L-2/T-1/WRE **Date: 04/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2021-2022

Sub: **WRE 203** (Engineering Geology and Geomorphology)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

Assume any reasonable value where necessary.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) What is geology? Enlist the branches of geology. **(2+4=6)**

   (b) Describe the physical properties of minerals (i) Streak (ii) Luster. **(3+3=6)**

   (c) What is minerals? Where you can find them? List five basic criteria of minerals. **(2+2+4=8)**

   (d) Classify rock forming minerals based on their based on their chemical composition (Dana system) and describe Oxides, Silicates, Sulfides and Halides groupe with appropriate examples. **(3+12=15)**

2. (a) What are the classification criteria for rocks? Describe extrusive and intrusive rocks. **(3+4=7)**

   (b) What are the driving forces of a rock cycle? Describe how they impact the rock cycle? **(3+4=7)**

   (c) Differentiate lithification and metamorphism. Shortly describe Gabbro and Basalt. **(4+4=8)**

   (d) Describe the Bowen's reaction series for igneous rocks? Explain with examples (i) mafic (ii) ultramafic rocks. **(7+6=13)**

3. (a) What is Metamorphism? Based on geological setting describe two major types of metamorphism. **(3+6)**

   (b) Distinguish between foliated and non-foliated metamorphic rocks. **(5)**

   (c) Define the process of formation of sedimentary rock in a diagram. **(6)**

   (d) Describe different structures of sedimentary rocks. **(15)**

4. (a) Shortly explain (i) Flexural slip and (ii) Kink folds. **(6)**

   (b) Illustrate different forms of erosion. What are the factors that impact erosion process? **(4+5=9)**

   (c) What is body wave and surface wave? How to locate the epicentre of an earthquake? **(5+5=10)**

   (d) Describe the active fault zones of Bangladesh. **(10)**

Contd P/2

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) With reference to figure: 1, Given the length of 1st order stream =15 km, 2nd order stream = 20 km, 3rd order stream = 25 km, 4th order stream = 40 km and the total area of the catchment is 300 sq. km. Calculate the following: **(25)**

   (i) Length ratio
   (ii) Bifurcation ratio
   (iii) Stream frequency
   (iv) Length of overland flow

   (b) Explain the purpose of stream ordering. Describe the Strahler's method of stream order designation. **(10)**

6. (a) Define and explain the different types of lacustrine deposits? Explain how the quality of lake water depends on the types of deposits. **(10)**

   (b) Draw an outline of different geomorphological processes with definition. **(10)**

   (c) Explain the different types of physical and chemical weathering processes. Also differentiate between weathering, erosion and abrasion as understood in geomorphology. **(15)**

7. (a) Briefly explain why kames and kettle holes occur in pairs? Define and explain the different types of glacial deposits. **(10)**

   (b) What are the most common disturbance theories found in modern geomorphology, explain in details. **(13)**

   (c) Briefly explain the following: **(12)**

   (i) natural levees, (ii) delta formation, (iii) oxbow lakes (iv) braided rivers

8. (a) What are the different types of drainage patterns most commonly found in a deltaic country like Bangladesh. Explain each type with a relevant diagram. **(15)**

   (b) Write short notes on the significant geomorphological characteristics of any 3 major rivers of Bangladesh. **(12)**

   (c) What are the different types of Aeolian deposits? Explain briefly. **(8)**

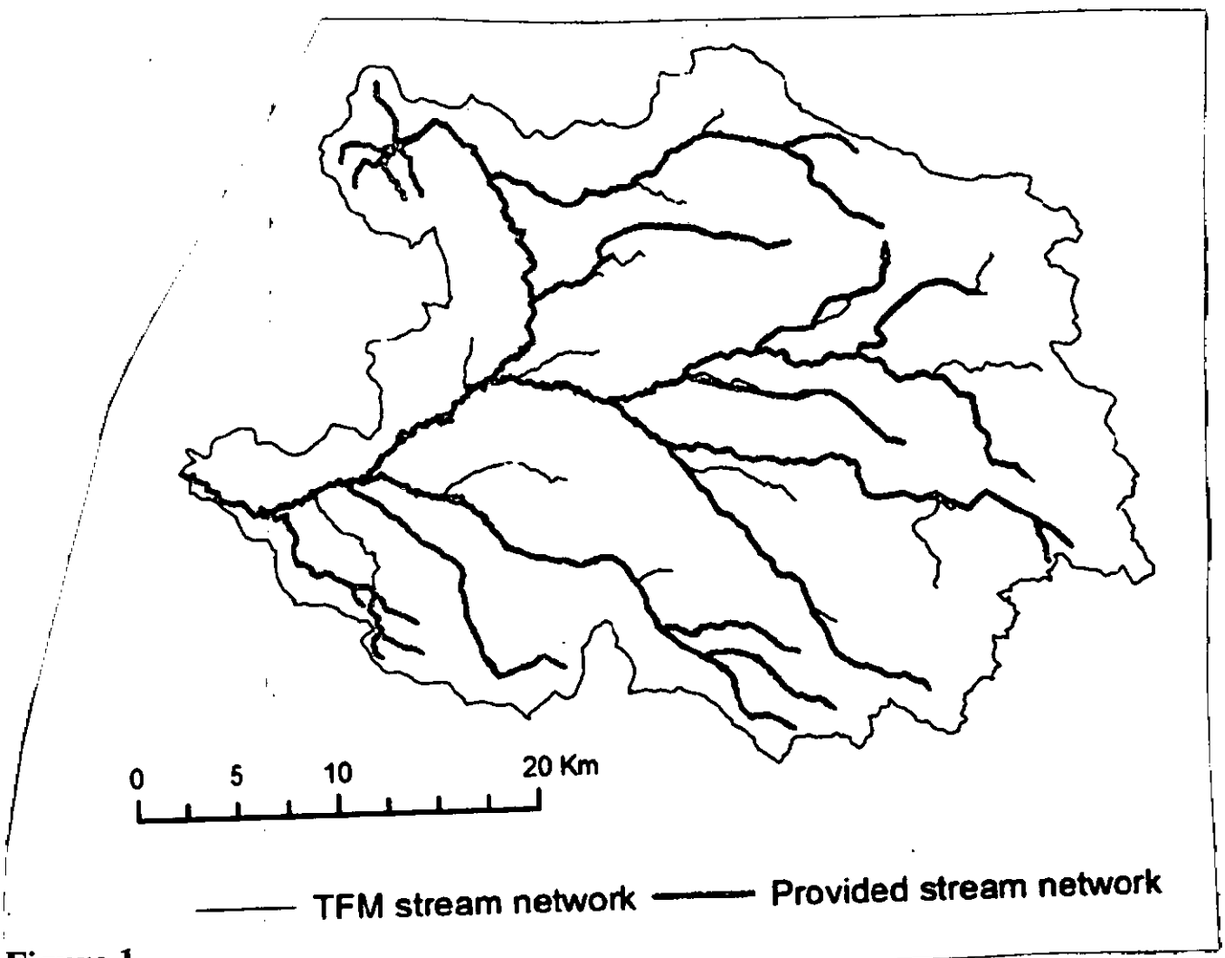

Figure 1

L-2/T-1/WRE Date: 06/05/2023

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2021-2022

Sub: **HUM 213** (Government)

Full Marks: 140 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) The state is an association of associations— Discuss. How does the State differ from a society? **(11 1/3)**

   (b) What is constitution? Explain the qualities of a good constitution. **(12)**

2. (a) Explain the factors of nationality. Is nationalism contradictory to internationalism? **(11 1/3)**

   (b) Discuss briefly the political rights and duties of a citizen in a state. **(12)**

3. (a) Classify democratic types of government with relevant examples. **(11 1/3)**

   (b) Describe the functions of the Executive branch in a state. **(12)**

4. Write short notes on any **THREE** of the following: **(23 1/3)**

   (a) Bicameral Legislature
   (b) Independence of Judiciary
   (c) Political Sovereignty
   (d) Legal Rights

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Write an essay on the strengths of democratic system. **(11 1/3)**

   (b) What is good governance? Discuss the agenda for ensuring good governance in developing countries. **(12)**

6. (a) Make a comparison between the political system of UK and USA. **(11 1/3)**

   (b) Describe the external and internal determinants of Bangladesh foreign policy. **(12)**

Contd P/2

HUM 213

7. (a) Discuss the major features of the constitution of the People's Republic of Bangladesh. **(11 ⅓)**

(b) Define local government. Discuss the problems and challenges of local government institutions in Bangladesh. **(12)**

8. Write short notes on any **THREE** of the following: **(23 ⅓)**

(a) Ideal type of bureaucracy

(b) Role of opposition in parliamentary democracy

(c) Language movement of 1952

(d) Major organs of the UNO.

L-2/T-1/WRE **Date: 30/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2021-2022

Sub: **CE 221** (Mechanics of Solids I)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. A closely-coiled helical spring made of 5 mm diameter steel wire has a solid length of 65 mm. The stiffness of the spring is 65 kN/m. The shear modulus of the material is 80 GPa. Calculate **(35)**

   (a) the mean diameter of the coils;

   (b) the stress induced for a deflection of 20 mm;

   (c) the work done in extending the spring 20 mm.

2. A torque of magnitude T = 4 kN-m is applied at end A of the composite shaft shown in Figure 1. The modulus of rigidity is 77 GPa for the steel and 27 GPa for the aluminum. Determine **(35)**

   (a) the maximum shearing stress in the steel core;

   (b) the maximum shearing stress in the aluminum jacket,

   (c) the angle of twist at A.

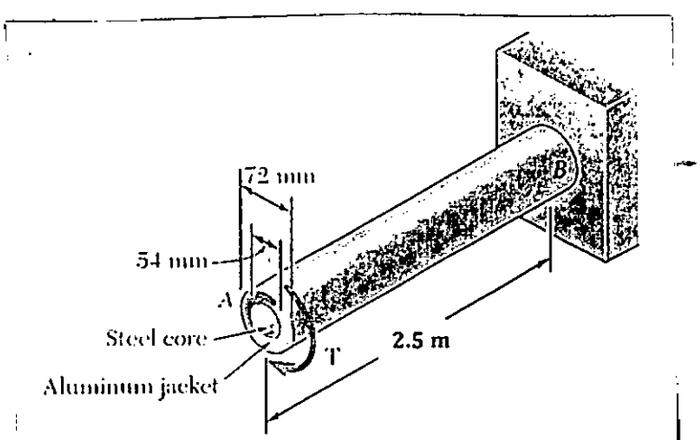

Figure 1.

Contd P/2

CE 221/WRE

3. Locate the shear center of the unsymmetrical I-beam cross-section as shown in Figure 2. **(35)**

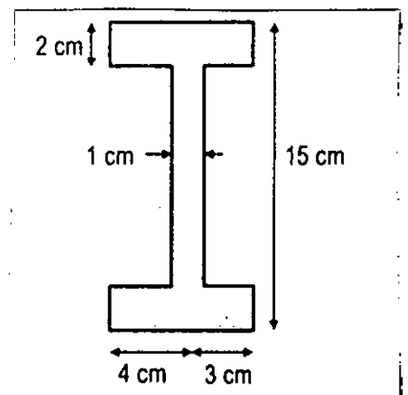

Figure 2.

4. Draw the shear force and bending moment diagrams for the beam shown in Figure 3 using integration method. **(35)**

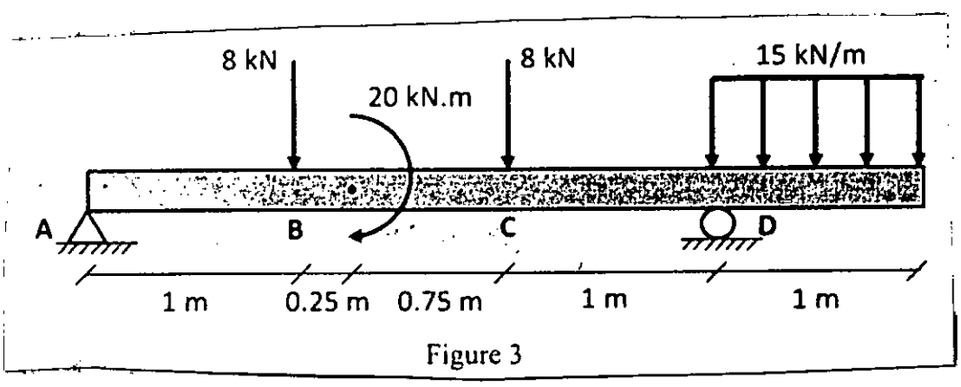

Figure 3

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

Assume any reasonable value if there is any missing value.

5. A simple beam on a 7.5 m span carries a load of 4 KN/m including its own weight. A wide flanged unsymmetrical I-section is formed by several wooden planks connected with lag screws as shown in Fig. 4. If each screw can resist a shear of 1500 N, determine the pitch (spacing) of the screws to connect the top and bottom flanges with the web section if the cross section is 2 m away from the support. **(35)**

Contd P/3

CE 211/WRE
Contd.... for Q. No. 5

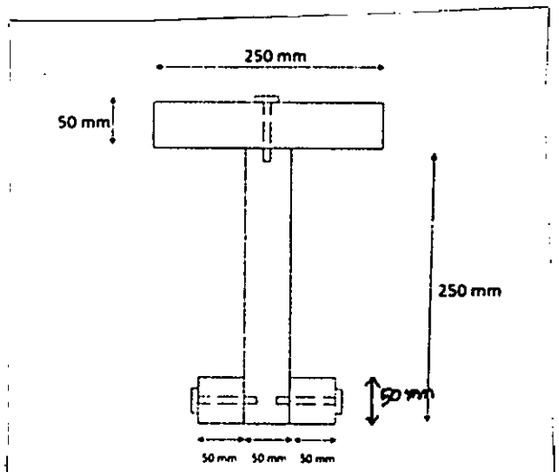

Figure 4

6. An overhanging beam shown in Figure 5(a) carries 0.5 KN/m load including its own weight with an upward concentrated force of 12 KN at the end. The beam's cross-section is shown in Figure 5 (b) (All the dimensions are in millimeters). Find the maximum tensile and compressive stresses acting normal to section A-A. **(35)**

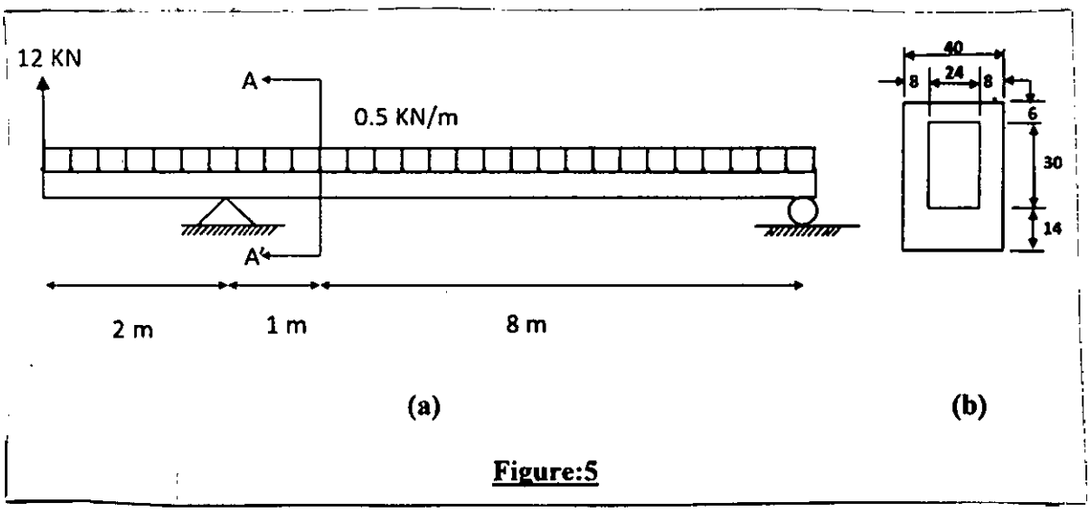

Figure:5

7. (a) Draw Axial Force, Shear Force, and Bending Moment diagram using the method of section for the beam in the figure below. **(20)**

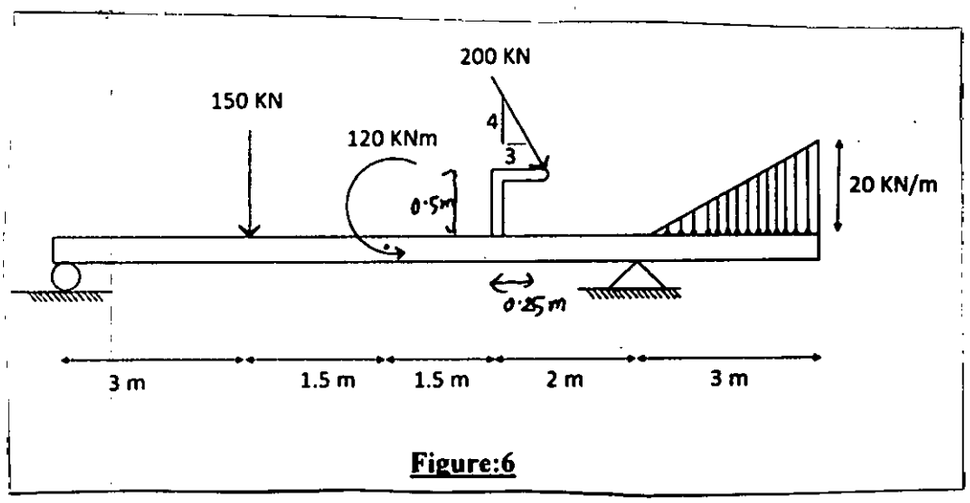

Figure:6

Contd P/4

CE 211/WRE

Contd.... for Q. No. 7

(b) Determine the internal system of forces at section a-a and section b-b. **(15)**

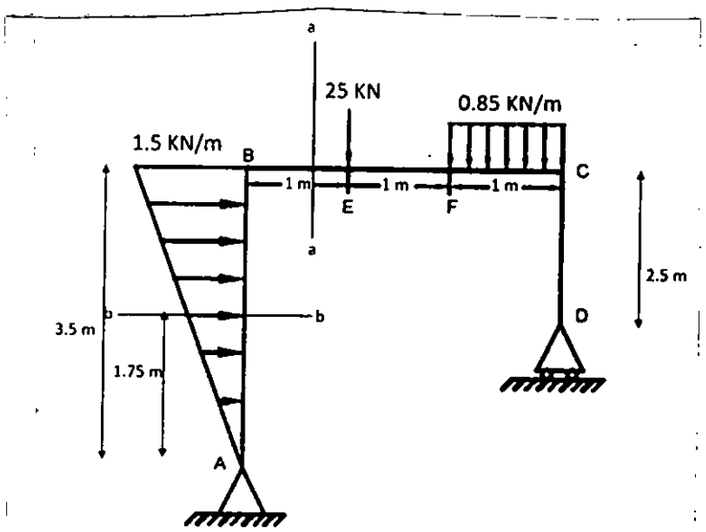

Figure:7

8. Two wires are connected to a rigid bar as shown in figure 8. The wire on the left is a copper alloy having an area of A = 0.15 in^2 and E = 20 × 10^6 psi. The aluminum alloy wire on the right has A = 0.25 in^2 and E = 10 × 10^6 psi. **(18+17=35)**

(a) If a weight of 2500 lb. is applied as shown in Figure 8, how much will it deflect due to stretch in the wire?

(b) Where should the weight be located such that the bar remains horizontal?

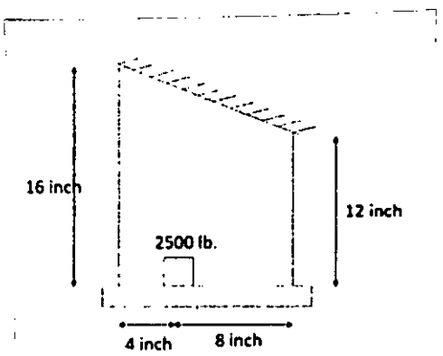

Figure:8

L-2/T-1/WRE **Date: 28/03/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2021-2022

Sub: **MATH 231** (Differential Equations)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

Symbols bear their usual meanings

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Obtain the differential equation of which $y^2 = 4a(x+a)$ is a solution. Identify the order, degree and linearity of the differential equation. **(11)**

(b) (i) How many arbitrary constants are there in the general solution of a differential equation of second-order? Determine the general solution of the differential equation. **(8+5)**

$$2xyy' = y^2 - x^2$$

(ii) Represent the solution curve graphically of $y' = -2xy, \quad y(0) = 1.8$.

(c) A cup of coffee is made with boiling water at a temperature of 100°C in a room with ambient temperature 20°C. After 4 minutes the coffee has cooled to 90°C. Does the coffee cool more in the first 4 minutes or the second 4 minutes? Why does this make sense in terms of the differential equation? **(11)**

2. (a) Interpret integrating factor in ordinary differential equations. Find an integrating factor and solve the initial value problem $\left(e^{x+y} + ye^{y}\right)dx + \left(xe^{y} - 1\right)dy = 0, \; y(0) = -1$. **(13)**

(b) Solve the following differential equations: **(11+11)**

(i) $y = (x-a)p - p^2$

(ii) $\tan y \dfrac{dy}{dx} + \tan x = \cos y \cos^2 x$.

3. (a) Find the complementary and particular integral of the differential equation **(11)**

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = x^2 + e^{2x} + \sin 2x.$$

(b) Solve the Cauchy-Euler's equation **(11)**

$$\left(x^2D^2 - 3xD + 5\right)y = x^2 \sin \log x, \quad D \equiv \frac{d}{dx}$$

(c) Applying the method of variation of parameter solve $\dfrac{d^2y}{dx^2} - y = \dfrac{2}{1+e^x}$. **(13)**

Contd P/2

MATH 231/WRE

4. (a) Locate and classify the singular point of the differential equation **(10)**

$$x^2(x-2)^2\frac{d^2y}{dx^2}+2(x-2)\frac{dy}{dx}+(x+1)y=0.$$

(b) Find the series solution of the equation $(x-x^2)y''+(1-5x)y'-4y=0$ using Fröbenius method. **(25)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Form a partial differential equation by eliminating the arbitrary functions f and h from $z=f(x^2-y)+h(x^2+y)$. **(10)**

(b) Solve: $(y+zx)p-(x+yz)q=x^2-y^2$. **(12)**

(c) Using Charpit's method find the complete integral of the partial differential equation $pxy+pq+qy=yz$ **(13)**

6. (a) Find the general solution of the following higher order partial differential equations:

(i) $(D_x^2-2D_xD_y-15D_y^2)z=12xy$ **(11)**

(ii) $(D_x^2+3D_y-2D_x)z=(x^2+2y^2)e^{2x+y}$ **(12)**

(b) Solve the following higher order partial differential equation: **(12)**

$$(x^2D_x^2-4xyD_xD_y+4y^2D_y^2+6yD_y)z=x^3y^4$$

7. (a) Prove that: $\frac{d}{dx}\{xJ_n(x)J_{n+1}(x)\}=x\{J_n^2(x)-J_{n+1}^2(x)\}$ **(12)**

(b) Show that: $xJ_x'(x)=nJ_n(x)-xJ_{n+1}(x)$ **(11)**

(c) Prove that: $J_{3/2}(x)\sqrt{\frac{2}{\pi x}}\left(\frac{\sin x}{x}-\cos x\right)$. **(12)**

8. (a) Use the generating function of Legendre polynomial to prove **(10)**

$$(n+1)P_{n+1}(x)=(2n+1)xP_n(x)-nP_{n-1}(x).$$

(b) Show that $\int_{-1}^{1}(x^2-1)P_{n+1}(x)P_n'(x)dx=\frac{2n(n+1)}{(2n+1)(2n+3)}$ **(12)**

(c) Prove the Rodrigue's formula for Legendre's polynomial **(13)**

$$P_n(x)=\frac{1}{2^n(n!)}\frac{d^n}{dx^n}(x^2-1)^n.$$

L-2/T-1/WRE **Date: 11/04/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2021-2022

Sub: **CE 291** (Engineering Materials)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

Assume reasonable values for missing data, if any.

The necessary tables are attached in the Annexure.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Draw a typical stress-strain diagram of mild steel and label all its significant points. **(8)**

(b) For the loading sequence shown in Figure 1, draw the likely strain response with time of an: **(24+3=27)**

(i) Elastic material, (ii) Elasto-plastic material, and (iii) Elasto-visco-plastic material

Assume, Equal time intervals, *i.e.*, $\Delta t = t_1 - t_0 = t_2 - t_1 = t_3 - t_2 = t_4 - t_3$

Also, give an example of these materials among the common civil engineering materials.

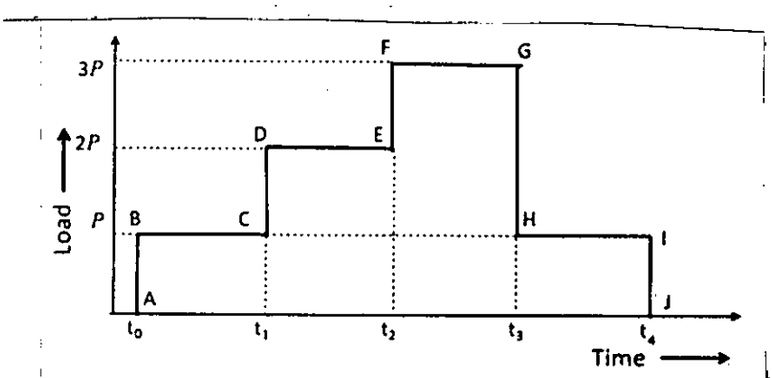

Figure 1

2. (a) Which factors affect corrosion? What measures should be taken to prevent corrosion in Reinforced Concrete (RC) elements? **(4+6=10)**

(b) What is Ferrocement? Draw a typical section of ferrocement and list the component materials of ferrocement. **(2+4+4=10)**

(c) What is spalling of concrete? Explain with a neat sketch how ferrocement can be used to repair spalling of the slab. **(3+12=15)**

Contd P/2

CE 291/WRE

3. (a) What is Fiber Reinforced Polymer (FRP)? Write the uses of FRP in Civil Engineering applications. **(2+5)**

(b) Define the workability of concrete. How can you measure the workability of fresh concrete by slump test? Show with neat sketches. **(4+8=12)**

(c) Calculate the quantity of materials required to produce 120 ft^3 of concrete with a mix proportion of 1:1.5:3. **(6)**

(d) Find the mix ratio by the "Minimum Voids Method" from the following data. Voids in CA is 50% and voids in fine aggregate is 40%. Allow 8% excess for cement and 6% excess for FA. **(10)**

4. (a) Write short notes on: **(3+3+3=9)**

(i) Curing

(ii) Segregation

(iii) Bleeding

(b) The amount of ingredients for a non-air-entrained concrete mix is to be designed following the ACI 211.1 method for a column. Specified strength is 30 MPa at 28 days, with slump between 1 to 2 in. Max. aggregate size is 1 in. Use the data given below and Tables 1-5, find the amount of ingredients required for 1 m^3 of concrete (Oven-dry basis). **(26)**

Specifications:

Cement types: Ordinary Portland cement, specific gravity = 3.0

Coarse aggregate:

Bulk sp. Gravity (OD) = 2.65

Adsorption capacity = 1.5%

Unit-weight (dry-rodded) = 1600 kg/m^3

Moisture content = 1.7%

Fine aggregate:

Bulk sp. Gravity (OD) = 2.60

Adsorption capacity = 2.1%

Fineness modulus = 2.65

Moisture content = 2.5%

Contd P/3

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Write down some merits and demerits of blended cement over OPC. Name the BDS-EN 197 cement types. **(7+3=10)**

(b) Estimate the mix ratio of Aggregate sample –A, B & C to obtain the aggregate blend to meet the specification. Also determine the FM of the aggregate blend. **(15)**

Material	Aggregate A	Aggregate B	Aggregate C	Target Specification
Sieve	% Passing	% Passing	% Passing	% Passing
1.5	100	100	100	
¾	42	81	96	**74%**
3/8	28	58	88	
No. 4	10	28	72	
No. 8	2	21	60	**20%**
No. 16	0	15	44	
No. 30	-	10	20	
No. 50	-	3	15	**5%**
No. 100	-	0	5	

(c) Write short note on- (i) Silicate bricks and (ii) Concrete masonry unit. **(10)**

6. (a) A teak wood lumber having 3.15 cft green volume is oven dried and the weight is found to be = 142.4 lb. Calculate (i) the density of the lumber at 45% moisture content and (ii) M_{max}. Assume fiber saturation point of teak = 30% and density of water = 64.5 lb/ft^3. **(10)**

(b) Describe the steps of lime plastering. Discuss the benefits of using lime as building material. **(7+5=12)**

(c) Define the following defects in bricks - lamination and lime blowing. Write down the advantages of tunnel kiln for brick manufacturing. **(8+5=13)**

7. (a) Diagrammatically show strength development rate of major constituents of cement. How the C-S-H gel formation and crystallization occurs during hydration reaction of cement? **(5+5=10)**

(b) Write down the advantages and disadvantages of Kiln seasoning. Describe different types of timber rot. **(7+8=15)**

Contd P/4

CE 291/WRE

Contd.... for Q. No. 7

(c) A full sized brick is tested in the lab for unit weight measurement. The brick is wax coated and weighed in air which is = 7.28 lb. If the weight of water displaced by wax coated brick is 4.85 lb and density of wax is 54.45 lb/ft^3, calculate the unit weight of the brick. Given, SSD weight and absorption capacity of the brick is 8.16 lb and 19.5% respectively. Assume water density = 62.4 lb/ft^3. **(10)**

8. (a) Discuss how to control alkali-aggregate reactivity. Also discuss the impact of presence of deleterious substances in aggregate mix on concrete properties. **(5+5=10)**

(b) Draw a diagram and show how bulking of sand varies with moisture content and grading of sand. **(4+8=12)**

To measure the bulking of a sand sample, sand is filled in a measuring cylinder up to 250 mm height. When the sand sample is completely drowned in water, the height of the sand sample comes down to 195 mm. Calculate the volume of this sand required to cast 100 m^3 concrete at a mix ratio 1:1.25:2.5 (volume basis).

(c) Write short note on the following properties of cement: (i) tensile and flexural strength of cement and (ii) chemical composition of cement. **(8+5=13)**

Explain how the formation ettringite helps the concrete to remain in plastic state for several hours.

Annexure

Table 1: Required average compressive strength when data are not available to establish a standard deviation

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	1.10f'_c + 5.0

Adapted from ACI 318.

Table 2: Relationship between water to cementitious material ratio and compressive strength of concrete.

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

Strength is based on cylinders moist-cured 28 days in accordance with ASTM C 31 (AASHTO T 23). Relationship assumes nominal maximum size aggregate of about 19 to 25 mm.
Adapted from ACI 211.1 and ACI 211.3.

Table 3: Bulk volume of coarse aggregate per unit volume of concrete

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

*Bulk volumes are based on aggregates in a dry-rodded condition as described in ASTM C 29 (AASHTO T 19). Adapted from ACI 211.1.

Table 4: Recommended slum values for various types of construction

Concrete construction	Slump, mm (In.)	
	Maximum*	Minimum
Reinforced foundation walls and footings	75 (3)	25 (1)
Plain footings, caissons, and substructure walls	75 (3)	25 (1)
Beams and reinforced walls	100 (4)	25 (1)
Building columns	100 (4)	25 (1)
Pavements and slabs	75 (3)	25 (1)
Mass concrete	75 (3)	25 (1)

*May be increased 25 mm (1 in.) for consolidation by hand methods, such as rodding and spading.
Plasticizers can safely provide higher slumps.
Adapted from ACI 211.1.

Table 5: Approximate mixing water in kg/m^3 and target air content for different slumps and nominal maximum aggregate sizes*

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
	Air-entrained concrete							
25 to 50	181	175	168	160	150	142	122	107
75 to 100	202	193	184	175	165	157	133	119
150 to 175	216	205	197	184	174	166	154	—
Recommended average total air content, percent, for level of exposure:†								
Mild exposure	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
Moderate exposure	6.0	5.5	5.0	4.5	4.5	4.0	3.5	3.0
Severe exposure	7.5	7.0	6.0	6.0	5.5	5.0	4.5	4.0