$ and $I = 0.05$ in/min. [8]



3. Define *Capacity* and *Competence* of a river. What is a *Graded stream*? [3]

4. From the figure shown below, calculate the horizontal distance between locations B and C. [8]



5. Derive the relationship between the diameter of the maximum size particle a river can carry and the velocity of the river stream. What happens to the diameter if the velocity is doubled? [4]

6. Calculate Stream Frequency (SF) of a catchment area (having Drainage Density, DD = 0.05 km/km^2) from the information provided in the table below. [8]

Stream Rank	No. of Streams (Ns_i)	BR	ABR	Mean Length (Lm_i,km)	LR	ALR
1	---			---		
2	8	---	2.8	---	3.0 ---	2.5
3	---	3		---		
4	---	2.5		100		

7. Define a **mineral**, stating its five essential characteristics. Explain the critical importance of a mineral's **crystalline structure** in both its identification and in determining its physical properties. [10]

8. Describe the formation process of **Igneous Rocks**. Differentiate between **Intrusive** and **Extrusive** igneous rocks based on three key criteria. [6]

9. Differentiate among the three main types of **Sedimentary rocks**. Provide a specific example for each type and briefly explain the engineering significance of two of these examples. [15]

10. Illustrate and fully explain the **Rock Cycle**. [10]

11. Two earthquakes occurred in the region and magnitude was measured by the same seismograph station.:

- **Earthquake A** measured a magnitude of 6.2 on the Richter scale.
- **Earthquake B** measured a magnitude of 4.5 on the Richter scale.

How many times greater was the maximum trace amplitude (A) of Earthquake A compared to Earthquake B? [10]

12. Discuss in depth the three processes of V-shaped valley formation. [15]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
2nd Year 1st Semester

Course Title: Material Science and Environmental Sustainability | Course Code: CE 207
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 150

Answer all the questions. Assume reasonable data if required.

PART A

QUESTION 1 [15 MARKS]

a. With a neat sketch, explain why two different unit cell structures, Face Centered Cubic (FCC) and Hexagonal Close Packed (HCP), have the same Atomic Packing Factor (APF). [5]

b. An X-ray diffraction test was conducted on a Body Centered Cubic (BCC) iron specimen and a Face Centered Cubic (FCC) aluminum specimen. The second order diffraction angle for the (111) set of planes in BCC iron was found to be 178°, while for the (111) planes in FCC aluminum, it was 38°. In both tests, the same monochromatic radiation was used. If the lattice parameter of FCC aluminum is 0.202 nm, determine the lattice parameter of BCC iron. [10]

QUESTION 2 [18 MARKS]

a. Briefly discuss anelasticity using graph. [6]

b. A tension test was conducted on material X, which fractured under a load of 500 kN. From the stress–strain graph shown in **Figure 1**, it is evident that material X is highly brittle, and this is supported by a ductility value of 6% elongation. Poisson's ratio for X is 0.27. Determine the final diameter of the tested specimen. (Given, modulus of elasticity of X is 100 GPa) [12]

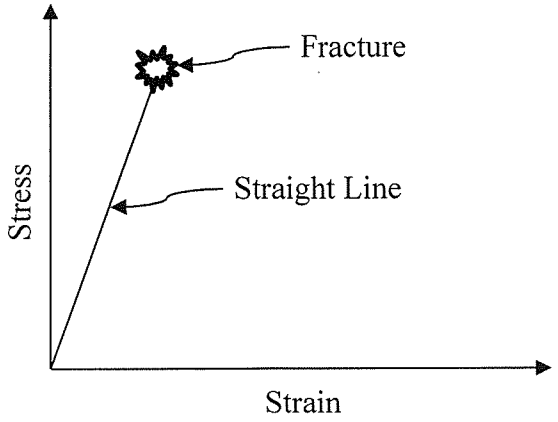


Figure 1: Sectional view of wall

QUESTION 3 [15 MARKS]

a. State the effects of nanoparticles in self-consolidating concrete.

[6]

b. With neat sketch define the following microstructural defects:

(i) Line Defect
(ii) High angle grain boundary
(iii) Twin boundary

[3×3=9]

QUESTION 4 [18 MARKS]

a. With neat sketch show an application of thermal expansion in civil engineering works.

[6]

b. A wall is constructed using concrete and styrofoam to provide thermal insulation in a building. The sectional view of the wall is shown in **Figure 2**. T_1, T_2, T_3 and T_4 represent the temperatures at different points along the thickness of the wall. During summer, a thermal flux of 4 W/m^2 flows from the outside to the inside. The material properties of concrete and styrofoam are given in **Table 1.**

(i) Calculate the thermal stress generated in the styrofoam due to the thermal flux.
(ii) Compare the thermal shock resistance of the wall materials in compression as well as in tension.

[7+5]

Table 1. Material properties of concrete and styrofoam

Name of the property	Concrete	Styrofoam
Fracture Strength	40 MPa (Compression) 4 MPa (Tension)	0.5 MPa (Compression) 3 MPa (Tension)
Linear Expansion Coefficient	8×10^{-6}/°C	70×10^{-6}/°C
Modulus of Elasticity	31.6 GPa (Compression) 10 GPa (Tension)	5 MPa (Compression) 20 MPa (Tension)
Thermal Conductivity	1.5 W/m-K	0.04 W/m -K

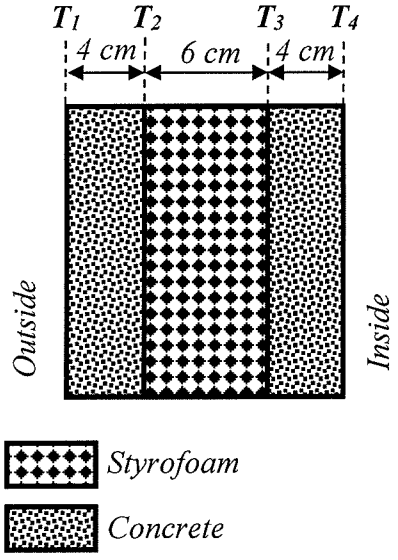


Figure 2: Sectional view of wall

QUESTION 5 [18 MARKS]

a. **Figure 3** shows the tensile engineering stress–strain behaviour for a metal alloy which will be used in construction. The maximum allowable rigidity is 3,000,000 J/m^3 and minimum required toughness is 30,000,000 J/m^3. Determine the rigidity and toughness and compare with the criteria. [8]

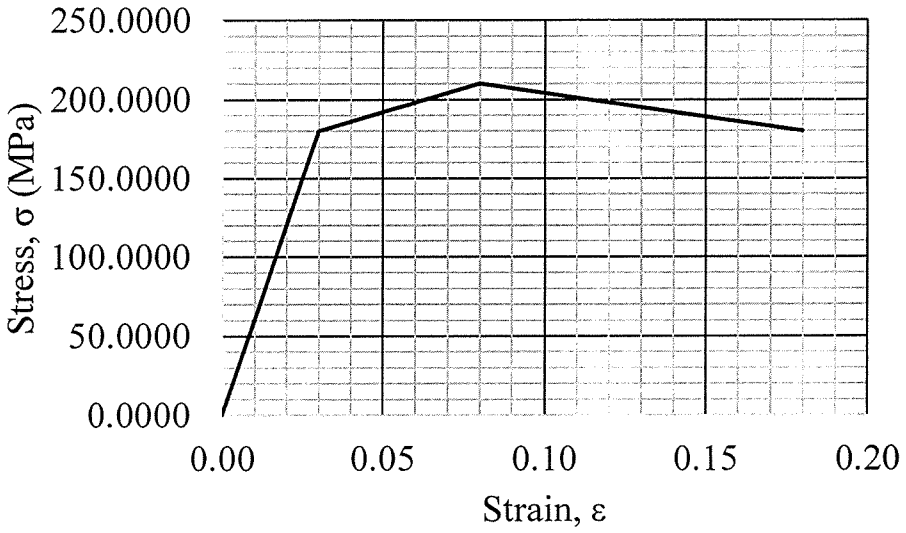


Figure 3: Stress vs Strain

b. A 4200 cm^3 solid nickel sphere is kept inside a thin-walled cylinder made of material **Y** as shown in **Figure 4** at 25°C. Then this assembly is heated to 1000 °C. The volume expansion coefficient of nickel is $\alpha_{nickel} = 12\times10^{-6}$/ °C. However, for material **Y** volume expansion coefficient is very low. As a result, change in volume is negligible in temperature shift of 25°C to 1000°C for material **Y**.

(i) Determine the change in radius of the sphere due to temperature change.

(ii) Give opinion on whether the nickel sphere stays in stress free condition or thermally stressed condition using mathematical explanation. (Given, modulus of elasticity of nickel is 200 GPa)

[6+4]

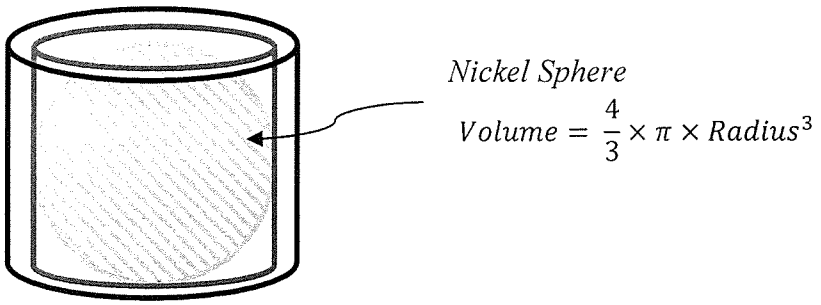


Figure 4: Solid nickel sphere inside a thin-walled cylinder

PART B

QUESTION 6 [22 MARKS]

a. State three functions of the Director General of Department of Environment.

[3]

b. List three limitations of GDP as an indicator of welfare.

[3]

c. Show the flow of mass between environment and economy with detailed notation.

[6]

d. Determine the Multidimensional Poverty Index (MPI) using data as provided.

[10]

Indicator		**Household**		
Household size		6	4	5
Health				
a.	At least one member is undernourished	1	0	1
b.	One or more children have died	0	0	0
Education				
a.	No one has completed at least six years of schooling	1	0	0
b.	At least one school-age child not enrolled in school	0	0	0
Standard of living				
a.	No electricity	1	0	0
b.	No access to improved sanitation	1	1	0
c.	No access to an improved source of drinking water	0	1	1
d.	House built with inadequate materials	1	0	1
e.	Household cooks with dung, wood, charcoal or coal	1	1	1
f.	Household does not own a car or truck and does not own more than one of the following assets: radio, television, telephone, computer, animal cart, bicycle, motorbike or refrigerator.	1	0	1

QUESTION 7 [22 MARKS]

a. A coastal town in Patuakhali is home to a busy fishing community. Due to frequent fog and rocky shores, many boats have experienced navigation problems at night. To improve safety, the town council installs a powerful automated lighthouse at the edge of the bay. The lighthouse turns on automatically at dusk and sends out a bright rotating beam that helps all ships safely navigate back to port. It requires no fee to be paid to function and is funded entirely through local taxes. Based on the scenario, explain why the lighthouse is considered a both a non-rivalrous and non-excludable in consumption.

[4]

b. List three differences between renewable and non-renewable energy.

[5]

c. Tabulate the objectives of sustainable development with two example each.

[5]

d. A steel manufacturing company emits 400 m^3 of industrial gases annually into the atmosphere. The Marginal Abetment Cost (MAC) curve for emission reduction is shown in **Figure 5**. The government has recently imposed an emission tax of 30 Taka per cubic meter of gas emitted in order to encourage pollution control. Mathematically demonstrate which amount of emission will be cost effective and the reason of not reducing the emission up to 240 m^3 annually upon tax introduction.

[8]

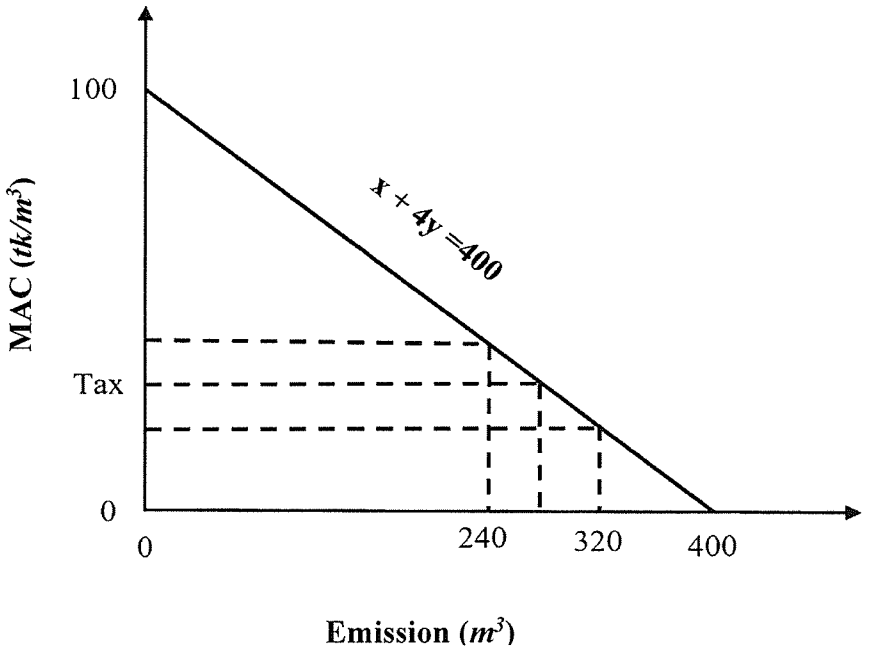


Figure 5: Marginal Abetment Cost Graph

QUESTION 8 [22 MARKS]

a. Green-lake Natural Park is a large, biodiverse conservation area located near the city of Dhaka. It features walking trails, rare wildlife, clean air, and a pristine lake. The local government is trying to estimate the economic value of different ecosystem services provided by the park, as well as assess the costs of pollution and the benefits of future conservation policies. They decide to use different valuation methods for different aspects of the park. To understand the recreational value of Green-lake Park, researchers collect data on how far visitors travel, how much they spend on fuel, lodging, food, and entrance fees, and how frequently they visit. This data is used to estimate the park's recreational value to the public. Clarify the following points.

(i) Valuation method used here.
(ii) Type of use value measured.
(iii) Limitations that might arise with this method for people who live very close to the park.

[4]

b. Water quality in a lake near a village has been declining over the past few years. Local authorities conducted an investigation and found the following situations:

- A wastewater treatment plant located near the lake has a damaged outlet pipe that sometimes releases untreated sewage directly into the water.
- During the rainy season, fertilizers and pesticides from nearby agricultural fields are washed off into streams that flow into the lake.
- Oil and litter are often carried into storm drains from the town's roads and parking lots after rainfall.

Identify which of the above pollution sources are point sources and which are non-point sources of water pollution and why. Recognize a method to classify the environmental standards.

[4+1]

c. Show the solid waste management hierarchy.

[5]

d. The following table shows the Human Development Index (HDI) indicator values of country 'X'. Calculate the Gender Development Index (GDI) of country 'X' and comment on it.

[8]

Indicators	Female	Male
Life Expectancy at Birth (years)	71	75
Expected Years of Schooling	9.8	10.8
Mean Years of Schooling	4.5	5.6
Estimated Earned Income (PPP USD)	3800	5400