L-2/T-1/CE **Date: 26/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2018-2019

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 **Q. No. 1** and any **TWO** from the rest.

Question No. 1 is compulsory.

Assume reasonable values for any missing data.

1. (a) Amount of ingredients for a non-air-entrained concrete mix is to be designed for a 15″ × 15″ column casting with characteristic strength 32 MPa at 28 days. Maximum allowable slump is 38 mm and maximum allowable w/c ratio is 0.4. Use ACI 211.1 method and provided Table 1-5 with the following data. **(15)**

Cement: Portland Composite Cement with specific gravity 2.9

Coarse Aggregate:

Maximum Size: 25 mm

Bulk Specific Gravity (OD): 2.62

Dry-rodded Unit Weight: 1650 kg/m^3

Fine Aggregate:

Fineness Modulus: 2.70

Bulk Specific Gravity (OD): 2.68

Dry-rodded Unit Weight: 1580 kg/m^3

Determine the following:

(i) Required average strength.

(ii) Mass of oven dry aggregates in kg/m^3.

(iii) Mix ratio on OD weight basis and w/c ratio.

(iv) If the w/c ratio is reduced by 10%, will the quantity of coarse aggregate increase, decrease or remain the same? Explain your answer.

(b) Discuss the effects of age of concrete and water/cement ratio on strength of concrete. **(10)**

(c) Write examples of elastic material, plastic material, elasto-plastic material and elasto-visco-plastic material. Show graphically the creep behavior of an elasto-visco-plastic material. **(10)**

Contd P/2

CE 201

Contd... Q. No. 1

(d) For the following loading sequence (Fig. 1) draw the likely strain response with time of: (i) a plastic material and (ii) an elasto-plastic material. Assume equal time interval i.e., $\Delta t = t_1 - t_0 = t_2 - t_1 = t_3 - t_2 = t_4 - t_3$. **(10)**

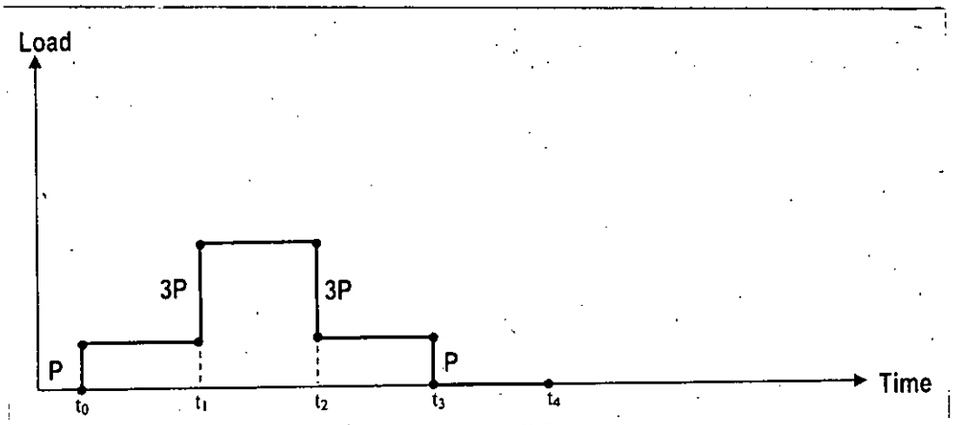

Fig. 1. Loading-unloading sequence

2. (a) The quantities of ingredients of a concrete mix for specific aggregates characteristic and strength requirements are obtained using British Method of mix design, without considering any admixture. The ingredients are water: 185 kg/m^3, cement: 450 kg/m^3, Fine Aggregate (SSD): 750 kg/m^3, and Coarse Aggregate (SSD): 1080 kg/m^3. As per the requirement of the client, a water reducing admixture need to be used, which can reduce 10% of water demand at a dose of 5 ml/kg cement. **(15)**

   (i) Find the amount of ingredients (SSD basis) required to get a concrete mix with same density when the specified admixture is used.

   (ii) Moisture content and absorption capacity of the Fine aggregate are 4.5 and 2.5, and moisture content and absorption capacity of the coarse aggregate are 1.5 and 2.2. Determine the amount of ingredients required to cast a 40 ft. long pile (16 in. diameter) after adjusting for aggregate moisture and admixture usage.

   (b) State the characteristics of open graded, uniform graded, and gap graded aggregate. Also draw their typical gradation curves. **(10)**

   (c) Write down the functions of Silica, Sodium and Lime in glass. **(5)**

3. (a) 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. Also, calculate the specific gravity of the combined aggregate, if the specific gravity of Aggregate A, B, and C are 2.95, 2.85, and 2.65. Use the following grain size distribution. **(15)**

Contd P/3

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Contd... Q. No. 3(a)

Sieve Size mm	Percent passing			
	Aggregate A	Aggregate B	Aggregate C	Specification
50	100	-	-	
38	100	-	100	98 to 100
25	95	100	98	98
19	89	55	88	-
9.5	50	15	60	-
4.76	10	5	32	20
2.36	2	2	10	-
1.18	2	0	6	-
0.6	0	0	2	-
0.3	0	0	0	-

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

(c) Briefly describe the ingredients and uses of cement mortar and lime mortar. **(5)**

4. (a) Write down the characteristics and qualities of good building stones. Compare between natural rubber and crude rubber. **(10)**

(b) Discuss the effects of water content, aggregate type and gradation, and aggregate/cement ratio on workability of concrete. **(10)**

(c) Describe the effect of Silicon and Sulphur on iron. Write two uses of Cast Iron, Wrought Iron, Mild Steel and Hard Steel. **(10)**

SECTION – B

There are **FOUR** questions in this section. Answer **Q. No. 5** and any **TWO** from the rest.

Question No. 5 is compulsory.

5. (a) Draw a typical section of ferrocement and show its different components. How does ferrocement reduces the chances of further spalling of concrete? **(10)**

(b) Define: (i) Modulus of resilience, (ii) Modulus of toughness. List five methods for preventing corrosion. **(10)**

(c) Discuss applicability/use of different types of ordinary Portland cement. Illustrate some merits of blended cement over OPC. **(10)**

(d) What is the significance of passivity to the practicing designer? **(5)**

Contd P/4

CE 201

6. (a) What are the functions of cambium layer and xylem present in a living exogenous tree trunk? Describe different types of timber rot. **(6+8)**

(b) A full sized brick is tested in the lab for unit weight measurement. At first time by mistake the brick is submerged in water without making wax coating over the brick and SSD weight of the brick found to be = 8.16 lb. The brick is then 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. Assume water density = 62.4 lb/ft^3 and absorption capacity of brick = 21.5%. **(12)**

(c) Write down some key benefits of using lime as construction material. Why is fat lime more preferable than hydraulic lime in structural construction? **(5+4)**

7. (a) Name different types varnishes based upon the type of solvent used. How anti-termite treatment is done to make structural barrier against sub-terrain termites? **(3+3)**

(b) The density of a piece of teak lumber 20% moisture content = 55.85 lb/ft^3. From lab analysis it is estimated that the cell wall of this teak wood get completely saturated at 30% moisture content while no water exists in cell lumens. **(12)**

Calculate density of the teak lumber at maximum possible moisture content. Assume any reasonable data, if needed.

(c) What is corrosion? Why does corrosion occur? Write the factors affecting corrosion. **(3+3+4)**

(d) Draw a neat sketch and show the rate of heat evolution at different stages of hydration reaction of Ordinary Portland cement. **(7)**

8. (a) Write short note on– (i) engineering bricks and (ii) sand-lime bricks. **(8)**

(b) How is loss on ignition of cement calculated in the lab? What is Blast furnace slag? How is it formed? **(3+4)**

(c) Write applicability of the following compounds used as base in oil paints: (i) lithopone and (ii) red lead. Describe briefly the process of lime plastering. **(5+5)**

(d) Briefly describe the constituents of Plastic. Write the main requirements of a heat insulating materials. **(10)**

Contd.... P/5

Tables for Question No. 1(a)

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 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: 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.

Table 5: 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.

L-2/T-1/CE **Date: 09/11/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2018-2019

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

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 **Q. No. 1 (compulsory)** and any **TWO** questions from the rest.

1. (a) Sandstone A has symmetrical ripple marks and sandstone B has asymmetrical ripple marks. What can you say about their formation? Give reasons and sketches if necessary. **(4)**

(b) Yosemite National Park, USA has majestic granite mountains such as the half-dome. What can you say about its formation? **(4)**

(c) The city of Thimpu is nestled in a valley surrounded by lush green mountains of Bhutan. Located near the plate boundary between Indian Plate and Eurasian plate, the Raidak river flows through the city. Give a brief account of the geological hazards you consider to be relevant to Thimpu and why? **(8)**

(d) What do you know about Taal Volcano, Philippines and formation of the lake? **(4)**

(e) Briefly describe the formation of the following with neat sketches (answer any three) **(5×3=15)**

(i) V-shaped rock outcrop

(ii) Angular unconformity

(iii) Mid-Atlantic Ridge

(iv) Shield Volcano

2. (a) Describe with neat sketches, different mechanisms how folds may be formed. Show different types of folds. Also discuss importance of folds in practical engineering applications. **(17)**

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

(i) Chemical sedimentary rock and Bio-chemical sedimentary rock

(ii) Contact metamorphism and Regional metamorphism

(iii) Intrusive and Extrusive igneous rocks

(iv) Abrasion and Corrosion methods of sea erosion.

Contd P/2

CE 203

3. (a) What kind of changes happen to the rock due to metamorphism? What do you mean by foliation? Show how foliation varies with grade of metamorphism. **(12)**

(b) Draw earthquake zoning map of Bangladesh as proposed in updated Bangladesh National Building Code. How does the zone coefficient values compare with those of neighbouring India? **(7)**

(c) Write short notes on the following (answer any four) **(4×4=16)**

(i) Historical earthquakes of Bangladesh

(ii) Loess deposit

(iii) Glacial till

(iv) Principle of superposition

(v) Shale

4. (a) Briefly discuss why earth is called a 'dynamic planet'? **(6)**

(b) What is a delta? With neat sketches, describe the formation of different beds of delta. **(8)**

(c) Show how geological time is divided into various era. Briefly describe the era of the dinosaurs. **(7)**

(d) Describe the formation of Himalaya mountains. What kind of faults you expect to see in the region? Discuss. **(7)**

(e) Name different types of sand dunes. Briefly describe any two types with neat sketches. **(7)**

SECTION – B

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

5. (a) Explain the following terms with respect to an alluvial land formation: (i) meandering River, (ii) Oxbow lake, (iii) cutoff, (iv) natural levee. **(12)**

(b) Explain with diagram the variation of the various morphological parameters of a river basin as it flows in the downstream direction. Explain these variations in the context of Bangladesh. **(23)**

6. (a) With all necessary diagrams, explain the channel cross sectional changes during one flood season. Explain the movement of light and heavy particles during the season. Explain these changes with the variation of the river discharge as well. **(23)**

(b) Write short notes on (i) Rectangular, (ii) Trellis, (iii) Radial types of drainage patterns with diagrams. **(12)**

Contd P/3

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7. What is river transportation? **(35)**

What are the factors affecting the transportation power of a river?

How the knowledge of river transportation can help in determining (i) suitable size and (ii) adequate volume of blocks in flood protection embankment design?

8. (a) Describe how minerals are classified based on the following properties (answer any three): **(4×2=12)**

(i) Tenacity

(ii) Cleavage

(iii) Hardness

(iv) Transparency

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

(i) Mica

(ii) Quartz

(iii) Kaolinite

(iv) Hematite

(v) Olivine

(c) What is the importance of Crystals in Geology? Describe with neat sketches different shapes of crystals. **(11)**

L-2/T-1/CE **Date: 20/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2018-2019

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. Using differential equations of equilibrium, find the general expression for shear and bending moment for the beam shown in Fig. 1. Using the derived expressions, draw shear force and bending moment diagrams. Locate the position of maximum moment and corresponding magnitude. **(26¼)**

2. Draw shear force and bending moment diagrams for the beam loaded as shown in Fig. 2. **(26¼)**

3. Locate the shear center for the thin-walled section shown in Fig. 3. **(26¼)**

4. A beam section shown in Fig. 4 carries a vertical shear of 100 kN. Determine the shear stress at the levels indicated and draw the distribution of shear stress over the section. **(26¼)**

5. (a) For a thin walled pressure container show that circumferential stress is twice the longitudinal stress. **(10)**

   (b) A small cylinder subjected to high pressure is made by brazing a plug "**p**" into each end of a steel tube of inside diameter d = 2.00″ and thickness 0.20″ as shown in Fig. 5. Through one of the plugs there is an accurately drilled hole of diameter 0.60″. The pressure is produced by filling the tube with a liquid and forcing in the 0.6″ diameter plunger with a load of **F**. If the allowable shearing stress in the brazing is 1600 psi, calculate: **(16¼)**

   (i) allowable pressure in the liquid,
   (ii) magnitude of load F to produce this pressure and
   (iii) the magnitude of circumferential stress and longitudinal stress developed in the tube.

Contd P/2

CE 211

SECTION – B

There are **FIVE** questions in this section. Answer any **FOUR** questions.
Assume reasonable value for any missing data.

6. (a) Derive the elastic flexure formula for flexural stress in beams with a vertical axis of symmetry. State the assumptions for this derivation. **(10)**

(b) A 100-hp motor is driving a line shaft through gear A at 26.3 rpm (Fig. 6). Bevel gear at B and C drive rubber-cement mixers. If the power requirement of the mixer driven by gear B is 25 hp and that of C is 75 hp, what are the required shaft diameters? The allowable shear stress in the shaft is 6 ksi. **(16¼)**

7. (a) The steel block as shown in Fig. 7 is subjected to a uniform pressure on all its faces. Knowing that the change in length of edge AB is 0.04 mm. Determine the pressure applied to the faces of the block and the change in length of the other two edges. **(10)**

Given: E = 200 GPa and $\nu = 0.3$.

(b) A steel rod with a cross-sectional area of 2 in^2 and a length of 15.0025 in. is loosely inserted into a copper tube, as shown in Fig. 8. The tube has a cross-sectional area of 3 in^2 and is 15.0000 in. long. If an axial force P = 25 kips is applied through a rigid cap, what stresses will develop in the two materials? **(16¼)**

Given: $E_s = 30 \times 10^6$ psi

$E_{cu} = 17 \times 10^6$ psi

8. (a) Determine the allowable bending moment around the horizontal axis for the composite beam of wood and steel plates having cross-sectional dimensions shown in Fig. 9. Materials are fastened so that they act as a unit. The allowable bending stresses are, $\sigma_{st} = 20$ ksi and $\sigma_w = 1.2$ ksi. **(10)**

Given: $E_{st} = 30 \times 10^6$ psi and $E_w = 1.2 \times 10^6$ psi

(b) A force P = 1 kN is applied to a rigid bar suspended by three wires, as shown in Fig. 10. All wires are of equal size and the same material. For each wire, A = 80 mm^2, E = 200 GPa and L = 4 m. Knowing that the wires were initially taut, determine the tension in each wire caused by the applied load. **(16¼)**

9. A shaft having the cross-section shown in Fig. 11 is subjected to a torque T = 150 N-m. **(26¼)**

(a) Estimate the percentage of torque carried by each of the two cross-sectional components and calculate the maximum shear stresses in each part, neglecting stress concentrations.

(b) Find the angle of twist per unit length caused by the applied torque.
Given: G = 25 × 10^3 GPa.

10. A channel shaped member, shown in Fig. 12, act as a horizontal beam in a machine. When vertical forces are applied to this member the distance AB increases by 0.0010 in. and the distance CD decreases by 0.0090 in. Determine, **(26¼)**

(a) The magnitude and sense of the applied moment and

(b) Normal stresses in the extreme fibers. (E = 15 × 10^6 psi)

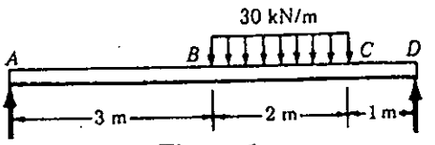


Figure-1

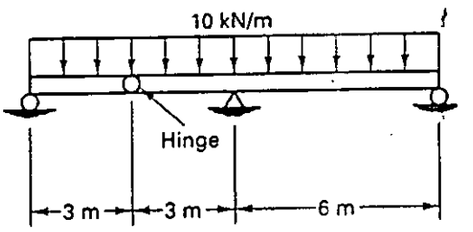


Figure-2

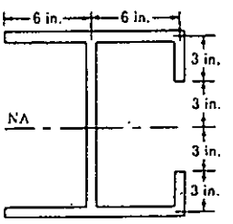


Figure-3

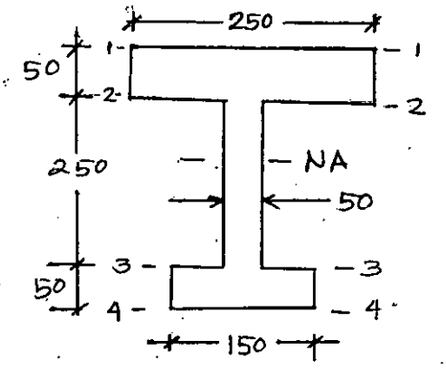


Figure-4

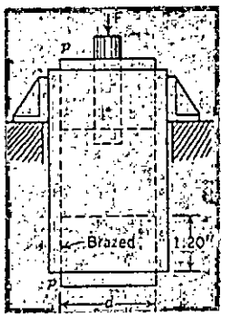


Figure-5

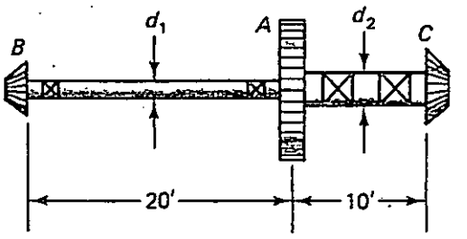


Fig. 6

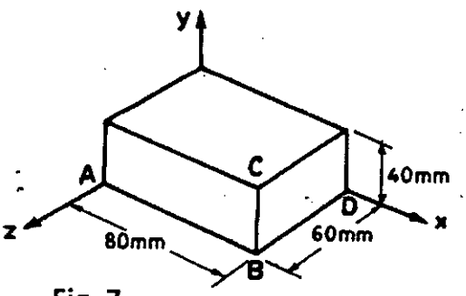


Fig. 7

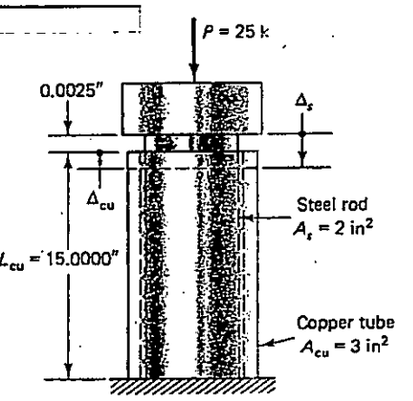


Fig. 8

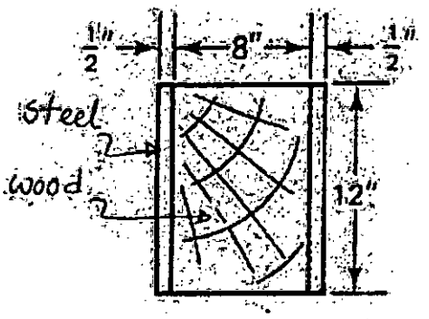


Fig. 9

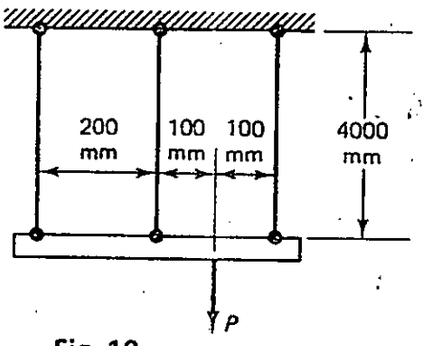


Fig. 10

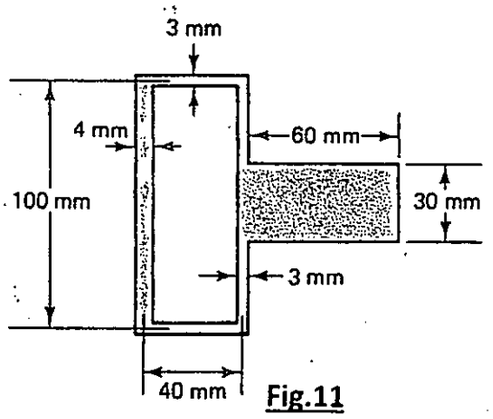
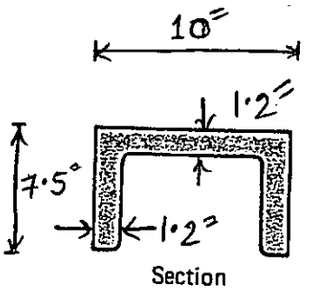


Fig.11



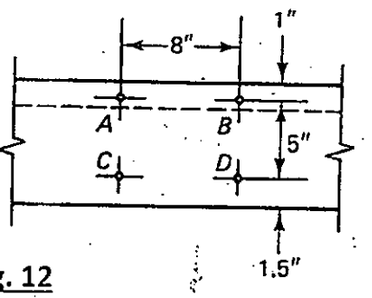


Fig. 12

For Q.9 and Fig.11

Formula for Torsion of Solid Non-Circular Bars

$$\tau_{max} = \frac{T}{\alpha b t^2} \qquad \phi = \frac{TL}{\beta b t^3 G}$$

Table of Coefficients for Rectangular Bars[17]

b/t	1.00	1.50	2.00	3.00	6.00	10.0	∞
α	0.208	0.231	0.246	0.267	0.299	0.312	0.333
β	0.141	0.196	0.229	0.263	0.299	0.312	0.333

Self-Study/CE **Date: 20/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations

Sub: **CE 333** (Environmental Engineering II)

Full Marks: 280 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) A waste stabilization pond system is to be designed for treatment of municipal wastewater. There will be one anaerobic pond, one facultative pond and two maturation ponds in series. Using the following information design the facultative pond to ensure influent BOD_5 = 50 mg/L to the first maturation pond. Show adequate checks for volumetric loading rate and surface loading rate for the facultative pond. Draw relevant plan and section views of the ponds. **(20)**

   Wastewater flow rate = 35 m^3/hr

   Initial BOD_5 concentration in wastewater = 200 mg/L

   The BOD_5 removal efficiency in the anaerobic pond = 40%

   BOD rate constant (base e), k_1 = 0.22/day at 20°C

   Design temperature = 28°C

   Assume any reasonable value of any missing data if required.

   (b) Write down the significance of sludge treatment. Discuss briefly different sludge processing methods. **(5+8⅔)**

   (c) Write short note on nitrification process of organic waste decomposition. **(6)**

   (d) Discuss the development initiatives taken by GoB to improve overall wastewater (sewage) management system for Dhaka city. **(7)**

2. (a) Write short note on **(14)**

   (i) fecal sludge management system and

   (ii) anaerobic baffled reactor

   (b) What are the criteria for an acceptable sanitation option? Discuss. **(12)**

   (c) Distinguish between types of pour flash latrine. Also write down some merits and demerits of pour flash latrine. **(20⅔)**

3. (a) What are the changes in design in small bore sewerage compared to conventional system? **(9)**

Contd P/2

CE 333

Contd... Q. No. 3

(b) Design a pit latrine for a family of 10 people. The soil is unconsolidated/loose, and the groundwater table is 3.5 m below ground surface. What would be the maximum possible design life of the pit, if 1.5 m diameter and 0.3 m depth concrete rings are used? Assume solid accumulation rate 0.06 m^3/capita/year. **(25⅔)**

Water availability in the area is limited. What kind of latrine would you suggest? (i) Simple (direct/partially offset/fully offset); (ii) VIP; (iii) ROEC.

Draw a neat sketch showing all elements of the designed latrine.

(c) Discuss sanitation scenario in Bangladesh - past situation and present progress. **(12)**

4. (a) Name different primary units used in domestic wastewater treatment facilities. What is the function of comminutor in wastewater treatment system? **(5+4)**

(b) In a wastewater treatment plant a primary clarifier receives 20,000 m^3 wastewater per day. A settling column analysis (column depth = 2.0 m) of the untreated wastewater is carried out to observe overall removal performance. The following data is obtained during the test: **(20)**

Particle Concentration, mg/L	410	340	275	200	140	85	35
Time, (hr)	0	0.5	1.0	1.5	2.5	3.5	5.0

If mass fraction of particles with velocity exceeding the surface over flow rate found to be 60%, determine–

(i) surface area of the primary clarifier and

(ii) total removal efficiency (%).

(c) Describe in brief the growth pattern for fission-reproduction of bacteria. **(9)**

(d) How recirculation ratio is calculated in a trickling filter? What are the advantages of recirculation in trickling filter? **(4+4⅔)**

SECTION – B

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

5. (a) Draw a neat sketch of house water service. How will you ensure no risk of contamination of the water supply in a building? **(9+9)**

(b) Write down the principle of design of water supply pipeline for a building. What are the basic considerations for water supply in tall buildings? **(7+6⅔)**

Contd P/3

CE 333

Contd... Q. No. 5

(c) Distinguish between natural purification processes and engineered purification processes. **(5)**

(d) Calculate the load in terms of Fixture Unit (FU) on the service pipe of a 6 storey building from the following data: **(10)**

Men and women's toilers are on alternate floors

2 water closets or 1 water closet and 1 pedestal urinal, and 1 lavatory on each floor. Water closet = 10 FU, Pedestal urinal = 10 FU, and Lavatory = 2 FU.

6. (a) Define "fixture trap". What do you understand by the strength of a trap and how is it determined? **(3+3)**

(b) What are the principal systems of plumbing drainage? Which system do you prefer and why? Distinguish between self-siphonage and induced-shiphonage. **(3+9+6)**

(c) What do you understand by sustainability of water supply and sanitation services? How can you make the urban sanitation sustainable? **(6+10)**

(d) Draw a diagram of solid waste management system in Dhaka city. **(6⅔)**

7. (a) Draw a typical graph to estimate the Inflow/Infiltration for new construction of RCC sewers and explain the nature of the graph and its application. **(12)**

(b) A 125 mm thick, 1200 mm dia. RCC pipe is laid in a trapezoidal trench with side slope 1:1.5 (V:H). The pipe rests on 150 mm thick hardcore overlain by 150 mm sand bed. The RL of the finished level (Road) is +3.000 m. The trench is backfilled with wet sand and damp clay (density 1920 kg/m^3). Determine the load on the sewer pipe. Neatly draw the trench section with every detail along with the RL of each level in the section. Assume reasonable value for missing data. **(18⅔)**

(c) A 2000 mm dia. RCC pipe is laid with a slope of 0.002 for a design flow of 0.5 m^3/sec when flowing partially full having a width of 1.414 m at the top. The sewer pipe provided is designed to carry domestic sewage having BOD_5 of 200 mg/L and a maximum temperature of 30°C. Determine the potential for Sulfide Generation (Z) and specify the appropriate measures to be taken to for stability of the sewer. **(16)**

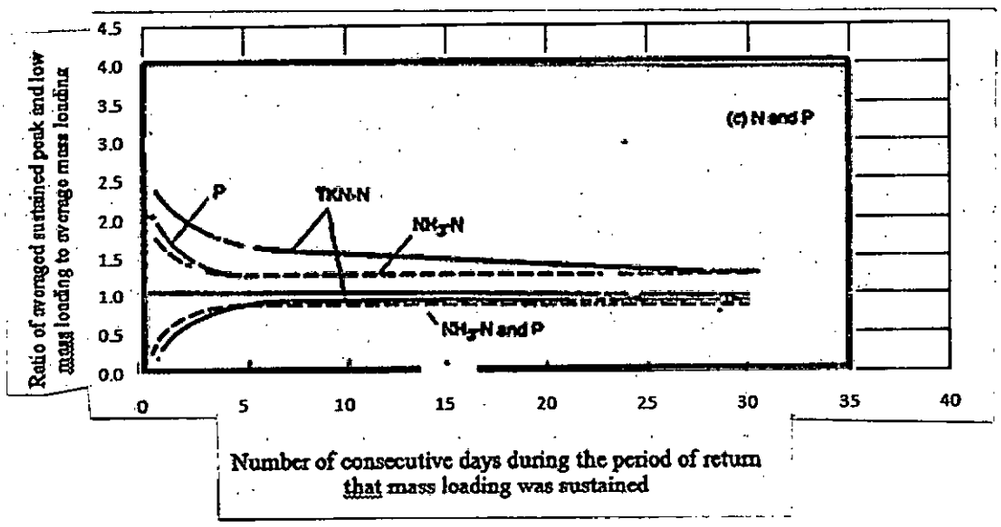
8. (a) In your opinion, which materials of sewer pipes are considered to be the best? Justify. **(12)**

(b) A WWTP employing biological treatment has been designed for long-term average inflow of 55 g/m^3 NH_3-N and 20 g/m^3 P. Given the average flow rate of 2 m^3/s draw the sustained low-flow loading curves for NH_3-N and P using the typical curves provided below. **(18⅔)**

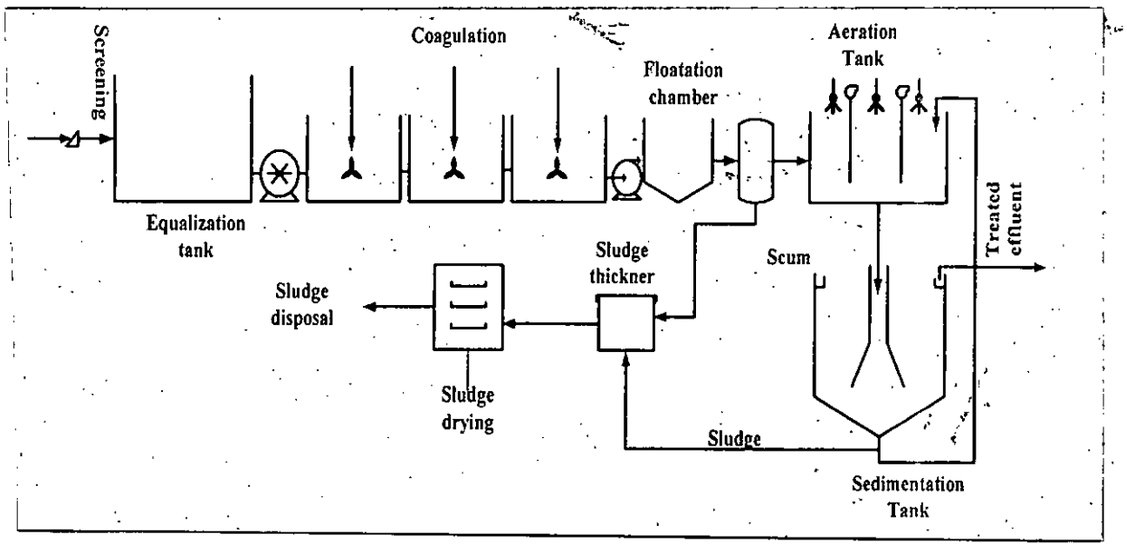
Contd P/4

CE 333

Contd... Q. No. 8(b)



(c) The following schematic diagram represents the treatment processes adopted at an ETP in a Textile Industry. **(16)**



Being the Environmental Engineer in charge of the ETP operations it is your responsibility to identify the reasons for each of the following scenario.

(i) On the certain workday it was observed that the flocs are breaking up at the flocculation chamber.

(ii) On another day the BOD_5 of the effluent exceeded the discharge standard set by the DoE.

What are the locations in the ETP you need to sample to identify the above problems?

L-2/T-1/CE **Date : 03/11/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **HUM 353** (Accounting)

Full Marks : 140 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 any **THREE**.

1. (a) Starline company produces memory enhancement kits for fax machines. The company's income statement for the most recent year is given below: **(20)**

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

Requirement:

(i) Compute the company's CM ratio and its break-even point in both units and 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 the 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 costs 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	Tk. 360,000
Less: Variable cost of sales	162,000
Contribution margin	198,000
Less: Fixed cost	180,000
Net operating income	36,000

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

*The management expects sales to increase by 15% next year. By how much should net operating income increase (use degree of operating leverage)?

*Verify your answer by preparing income statement.

Contd P/2

HUM 353

Contd ... Q. No. 1

(b) What do you understand by cost structure? (3⅓)

2. (a) In what situation, absorption costing will result higher net income than variable costing? Why? (3⅓)

(b) Consider the following data of ABC Manufacturing company for the year ended on December 31, 2016: (20)

Units produced	30,000
Units sold	25,000
Unit selling price	Tk. 100

Variable cost per unit:	
Direct Materials	Tk. 25
Direct labour	14
Variable manufacturing overhead	13
Variable selling and administrative overhead	10
Fixed cost for the period:	
Fixed manufacturing overhead	Tk. 220,000
Fixed selling and administrative overhead	100,000

Requirement:

(i) Compute unit product cost under absorption costing and variable costing methods.

(ii) Prepare income statement under both of the methods.

3. (a) What do you mean by overhead cost? Why are administrative costs and selling and distribution costs treated as overhead cost? (3⅓)

(b) Speedy 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 13.6 per mile. (20)

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?

Contd P/3

HUM 353

Contd ... Q. No. 3

(c) Various costs and sales data for Rosebud Company for the year ended on December 31, 2017 are as follows: **(10)**

Depreciation, factory equipment	Tk. 27,000
Administrative cost	70,000
Officers salaries	40,000
Supervisors salaries	16,000
Maintenance, factory	32,000
Indirect labour, factory	3,000
Supplies (30% for factory, 70% for office)	12,000
Insurance, factory	4000
Purchase of raw materials	12,500
Direct labour	15,000
Sales	600,000
Rent (60% for factory, 40% for office)	45,000
Advertisement cost	60,000
Sales managers salaries	30,000
Property taxes, factory	15,000

Inventories	January 1	December 31
Raw materials	Tk. 9000	Tk. 6000
Work-in-process	17,000	30,000
Finished goods	20,000	40,000

Requirements:

Prepare a cost of goods sold statement and an income statement for the year.

4. (a) Differentiate between direct method and reciprocal service method for cost allocation. Which one is the best and why? **(3⅓)**

(b) Savana Pharmaceuticals has two producing departments - Molding and Finishing and two service departments - Plant maintenance and Marketing. The overhead costs across the departments and other relevant data for allocating service departments costs over production departments are given below: **(17)**

	Production Departments		Service Departments	
Overhead costs before allocation (Tk.)	Tk. 400,000	200,000	600,000	116,000
Cost allocated by				
Plant maintenance deptt:				
Budgeted machine hours in %	30%	50%	-	20%
Marketing deptt:				
Budgeted sales in %	80%	10%	10%	-

Requirement:

Allocate the service departments costs to the production departments using Direct Method and Reciprocal Service Method.

Contd P/4

HUM 353

Contd ... Q. No. 4

(c) A manufacturing company has three production departments - A, B and C. Overhead costs of these three departments after allocation of service department costs are Tk. 11657, Tk. 10234 and Tk. 10934 respectively. What will be the cost of a product if its direct material cost is Tk. 50 and direct labour cost is Tk. 30 and it passes through departments A, B, and C for 4 hours, 5 hours and 3 hours respectively. Working hours for A, B and C departments are 6226 hours, 4028 hours and 4066 hours respectively. **(3)**

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? **(3⅓)**

(b) Jamuna Resort has the following transactions on May 2019. **(20)**

May-1: The owner Investment Tk. 20,00,000 cash.

May-2: Utility incurred on account Tk. 5,000.

May-5: Purchase furniture for cash Tk. 60,000.

May-10: Purchase decoration material for the resort for Tk. 1,50,000 paying Tk. 50,000 in cash and remaining on account.

May-12: Service provided on account Tk. 3,00,000.

May-15: Paid personal bill from the business Tk. 10,000.

May-18: Employee salary paid for the month in cash Tk. 25,000.

May-20: Paid balance due for utility bill.

May-22: Cash received from customer for May 12 transaction.

May-24: Provide services for cash Tk. 20,000.

Required: Prepare the tabular summary of the above transactions for May 2019.

6. (a) Selected financial statement data for Skylark Corporation are presented below:

	2018 (tk.)	2017 (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 Shareholders' 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

Contd.... P/5

HUM 353

Contd ... Q. No. 6(a)

Additional information: For 2016, Total Assets was Tk. 5,33,000; Current Liability was Tk. 70,000 and Non-current Liability was Tk. 50,000.

Required: (a) Compute the following ratios for 2018 and 2017. **(18)**

(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) Based on the ratios calculated, discuss briefly the improvement of lack thereof in the financial performance and position of the company from 2017 to 2018. **(5⅓)**

7. (a) What is the account? Explain with examples. **(3⅓)**

(b) The following events are occurred at July 2018 at Thread Grocery Store: **(20)**

July-1: Invest Tk. 1,00,000 cash in the business.

July-5: Sell goods in cash Tk. 20,000.

July-10: Paid shop rent Tk. 8,000

July-13: Paid employee salary Tk. 5,000.

July-15: Purchase furniture on account Tk. 10,000.

July-19: Sell goods on account Tk. 5,000.

July-25: Owner take Tk. 1,000 cash from the business.

July-30: Receive cash for sale on account on July-19.

July-31: Hire an employee for the next month.

Required: (i) Prepare journal entries for July 31st, 2018.

(ii) Prepare the cash ledger.

8. (a) What types of comparisons can be done through financial statements analysis? **(3⅓)**

(b) The following is the trial balance of Feacon Company as on December 31st, 2018. **(20)**

HUM 353

Contd ... Q. No. 8(b)

Feacon Company Adjusted Trial Balance December 31, 2018		
	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		17,100
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 2018.

L-2/T-1/CE **Date : 30/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2018-2019

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

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 any **THREE**.

Symbols used have their usual meaning.

1. (a) Show that any vector **r** can be represented as a linear combination of three non coplanar vectors **a, b, c**. Hence find a linear relation among the vectors (1, 3, 4), (1, -2, 3), (1, 5, -2) and (6, 14, 4). **(15)**

   (b) By vector method prove that the angle in a semicircle is a right angle. **(10)**

   (c) By vector method find the length of the perpendicular from P:(5, 5, 5) upon the line joining the points A: (3, 4, -1) and B: (1, 3, 1). **(10)**

2. (a) A 90 kg wt. force acts along the line from (-1, 4, 3) to (5, 3, 1). Calculate the moment of the force about an axis through the point (-1, 0, 0) whose direction ratios are 0, 6, 8. **(12)**

   (b) Solve the vector equation for **x: (a × x) + (a.x)a + b = 0** where, **a, b** are two given vectors. **(12)**

   (c) Derive the Frenet-Serret formulae. **(11)**

3. (a) Prove that, $\nabla^2 f(r) = \frac{d^2 f(r)}{dr^2} + \frac{2}{r}\frac{2df(r)}{dr}$

   Where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ and $r^2 = x^2 + y^2 + z^2$. **(12)**

   (b) Determine whether the vector field **F** has a scalar or vector potential and then find its potential where $\mathbf{F} = \mathbf{i}\,(ysinz - sinx) + \mathbf{j}(xsinz + 2yz) + \mathbf{k}(xycosz + y^2)$. **(12)**

   (c) Define normal and directional derivative. In what direction has $\varnothing = 3xy^2 + 12yz - 4x^3z^2$ the maximum derivative at the point (1, 2, -1)? Find also the value of this maximum derivative. **(11)**

4. (a) If $\mathbf{v} = \frac{x}{x^2+y^2}\mathbf{i} + \frac{y}{x^2+y^2}\mathbf{j}$, show that $\int_c \mathbf{v}.d\mathbf{r} = 0$ for every closed path that does not include the origin. What is the value of the integral over the circle $x^2 + y^2 = 1$? **(11)**

   (b) Evaluate $\iint_S \mathbf{A}.\mathbf{n}dS$ where $\mathbf{A} = y\mathbf{i} + 2x\mathbf{j} - z\mathbf{k}$ and S is the surface of the plane $2x + y = 6$ in the first octant cut off by the plane $z = 4$. **(12)**

Contd P/2

MATH 237
Contd... Q. No. 4

(c) Evaluate $\iiint_V (2x+y)dV$ where V is the closed region the parabolic cylinder bounded by $z=4-x^2$, $x=0$, $y=0$, $y=2$, $z=0$. **(12)**

SECTION - B

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

5. (a) Use Green's Theorem to find the work done by the force field $\mathbf{F} = xyi + (\frac{1}{2}x^2 + xy)\mathbf{j}$ on a particle that moves along the stated path. The particle starts at (5, 0), traverses the upper semicircle $x^2+y^2=25$, and returns to its starting point along the x-axis. **(17)**

(b) Use a line integral to find the area of the region enclosed by the asteroid **(18)**

$$x = a\cos^3\varphi, \quad y = a\sin^3\varphi \quad (0 \le \varphi \le 2\pi).$$

6. (a) Use Divergence Theorem to find the outward flux of $\mathbf{F} = x^3\mathbf{i} + y^3\mathbf{j} + z^2\mathbf{k}$ across the surface of the solid bounded by $x^2+y^2=9$, $z=0$, $z=2$. **(17)**

(b) State and verify Stokes' Theorem for the vector field $\mathbf{F}(x,y,z) = 2z\mathbf{i} + 3x\mathbf{j} + 5y\mathbf{k}$, taking S to be the portion of the paraboloid $z=4-x^2-y^2$ for which $z \ge 0$ with upward orientation, and C to be the positively oriented circle $x^2+y^2=4$ that forms the boundary of S in the xy-plane. **(18)**

7. (a) Find (i) $L\{\sin\sqrt{t}\}$ and (ii) $L\left\{\frac{\cos\sqrt{t}}{\sqrt{t}}\right\}$. **(15)**

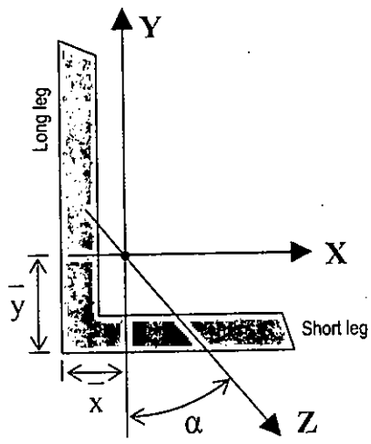
(b) Evaluate: $L^{-1}\left\{\frac{s^{-3/2}}{(s-1)}\right\}$ by using convolution theorem. **(10)**

(c) Evaluate: $L^{-1}\left\{\frac{(s+1)e^{-\pi s}}{s^2+s+1}\right\}$. **(10)**

8. Solve the following ordinary differential equations using Laplace transform

(a) $Y''(t) - 3Y'(t) + 2Y(t) = 4e^{2t}$, $Y(0) = -3$, $Y'(0) = 5$. **(17)**

(b) $tY''(t) + 2Y'(t) + tY(t) = 0$, $Y(0+) = 1$, $Y(\pi) = 0$. **(18)**



Angles (L Section)

Properties

Designation	Area (A)	Axis 'X-X'			Axis 'Y-Y'			Axis 'Z-Z'	
		I	r	$\bar{y}$	I	r	$\bar{x}$	r	tan α
inch	$inch^2$	$inch^4$	inch	inch	$inch^4$	inch	inch	inch	
L 7×4×$\frac{3}{4}$	7.69	37.8	2.22	2.51	9.05	1.09	1.01	0.860	0.324
L 7×4×$\frac{5}{8}$	6.48	32.4	2.24	2.46	7.84	1.10	0.963	0.865	0.329
L 7×4×$\frac{1}{2}$	5.25	26.7	2.25	2.42	6.53	1.11	0.917	0.872	0.335
L 7×4×$\frac{3}{8}$	3.98	20.6	2.27	2.37	5.10	1.13	0.870	0.880	0.340
L 6×6×1	11.0	35.5	1.80	1.86	35.5	1.80	1.86	1.17	1.000
L 6×6×$\frac{7}{8}$	9.73	31.9	1.81	1.82	31.9	1.81	1.82	1.17	1.000
L 6×6×$\frac{3}{4}$	8.44	28.2	1.83	1.78	28.2	1.83	1.78	1.17	1.000
L 6×6×$\frac{1}{2}$	5.75	19.9	1.86	1.68	19.9	1.86	1.68	1.18	1.000
L 6×6×$\frac{3}{8}$	4.36	15.4	1.88	1.64	15.4	1.88	1.64	1.19	1.000
L 6×4×$\frac{3}{4}$	6.94	24.5	1.88	2.08	8.68	1.12	1.08	0.860	0.428
L 6×4×$\frac{5}{8}$	5.86	21.1	1.90	2.03	7.52	1.13	1.03	0.864	0.435
L 6×4×$\frac{1}{2}$	4.75	17.4	1.91	1.99	6.27	1.15	0.987	0.870	0.440
L 6×4×$\frac{3}{8}$	3.61	13.5	1.93	1.94	4.90	1.17	0.941	0.877	0.446
L 6×3$\frac{1}{2}$×$\frac{1}{2}$	4.50	16.6	1.92	2.08	4.25	0.972	0.833	0.759	0.344
L 6×3$\frac{1}{2}$×$\frac{3}{8}$	3.42	12.9	1.94	2.04	3.34	0.988	0.787	0.767	0.350
L 5×5×$\frac{7}{8}$	7.98	17.8	1.49	1.57	17.8	1.49	1.57	0.973	1.000
L 5×5×$\frac{3}{4}$	6.94	15.7	1.51	1.52	15.7	1.51	1.52	0.975	1.000
L 5×5×$\frac{5}{8}$	5.86	13.6	1.52	1.48	13.6	1.52	1.48	0.978	1.000

Contd. — P/10

Designation	Area (A)	Axis 'X-X'			Axis 'Y-Y'			Axis 'Z-Z'	
		I	r	$\bar{y}$	I	r	$\bar{x}$	r	tan α
inch	$inch^2$	$inch^4$	inch	inch	$inch^4$	inch	inch	inch	
L $5\times5\times\frac{1}{2}$	4.75	11.3	1.54	1.43	11.3	1.54	1.43	0.983	1.000
L $5\times5\times\frac{3}{8}$	3.61	8.74	1.56	1.39	8.74	1.56	1.39	0.990	1.000
L $5\times3\frac{1}{2}\times\frac{3}{4}$	5.81	13.9	1.55	1.75	5.56	0.977	0.996	0.748	0.464
L $5\times3\frac{1}{2}\times\frac{5}{8}$	4.92	12.0	1.56	1.70	4.83	0.991	0.951	0.751	0.472
L $5\times3\frac{1}{2}\times\frac{1}{2}$	4.00	9.99	1.58	1.66	4.05	1.01	0.906	0.755	0.479
L $5\times3\frac{1}{2}\times\frac{3}{8}$	3.05	7.78	1.60	1.61	3.18	1.02	0.861	0.762	0.486
L $5\times3\frac{1}{2}\times\frac{1}{4}$	2.06	5.39	1.62	1.56	2.23	1.04	0.814	0.770	0.492
L $5\times3\times\frac{5}{8}$	4.61	11.4	1.57	1.80	3.06	0.815	0.796	0.644	0.349
L $5\times3\times\frac{1}{2}$	3.75	9.45	1.59	1.75	2.58	0.829	0.750	0.648	0.357
L $5\times3\times\frac{3}{8}$	2.86	7.37	1.61	1.70	2.04	0.845	0.704	0.654	0.364
L $5\times3\times\frac{1}{4}$	1.94	5.11	1.62	1.66	1.44	0.861	0.657	0.663	0.371
L $4\times4\times\frac{3}{4}$	5.44	7.67	1.19	1.27	7.67	1.19	1.27	0.778	1.000
L $4\times4\times\frac{5}{8}$	4.61	6.66	1.20	1.23	6.66	1.20	1.23	0.779	1.000
L $4\times4\times\frac{1}{2}$	3.75	5.56	1.22	1.18	5.56	1.22	1.18	0.782	1.000
L $4\times4\times\frac{3}{8}$	2.86	4.36	1.23	1.14	4.36	1.23	1.14	0.788	1.000
L $4\times4\times\frac{1}{4}$	1.94	3.04	1.25	1.09	3.04	1.25	1.09	0.795	1.000
L $4\times3\frac{1}{2}\times\frac{1}{2}$	3.50	5.32	1.23	1.25	3.79	1.04	1.00	0.722	0.750
L $4\times3\frac{1}{2}\times\frac{3}{8}$	2.67	4.18	1.25	1.21	2.95	1.06	0.955	0.727	0.755
L $4\times3\frac{1}{2}\times\frac{1}{4}$	1.81	2.91	1.27	1.16	2.09	1.07	0.909	0.734	0.759
L $4\times3\times\frac{1}{2}$	3.25	5.05	1.25	1.33	2.42	0.864	0.827	0.639	0.543
L $4\times3\times\frac{3}{8}$	2.48	3.96	1.26	1.28	1.92	0.879	0.782	0.644	0.551
L $4\times3\times\frac{1}{4}$	1.69	2.77	1.28	1.24	1.36	0.896	0.736	0.651	0.558
L $3\frac{1}{2}\times3\times\frac{1}{2}$	3.00	3.45	1.07	1.13	2.33	0.881	0.875	0.621	0.714
L $3\frac{1}{2}\times3\times\frac{3}{8}$	2.30	2.72	1.09	1.08	1.85	0.897	0.830	0.625	0.721

Contd. — P/11

Designation	Area (A)	Axis 'X-X'			Axis 'Y-Y'			Axis 'Z-Z'	
		I	r	$\bar{y}$	I	r	$\bar{x}$	r	tan α
inch	$inch^2$	$inch^4$	inch	inch	$inch^4$	inch	inch	inch	
L $3\frac{1}{2}\times3\times\frac{1}{4}$	1.56	1.91	1.11	1.04	1.30	0.914	0.785	0.631	0.727
L $3\times3\times\frac{1}{2}$	2.75	2.22	0.898	0.932	2.22	0.898	0.932	0.584	1.000
L $3\times3\times\frac{3}{8}$	2.11	1.76	0.913	0.888	1.76	0.913	0.888	0.587	1.000
L $3\times3\times\frac{1}{4}$	1.44	1.24	0.930	0.842	1.24	0.930	0.842	0.592	1.000
L $3\times2\frac{1}{2}\times\frac{1}{2}$	2.50	2.08	0.913	1.00	1.30	0.722	0.750	0.520	0.667
L $3\times2\frac{1}{2}\times\frac{3}{8}$	1.92	1.66	0.928	0.956	1.04	0.736	0.706	0.522	0.676
L $3\times2\frac{1}{2}\times\frac{1}{4}$	1.31	1.17	0.945	0.911	0.743	0.753	0.661	0.528	0.684
L $3\times2\times\frac{1}{2}$	2.25	1.92	0.924	1.08	0.672	0.546	0.583	0.428	0.414
L $3\times2\times\frac{3}{8}$	1.73	1.53	0.940	1.04	0.543	0.559	0.539	0.430	0.428
L $3\times2\times\frac{1}{4}$	1.19	1.09	0.957	0.993	0.392	0.574	0.493	0.435	0.440
L $3\times2\times\frac{3}{16}$	0.902	0.842	0.966	0.970	0.307	0.583	0.470	0.439	0.446
L $2\times2\times\frac{3}{8}$	1.36	0.479	0.594	0.636	0.479	0.594	0.636	0.389	1.000
L $2\times2\times\frac{1}{4}$	0.938	0.348	0.609	0.592	0.348	0.609	0.592	0.391	1.000
L $2\times2\times\frac{3}{16}$	0.715	0.272	0.617	0.569	0.272	0.617	0.569	0.394	1.000
L $2\times2\times\frac{1}{8}$	0.484	0.190	0.626	0.546	0.190	0.626	0.546	0.398	1.000
L $1\frac{3}{4}\times1\frac{3}{4}\times\frac{1}{4}$	0.813	0.227	0.529	0.529	0.227	0.529	0.529	0.341	1.000
L $1\frac{3}{4}\times1\frac{3}{4}\times\frac{3}{16}$	0.621	0.179	0.537	0.506	0.179	0.537	0.506	0.343	1.000
L $1\frac{1}{2}\times1\frac{1}{2}\times\frac{1}{4}$	0.688	0.139	0.449	0.466	0.139	0.449	0.466	0.292	1.000
L $1\frac{1}{2}\times1\frac{1}{2}\times\frac{3}{16}$	0.527	0.110	0.457	0.444	0.110	0.457	0.444	0.293	1.000
L $1\frac{1}{4}\times1\frac{1}{4}\times\frac{1}{4}$	0.563	0.077	0.369	0.403	0.077	0.369	0.403	0.243	1.000
L $1\frac{1}{4}\times1\frac{1}{4}\times\frac{3}{16}$	0.434	0.061	0.377	0.381	0.061	0.377	0.381	0.244	1.000
L $1\frac{1}{8}\times1\frac{1}{8}\times\frac{1}{8}$	0.266	0.032	0.345	0.327	0.032	0.345	0.327	0.221	1.000
L $1\times1\times\frac{1}{8}$	0.234	0.022	0.304	0.296	0.022	0.304	0.296	0.196	1.000