BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1   B. Sc. Engineering Examinations 2020-2021

Sub: **CE 201** (Engineering Materials)

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) What are exogenous and endogenous trees? Write down some advantages and disadvantages of using timber.   **(4+6=10)**

     (b) Write down some characteristics of good paint. What are the defects that may occur on the painted surface?   **(5+5=10)**

     (c) Write short notes on Smith's Test, Brad's Test, and Acid Test of stones.   **(10)**

     (d) What are the functions of sand in mortar?   **(5)**

2.   (a) Why is artificial cement popular? Write short notes on the phase compositions in Portland cement.   **(4+8=12)**

     (b) Briefly describe the functions of chief ingredients of burnt clay bricks.   **(10)**

     (c) Define Calcination, Carbonation, and Slaking of lime.   **(6)**

     (d) Briefly describe the process of varnishing.   **(7)**

3.   (a) What are the factors affecting the hydration of cement? Write short notes on cement silos, soundness of cement, white Portland cement, and blast furnace slag.   **(3+8=11)**

     (b) What are the advantages of using bricks as construction materials? Write down some characteristics of good quality clay bricks.   **(5+8=13)**

     (c) Write short notes on limewash, gauged mortar, and distempering.   **(6)**

     (d) Define seasoning of timber? What are the objectives of seasoning?   **(5)**

4.   (a) Quantities of ingredients for specific aggregates characteristics and strength requirements of a concrete mix are obtained using the British Method of mix design. The ingredients are water: 185 kg/m^3, cement: 425 kg/m^3, Fine Aggregate (SSD): 785 kg/m^3, and Coarse Aggregate (SSD): 1050 kg/m^3. The following data were obtained upon testing the aggregates available for casting a 100 ft. × 80 ft. basement slab (12-inch thick).   **(15)**

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Contd... Q. No. 4(a)

Coarse Aggregate:

    Absorption Capacity: 1.5%

    Moisture Content: 2.2%

    OD Unit Weight: 1600 kg/m^3

Find Aggregate:

    Absorption Capacity: 4.5%

    Moisture Content: 3.0%

    OD Unit Weight: 1550 kg/m^3

Determine the amount of cement (in no. of bags), aggregates (in tonnes), and water (in liter) that will be required to cast the basement slab.

(b) Discuss the effect of alkali-aggregate reactivity on aggregate behavior. List the measures that can control alkali-aggregate reactivity. **(10)**

(c) Write short note on:

    (i)   Causes and remedies of segregation in concrete

    (ii)   Characteristics and grain-size distribution of uniformly graded aggregate   **(10)**

SECTION – B

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

5.   (a) Compare between (i) modulus of resilience and modulus of toughness, (ii) ductile material and brittle material. **(10)**

Compare the characteristics of (i) plastic strain and (ii) viscous strain.

(b) Compare wrought iron and cast iron in terms of (i) carbon content, (ii) elasticity, (iii) rust potential, (iv) tensile and compressive strength, (v) salinity resilience. **(10)**

(c) Write down the steps in repairing a damp wall using ferro-cement. Draw the details in neat sketches and write the specifications of each step. **(10)**

(d) Compare between Acoustic Pulp and Acoustical Plaster. **(5)**

6.   (a) Why is corrosion prevention important? Discuss the chemical reactions involved in corrosion of steel in Hydrochloric Acid (HCl). **(10)**
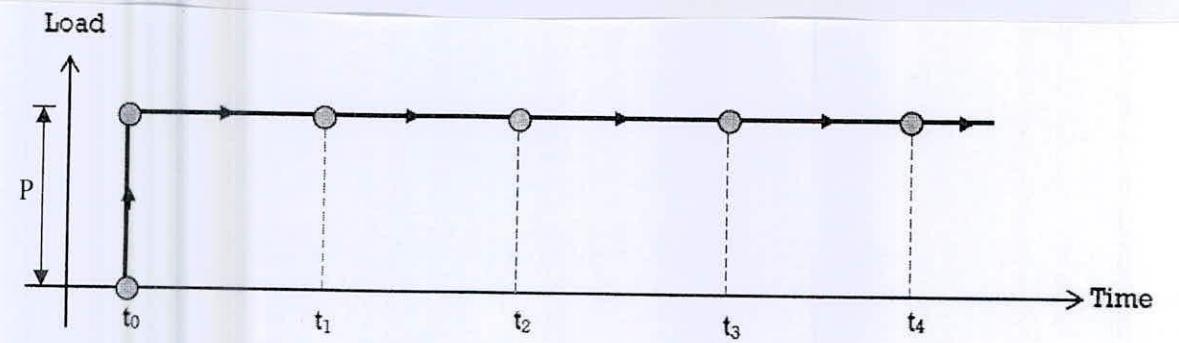
(b) Write down the functions of (i) binder, (ii) fillers, and (iii) plasticizers on plastic. Write down the properties and uses of plastic laminates. **(10)**

(c) Compare the composition and properties of flint glass and pyrex. Write down the characteristics and uses of structural glass. **(10)**

(d) Write down the requirements of sound insulating materials. **(5)**

CE 201

7. (a) Compare natural rubber and synthetic rubber. **(10)**

(b) Draw creep behavior for an elasto-visco plastic material for the following loading sequence (Figure 1). Consider, $\nabla t = t_1 - t_0 = t_2 - t_1 = t_3 - t_2$ **(10)**

Figure 1: Loading sequence for an elasto-visco-plastic material

7. (c) Determine the mix ratio of Aggregates A, B, and C to obtain the aggregate blend to meet the specification. Estimate the Fineness Modulus (FM) of the combined aggregate. **(15)**

Sieve Size	Percent passing			
mm	Aggregate A	Aggregate B	Aggregate C	Specification
25	100	100	100	-
19	95	100	100	-
12.5	89	100	100	-
9.5	50	85	100	-
4.75	10	55	100	57
2.36	2	15	88	-
1.18	2	5	55	19
0.6	2	3	35	-
0.3	2	2	22	8
0.15	2	2	15	-
0.075	2	1	6	-

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8. (a) Briefly discuss how water/cement ratio, workability, and strength of concrete are related. Explain with neat sketches. **(10)**

(b) Determine the preliminary mix proportions (on OD basis) of the concrete mix to be used for casting a 6-inch thick floor slab. The minimum strength of the concrete is 30 MPa at 28 days and the maximum allowable slump is 40 mm. Use ACI 211.1 method with the following data. **(25)**

Cement:
Type: Ordinary Portland Cement
Specific gravity: 3.15

Coarse Aggregate:
Maximum Size: 25 mm
Absorption Capacity: 1.5%
Moisture Content: 1.0%
Bulk Specific Gravity (OD): 2.62
Dry-rodded Unit Weight: 1600 kg/m^3

Fine Aggregate:
Fineness Modulus: 2.70
Absorption Capacity: 2.8%
Moisture Content: 3.5%
Bulk Specific Gravity (OD): 2.68
Dry-rodded Unit Weight:1550 kg/m^3

Admixture:
Water reducer: reduce 5% of water demand at a dose of 10 ml/kg cement
Specific gravity: 1.1

Use the provided Table and Charts. Also, assume reasonable values for any missing data.

Tables for Question No. 8(b)

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	$1.10 f_c' + 5.0$

Adapted from ACI 318.

Table 2: Relationship between water to cement 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: Recommended slumps 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 4: 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.

Tables for Question No. 8(b)

Table 5: Approximate mixing water and target air content requirements for different slumps and nominal maximum sizes of aggregates

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

* These quantities of mixing water are for use in computing cementitious material contents for trial batches. They are maximums for reasonably well-shaped angular coarse aggregates graded within limits of accepted specifications.
** The slump values for concrete containing aggregates larger than 37.5 mm are based on slump tests made after removal of particles larger than 37.5 mm by wet screening.
† The air content in job specifications should be specified to be delivered within −1 to +2 percentage points of the table target value for moderate and severe exposures.
Adapted from ACI 211.1 and ACI 318. Hover (1995) presents this information in graphical form.

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1   B. Sc. Engineering Examinations 2020-2021

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

Full Marks: 210   Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

There are **FOUR** questions in this section.

Answer **Q. No. 1 (Compulsory)** and any **TWO** from the rest.

1. (a) Draw a sketch of a symmetrical fold "A" next to an unsymmetrical fold B. Discuss the mechanism and time sequence of formation of the folds A and B.   **(5)**

    (b) The Blue Mountains consist of sandstone peaks with steep cliffs (Fig. 1) overlying 470 million year old quartzite. Comment on the possible mechanism of this geological formation.   **(5)**

    (c) What do you think about the type of lake and formation of the lake shown in Fig. 2 up in the mountain ranges of Northern Cascades National Park in Northwest USA?   **(5)**

    (d) How was Mt. Fuji of Japan formed? What in your opinion are the geological hazards present there? Discuss.   **(7)**

    (e) What do you know about the rock formation of the Appallachian (Smokey) Mountains in the Eastern USA? Is the formation connected to present plate movements?   **(5)**

    (f) "Clastic sedimentary rocks can be made of multicycled particles" – Discuss in the light of rock cycle. Present neat sketches.   **(8)**

2. (a) Give a list of different applications of Geology.   **(7)**

    (b) Briefly describe with neat sketches and examples the formation of the following (answer any two):   **(5×2=10)**

    　　(i) Hawaian Islands

    　　(ii) Columnar Joints

    　　(iii) Horst and Grabenos

    (c) Distinguish between (answer any three)   **(6×3=18)**

    　　(i) Transverse Dune and Longitudinal Dune

    　　(ii) Bottomset Beds and Foreset Beds of Delta

    　　(iii) Plucking and Abrasion Methods of Glacier Erosion

    　　(iv) Abrasion and Corrosion Methods of Sea Erosion

CE 203

3. (a) What do you mean by tectonic plates? With neat diagrams, describe the different types of plate boundaries. Discuss the significance of these plate Boundaries with regard to earthquakes. **(13)**

(b) What do you mean by rock texture? Briefly describe the different textures of metamorphic rocks. **(10)**

(c) Write short notes on (answer any three) **(4×3=12)**

   (i) Principle of uniformity

   (ii) Marble

   (iii) Continental Glacier/Ice sheet

   (iv) Cenozoic Era

4. (a) What is the importance of sedimentary structures? Briefly describe various sedimentary structures with neat sketches. **(17)**

(b) Briefly describe different types of igneous rocks based on mineralogy. Give examples. **(7)**

(c) With neat sketches, describe physiographical evidences for the identification of faults. **(5)**

(d) Discuss various non-tectonic causes of folding. **(6)**

SECTION – B

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

5. (a) What is river transportation? What are the factors affecting the transportation power of a river? What do you understand by "Capacity" and "Competence" in river transportation? **(20)**

(b) What are geomorphic process and geomorphic agent? Explain both with examples in the context of Bangladesh. **(15)**

6. (a) Explain how the following channel properties vary as we move towards the downstream direction: (i) Flow rate, (ii) Channel width, (iii) Channel depth, in the context of Bangladesh. **(15)**

(b) Explain the following terms with respect to an alluvial floodplain: i) Cut off, ii) Meander neck, iii) Back swamp. **(9)**

(c) Define geomorphology. Why do Civil Engineering need to study geomorphology? Explain in the context of Bangladesh **(11)**

CE 203

7.   (a) As an effect of urbanization in Dhaka. What sort of change do you expect in the overall condition of run off and ground water table?   **(17)**

(b) What is longitudinal profile of a stream? Why is it important? Derive the general equation of longitudinal profile of a stream. How the specific equation for a stream can be determined?   **(18)**

8.   (a) 'Minerals are crystalline substances' - what do you mean by this statement? Present sketches of crystal forms. Can you give an example of a mineral to have different crystals?   **(8)**

(b) Give a list of physical characteristics that may be used for identifying a mineral. Describe three characteristics related to strength and deformability. What is the best way to confirm a mineral?   **(12)**

(c) Write short notes on the following: **(5×3=15)**

   (i) Kaolinite (ii) Amphiboles (iii) Hematite

Fig.1

Fig.2

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1   B. Sc. Engineering Examinations 2020-2021

Sub: **CE 211** (Mechanics of Solids-I)

Full Marks: 210   Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION
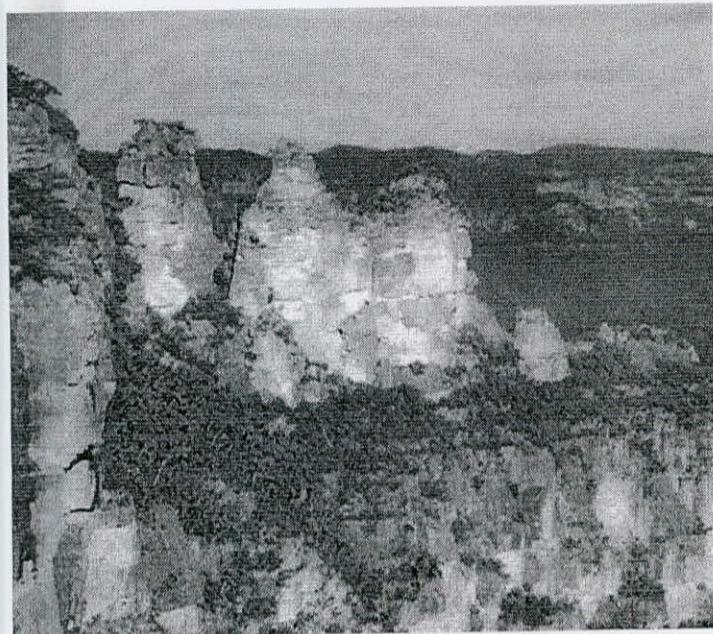
SECTION – A

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

1. Draw shear and moment diagrams for the beam acted upon by a uniformly distributed load and a concentrated load as shown in Figure-1. $(26\frac{1}{4})$

2. Draw shear and moment diagrams for the cantilever beam acted upon by a uniformly distributed load and a couple as shown in Figure-2. $(26\frac{1}{4})$

3. A box beam is composed of four planks, each 2 in. by 8 in., securely spiked together to from the section shown in Figure-3. Show that $I_{NA} = 981.3$ in^4 if $w_0 = 300$ lb/ft. Also find "P" to cause a maximum flexural stress of 1400 psi. $(26\frac{1}{4})$

4. For the beam loaded as shown in Figure-4(a), calculate the shear stresses at levels indicated in Figure-4(b). Draw the distribution of shear stress at location of maximum vertical shear. $(26\frac{1}{4})$

5. Determine the location of the shear center for the beam having the cross-sectional dimensions shown in Figure-5. Consider thin walled section and use the centerline dimensions for calculations. $(26\frac{1}{4})$

SECTION – B

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

Assume any reasonable value of missing data.

6. The two aluminum rods *AB* and *AC* have diameters of 15 mm and 10 mm, respectively as shown in Fig.6. Supports B and C are pin supported with a diameter of 12 mm. Both pins are subjected to single shear. Determine the largest vertical force **P** that can be supported. The allowable stresses for the aluminum rods are in tension = 150 MPa, in compression = 120 MPa, and in shear = 80 MPa. The allowable shear stress for the pins is 100 MPa. $(26\frac{1}{4})$

CE 211

7. The assembly consists of three titanium rods (E = 120 GPa) and a rigid bar AC. The cross-sectional area of each rod is given as shown in Fig. 7. If a force of 90 kN is applied to the ring F, determine the horizontal displacement of point F. **(26¼)**

8. A stepped shaft *ABC* consisting of two solid circular segments in subjected to torques T_1 and T_2 acting in opposite directions, as shown in Fig. 8. The larger segment of the shaft has a diameter of $d_1 = 60$ mm and length $L_1 = 800$ mm; the smaller segment has a diameter of $d_2 = 50$ mm and length of $L_2 = 500$ mm. The material is steel with shear modulus $G = 76$ GPa, and the torques are $T_1 = 2500$ N.m and $T_2 = 1200$ N.m.

   Calculate the maximum shear stress τ_{max} in the shaft and the angle of twist ϕ_c (in degrees) at end *C*. **(26¼)**

9. Calculate the shear stress τ and the angle of twist ϕ (in degrees) for a steel tube (G = 76 GPa) having the cross section shown in Fig. 9. The tube has length L = 3 m and is subjected to a torque, T = 20 kN.m. **(26¼)**

10. (a) A fabric used in air-inflated structures in subjected to a biaxial loading that results in normal stresses $\sigma_x = 18$ ksi and $\sigma_z = 24$ ksi as shown in Fig. 10. Knowing that the properties of the fabric can be approximated as Young's modulus, $E = 12.6 \times 10^6$ psi and Poisson's ratio, $\nu = 0.34$, determine the change in length of diagonal AC. **(13¼)**

   (b) A closely coiled helical spring made of steel wire of diameter 6 mm has 15 coils. The spring has mean coil diameter of 100 mm and is subjected to an axial vertical load of **F** producing a maximum shear stress of 90 MPa. Find the load F and the work done as a result of the application of this load. Consider, $G = 80$ kN/mm². **(7+6=13)**

----

200 lb/ft   300 lb

Hinge

2'   2'

6'   4'

Figure-1

5 kN/m   M = 60 kN·m

2 m   2 m   1 m

Figure-2

9 ft   P

w_0

12 ft

R_1 R_2

2 in.

8 in.

2 in.

8 in.

Figure-3

2   2   10

2

80 mm

2

40   40   10

Figure-5

8 k

3 k/ft

4'   8'   2'
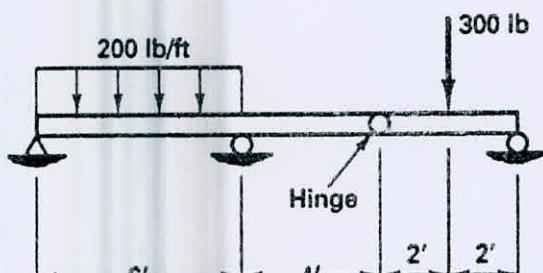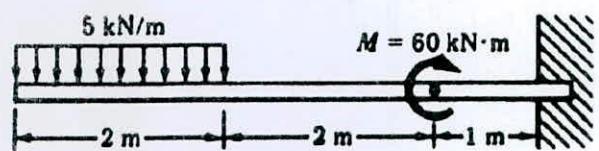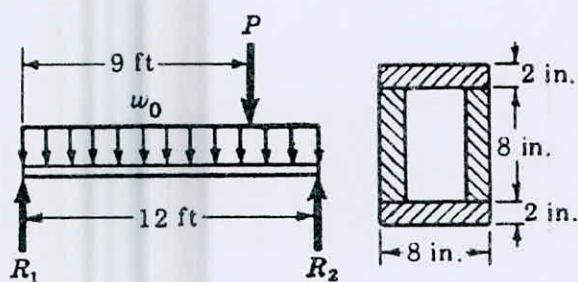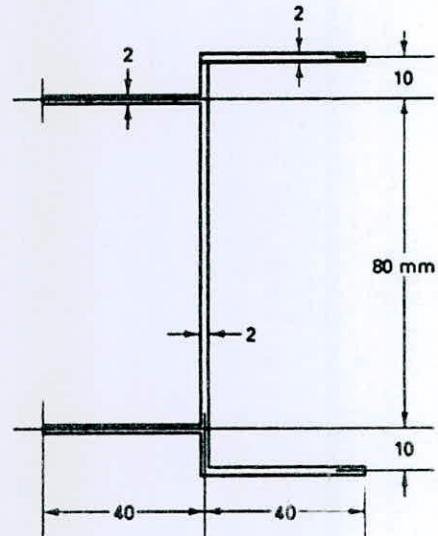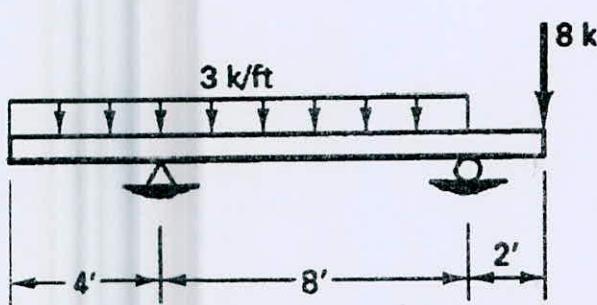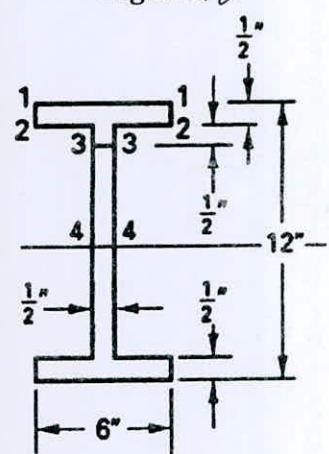
(a) [beam with loadings]

$\frac{1}{2}$"

1   1
2   2

3   3 $\frac{1}{2}$"

4   4   12"

$\frac{1}{2}$" $\frac{1}{2}$"

6"

(b) [beam section and levels]

Figure-4
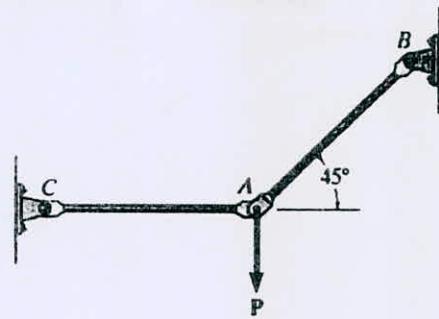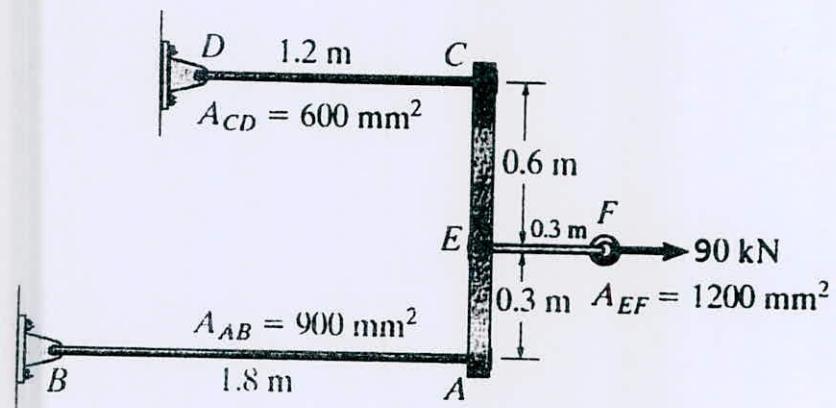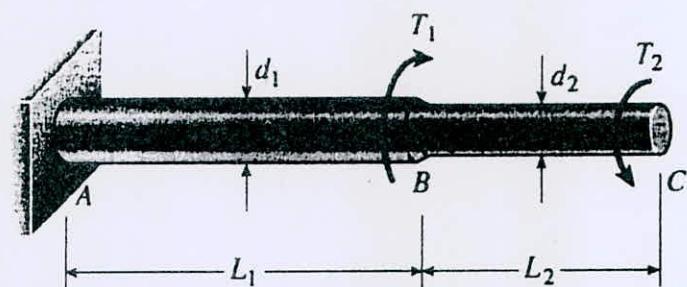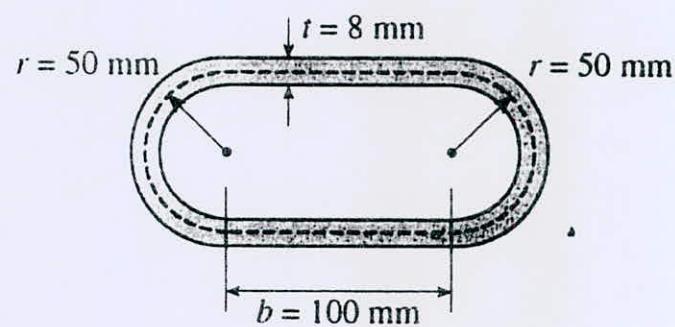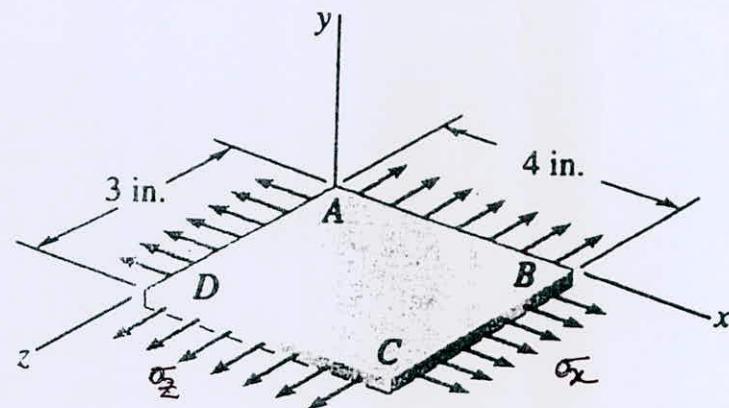
Fig. 6

D 1.2 m C

$A_{CD} = 600$ mm^2

0.6 m

E 0.3 m F

90 kN

0.3 m $A_{EF} = 1200$ mm^2

$A_{AB} = 900$ mm^2

B 1.8 m A

Fig. 7

T_1 T_2

d_1 d_2

A B C

L_1 L_2

Fig. 8

$t = 8$ mm

$r = 50$ mm $r = 50$ mm

$b = 100$ mm

Fig. 9

y

3 in. 4 in.

A

D

z B x

C

σ_z σ_x

Fig. 10

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1   B. Sc. Engineering Examinations 2020-2021

Sub: **MATH 237** (Laplace Transform and Vector Analysis)

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.

Symbols used have their usual meaning.

1.   (a) Are the following vectors linearly dependent? If so, determine a linear relation among them.   **(12)**

$$(1,2,3), (3,5,7) \text{ and } (5,9,13)$$

(b) A wheel is rotating about the line $y = x, z = 0$ with angular speed $\omega = 10$ rad / sec. The rotation appears clockwise if one looks from the origin. Find the velocity and speed at the point (4, 2, -2). Make a sketch.   **(12)**

(c) Prove that $\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) = \mathbf{B}(\mathbf{A} \cdot \mathbf{C}) - \mathbf{C}(\mathbf{A} \cdot \mathbf{B})$ **(11)**

2.   (a) A particle moves along the curve $\mathbf{r} = (t^3 - 4t)\mathbf{i} + (t^2 + 4t)\mathbf{j} + (8t^2 - 3t^3)\mathbf{k}$, where t is the time. Find the magnitudes of the tangential and normal components of its acceleration when $t = 2$.   **(12)**

(b) Derive the Frenet-Serret formulas.   **(12)**

(c) Find the curvature and radius of curvature of the curve with position vector $r = a\cos t\, i + b\sin t\, j$, where a and b are positive constants. Interpret the case where $a = b$.   **(11)**

3.   (a) If $\varnothing = r^n$, find the gradient of $\varnothing$ and the directional derivative of $\varnothing$ in the direction of **r**.   **(11)**

(b) Prove that $\nabla \times (\varnothing\, \mathbf{A}) = (\nabla\varnothing) \times \mathbf{A} + \varnothing\,(\nabla \times \mathbf{A})$ **(12)**

(c) Show that $\mathbf{E} = \dfrac{\mathbf{r}}{r^2}$ is irrotational. Find $\varnothing$ such that $E = -\nabla\varnothing$ and $\varnothing(a) = 0$ where $a > 0$.   **(12)**

4.   (a) Evaluate $\oint_C F \cdot dr$ from (0,3,1) to (3,0,1) around a circle $C : x^2 + y^2 = 9, z = 1$; if the force field is given by   **(15)**

$$\mathbf{F} = (2x - y + z)\mathbf{i} + (x + y - z^2)\mathbf{j} + (3x - 2y + 4z)\mathbf{k}$$

(b) Evaluate $\iiint_v F dv$ for the region above the xy plane boundaed by the cone $z^2 = x^2 + y^2$ and the plane $z = 4$, if the velocity vector of the fluid is given as $\mathbf{F} = 4xz\,\mathbf{i} + xyz^2\,\mathbf{j} + 3z\,\mathbf{k}$.   **(20)**

MATH 237/CE

SECTION – B

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

5.   (a) Find the outward flux of the vector field $\vec{F}(x,y,z) = x^3\hat{i} + y^3\hat{j} + z^3\hat{k}$ across the surface of the region that is enclosed by the hemisphere $z = \sqrt{4 - x^2 - y^2}$ and the plane $z = 0$. **(18)**

(b) Find the work performed by the force field $\vec{F}(x,y,z) = x^2\hat{i} + 4xy^3\hat{j} + y^2 x\hat{k}$ on a particle that traverses on a rectangle with vertices $(1,0,0), (0,0,0), (0,3,3)$ and $(1,3,3)$ in the plane $z = y$. **(17)**

6.   (a) Compute the Laplace Transformation of the following triangular wave function shown in Figure 1. **(11)**
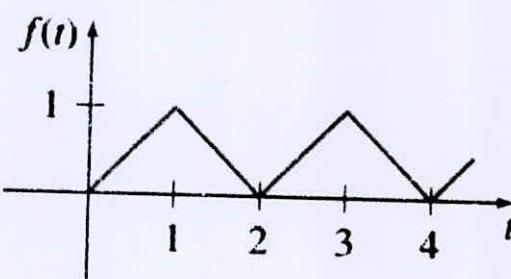
Figure 1 for 6 (a)

(b) Use Laplace transform of derivative to find $L\left\{\dfrac{\cos\sqrt{t}}{\sqrt{t}}\right\}$. **(12)**

(c) Define Error function and complementary error function. Hence evaluate $L\left\{erf\left(\sqrt{t}\right)\right\}$. **(12)**

7.   (a) State convolution theorem for Laplace transform. Use Convolution theorem to compute $L^{-1}\left\{\dfrac{1}{s^2(s+1)^2}\right\}$. **(12)**

(b) Apply Heaviside expansion theorem to compute $L^{-1}\left\{\dfrac{s+5}{(s+1)(s^2+1)}\right\}$. **(11)**

(c) Solve the initial value problem using Laplace Transform
$\dfrac{d^2y}{dt^2} + 2\dfrac{dy}{dt} + 101y = 5\sin 10t,\ y(0) = 0,\ y'(0) = 20$. **(12)**

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8.   (a) Solve the following integral equation by using Laplace Transform

$$\int_0^t \frac{Y(u)}{\sqrt{t-u}}\, du = 1 + t + t^2 .$$

(10)

(b) Solve the following heat conduction equation using Laplace Transform   **(15)**

$$\frac{\partial}{\partial t} u(x,t) = a \frac{\partial^2 u(x,t)}{\partial x^2}, \qquad x > 0, t > 0$$

where $u(x,0) = 0, u(0,t) = u_0$ and $|u(x,t)| < M$ for all x and t.

(c) An inductor of 2 henrys, a resistor of 16 ohms and a capacitor of 0.02 farads are connected in series with an e.m.f of E = 120 sin3t (volts). At t = 0 the charge on the capacitor and current in the circuit are zero. Using Laplace Transform find the charge and current at any time $t > 0$.

(10)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1   B. Sc. Engineering Examinations 2020-2021

Sub : **HUM 353** (Accounting)

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**.

1. (a) Starwood company produces memory enhancement kits for fax machines. The company's income statement for the most recent year is given below: $(23\frac{1}{3})$

	Sales (12,400 units @ Tk. 20 per unit)	Tk. 248,000
Less:	Variable cost of sales	Tk. 189,000
	Contribution margin	Tk. 59,000
	Less: Fixed cost for the period	Tk. 60,000
	Net operating loss	Tk. (1000)

Requirements:

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

(ii) The sales manager feels that Tk. 8000 increase in the advertising cost will result in a Tk. 70,000 increase in sales. If the sales manager is right, what will be the effect on company's net operating income or loss?

(iii) The management is convinced that a 10% reduction in the selling price, combined with an increase of Tk. 15,000 in the advertisement cost, will cause unit sales to double. What will be the new income statement look like if these changes are adopted?

(iv) Refer to the original data. The company's advertising agency thinks that a new package would help sales. The proposed new package would increase packing cost Tk. 0.50 per unit. Assuming no other changes, how many units would have to be sold to earn a profit of Tk. 5000?

(v) Assume that the operating result for the last year were as follows:

	Sales (12,400 units @ Tk. 20 per unit)	Tk. 360,000
Less:	Variable cost of sales	Tk. 162,000
	Contribution margin	Tk. 198,000
	Less: Fixed cost for the period	Tk. 180,000
	Net operating income	Tk. 18,000

• What will be the degree of operating leverage in this situation?

• The management expects sales to increase by 25% next year. By how much should net operating income increase (use degree of operating leverage)?

• Verify your answer by preparing income statement.

HUM 353

2. (a) What is the basic difference between absorption costing and variable costing methods? $(3\frac{1}{3})$

(b) Chuck Wagon grills manufacturing company makes specially barbecue grill that is sells for Tk. 60. Cost data for the last year's operation follow (20)

Unit produce during the period	Tk. 17,500
Unit sold during the period	Tk. 15,000

Variable costs per unit:

Direct Materials	Tk. 7
Direct labor	Tk. 10
Variable manufacturing overhead	Tk. 5
Variable selling and administrative overhead	Tk. 3

Fixed cost of the period:

Fixed manufacturing overhead	Tk. 3,15,000
Fixed selling and administrative overhead	Tk. 2,45,000

Required:

(i) Determine unit produce cost under absorption costing and variable costing methods.

(ii) Prepare income statement under both methods.

3. (a) What do you mean by overhead cost? Why are administrative costs and selling & distribution costs treated as overhead cost? $(3\frac{1}{3})$

(b) Fast Parcel Service operates a fleet of delivery trucks in a Large metropolitan area. A careful study by the company's cost analyst has determined that if a truck is driven 120,000 miles during a year, the average operating cost is Tk. 11.6 per mile. If a truck is driven only 80,000 miles during a year, the average operating cost increases to Tk. 13.6 per mile. (10)

Requirement:

(i) Using the high-low point method, determine the variable cost per mile driven and fixed operating cost of truck operation during a year?

(ii) Express the variable cost and fixed cost element in the form of $Y = mx + c$.

(iii) If a truck is driven 100,000 miles during a year, what total operating cost would you expect to be incurred?

(c) Various cost data and sales data for Strafford company for the just ended year are as follows: (10)

Selling expenses	Tk. 140,000
Rent for show room	30,000
Beginning raw materials	80,000
Ending raw materials	50,000
Utilities, factory	36,000
Direct labor	300,000

HUM 353

Contd ... Q. No 3(c)

Depreciation, plant equipment (factory)	162,000
Purchase of raw materials	750,000
Sales	30,00,000
Insurance for factory	40,000
Indirect labor	150,000
Maintenance for plant equipment (factory)	87,000
Officer's salary	50,000
Director's fee	130,000
Supervisor's Salary	40,000
Advertisement expenses	45,000
Sales manager's salary	20,000
Beginning work-in-process	180,000
Ending work-in-process	100,000
Beginning finished goods	260,000
Ending finished goods	210,000
Cleaning supplies, factory	7,000
Rent (67% Factory and 33% office)	120,000
Gas and Water, Factory	2,500
Travelling expenses, factory	6,000
Travelling expenses, office	7,000

Required:

(i) Prepare a cost of goods sold statement in a good form and also

(ii) Prepare an income statement for the period.

4. (a) Differentiate between direct method and reciprocal services service method for cost allocation. (3⅓)

(b) A manufacturing company has two service departments – Plant Maintenance and Information System and two production departments – Machining and Assembly. The relevant data for allocating service department costs over production department are given below: (20)

	Service Departments		Production Departments		
	Plant Maintenance	Information System	Machining	Assembly	Total
Overhead cost before allocation (Tk.)	600,000	1,16,000	400,000	200,000	13,16,000
Service work finished by: Plant Maintenance (Budgeted Labor Hours in percentage)	---	20%	30%	50%	100%
Service work finished By: Information System (Budgeted Computer Hours in percentage)	10%	---	80%	10%	100%

Required:

Allocate two service departments cost to the two production departments by using

(i) Direct method

(ii) Reciprocal service method.

HUM 353

SECTION – B

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

5. (a) What are the components of financial statement? What types of information do the components provide? $(3\frac{1}{3})$

(b) Hyzer Disc Golf Course was opened on May 1 by Barry Schultz. The following selected events and transactions occurred during May. (20)

May-1:	Invested $20,000 cash in the business.
May-2:	Purchased Heeren's Gold Land for $15,000 cash.
May-5:	Advertised the opening of the driving range and miniature golf course, paying advertising expenses of $700.
May-10:	Paid cash $600 for a one-year insurance policy.
May-12:	Purchased gold discs and other equipment for $1,050 from Innova Company payable in 30 days.
May-15:	Received $340 in cash for golf fees earned.
May-18:	Sold 100 coupon books for $10 each. Each book contains 4 coupons that enable the holder to play one round of disc golf.
May-20:	Withdraw $800 cash for personal use.
May-22:	Paid salaries of $250.
May-24:	Paid Innova Company in full
May-30:	Received $200 cash for fees earned.

Required: Journalize the above transactions for May 2021.

6. (a) Selected financial statements data for Samrin Corporation are presented below: (12)

	2021 (Tk.)	2020 (Tk.)
Net Sales (all in credit)	7,00,000	6,50,000
Cost of Goods Sold	4,20,000	4,00,000
Interest Expense	35,000	30,500
Net Income	45,000	30,000
Account Receivable	45,000	48,000
Inventory	1,33,000	1,15,500
Total Assets	6,40,000	6,00,000
Current Liabilities	75,000	80,000
Non-current Liabilities	80,000	85,000
Total Shareholder's Equity	4,85,000	4,35,000
Weighted average common shares outstanding	34,000	31,000
Market price of each share	Tk. 4.00	Tk. 5.00

Additional information: For 2019, Total Assts was Tk. 5,33,000; Current Liability was Tk. 70,000 and Non-current Liability was Tk. 50,000.

HUM 353

Contd ... Q. No 6(a)

Required: Compute the following ratios for 2021 and 2020.

(i) Current Ratio

(ii) Profit Margin

(iii) Return on Total Asset

(iv) Earnings per share

(v) Price-earnings ratio

(vi) Debt to Asset ratio

(b) The comparative Income Statement of Hendi Corporation are shown below: (11 ⅓)

Particulars	2021	2020
Net Sales	$600,000	$500,000
Cost of Goods Sold	(483,000)	(420,000)
Gross Profit	117,000	80,000
Operating Expenses	(57,200)	(44,000)
Net Income	59,800	36,000

(i) Prepare a horizontal analysis of the income statement, 2021 data for Hendi Corporation using 2020 as a base.

(ii) Prepare a vertical analysis of the income statement data for Hendi Corporation in columnar form for both years.

7. The trial balance of Arish Company on September 30, 2020 is given below: (23 ⅓)

Arish Company

Trial Balance

September 30, 2020

Accounting Title	Debit (Tk.)	Credit (Tk.)
Cash	12,800	
Supplies	2,500	
Prepaid Insurance	3,000	
Office Equipment	5,000	
Note Payable		5,000
Account Payable		2,500
Unearned Revenue		1,200
Capital		10,000
Drawings	500	
Service Revenue		10,000
Salary Expense	4,000	
Utility Expense	900	
Total	28,700	28,700

HUM 353

Contd ... Q. No 7

Analysis reveals the following additional data:

(i) Supplies on hand on January 31, Tk. 1,200.

(ii) Insurance policy is for two years.

(iii) Depreciation Tk. 200 for each month.

(iv) Unearned revenue is still unearned Tk. 800.

(v) Interest accrued at January Tk. 200.

(vi) Service provided but not received Tk. 1,200.

Required:

(i) Prepare adjusting entries for September 30, 2020.

(ii) Prepare adjusted trial balance as on September 30, 2020.

8. (a) What types of comparisons can be done through financial statement analysis?   (3 ⅓)

(b) The following is the trial balance of Kasem Company as on December 31ˢᵗ, 2021.   (20)

Kashem Company

Adjusted Trial Balance

December 31, 2021

	Debit (Tk.)	Credit (Tk.)
Cash	8,700	
Accounts receivable	11,500	
Supplies	650	
Prepaid insurance	1,200	
Equipment	17,300	
Notes payable		10,000
Accounts payable		2,500
Salaries Payable		725
Interest Payable		100
Unearned Rent Revenue		1,050
Owner's capital		22,000
Owner's drawing	1,600	
Service revenue		17,000
Rent Revenue		2,260
Salary expense	8,725	
Rent expense	2,900	
Depreciation expense	700	
Supplies expense	850	
Utilities expense	1,510	
Interest expense	100	
Total	**55,735**	**55,735**

Required:

(a) Prepare an Income Statement and Owners Equity Statement.

(b) Prepare a Balance Sheet as on 31ˢᵗ December, 2021.