

SECTION – A

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

1. (a) In what situation, absorption costing will result higher net income than variable costing? Why? (4 ⅓)

- (b) For the income year ended on December 31, 2013; you have been given the information below: (19)

<u>Particulars</u>	<u>Amount (Tk.)</u>
Selling price per unit	50
Manufacturing costs:	
Direct material cost per unit	8
Direct labour cost per unit	7
Variable manufacturing cost per unit	5
Fixed manufacturing cost for the period (Total)	100,000
Selling and Administrative costs:	
Variable cost per unit	2
Fixed cost for the period (Total)	80,000

During the year, a total of 10,000 units produced but only 8500 units sold.

Requirements:

- (i) Determine the unit product cost under absorption costing and variable costing techniques.
 - (ii) Prepare income statement under both of the techniques.
 - (iii) Reconcile the amount of net income under these two techniques.
2. Crown Creative Inc. makes high quality Personal Digital Assistant (PDA). Sales and production data relating to the most recent year are given below: (23 ⅓)

Sales (in units)	2800
Selling price per unit (Tk.)	265
Contribution margin ratio	60%
Annual fixed costs (Tk.)	111,300

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Contd... Q. No. 2

Management is anxious to improve the company's profit performance and has asked for several items of information.

Requirements:

- (a) Compute break-even-point in units and sales Taka.
- (b) Assume that sales increases by Tk. 60,000 next year. If cost behaviour patterns remain unchanged, by how much will the company's net income increases?
- (c) Refer to the original data. Assume that next year management wants to earn a Tk. 182,850 profit. How many units will have to be sold to meet this target profit?
- (d) Refer to the original data. The sales manager is convinced that a 15% reduction in the selling price combined with a Tk. 56,100 increase in advertising expenditure would cause annual sales in units to increase by 40%. Would you recommend that the company should do as the sales manager suggests?
- (e) Refer to the original data. Compute margin of safety both in Tk. and percentage form.
- (f)
 - (i) Compute degree of operating leverage at the present level of sales.
 - (ii) Assume that the company like to increase its net profit by 90% next year. By what percentage would you expect sales to increase? Use DOL to answer.
 - (iii) Verify your answer to (ii) by preparing income statement.

3. (a) Name the three types of inventories that appear on a manufacturer's balance sheet. Define each of them with an example. (5 1/3)

- (b) Various cost data and sales data for Stratford Company for the just ended year are as follows: (18)

<u>Particulars</u>	<u>Tk.</u>
Selling expenses	110,000
Rent for show room	30,000
Beginning raw materials	90,000
Ending raw materials	60,000
Plant utilities	36,000
Direct labour	300,000
Depreciation, plant equipment	162,000
Purchase of raw materials	750,000
Sales	30,00,000
Insurance for factory	40,000
Indirect labour	150,000

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Maintenance for plant equipment	87,000
Legal fees	50,000
Directors fees	1,30,000
General expenses	40,000
Advertisement expenses	45,000
Sales managers' 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 ($\frac{2}{3}$ for factory, $\frac{1}{3}$ for office)	120,000
Gas and Water, factory	2,500
Carriage outwards	6,000
Carriage inwards	7,000

Requirements:

- Prepare a cost of goods sold statement
- Prepare an Income Statement.

4. (a) What is the major disadvantage of high and low point method? (2 $\frac{1}{3}$)

(b) The data below have been taken from the cost records of Atlanta Processing Company. The data relate to the cost of operating one of the company's processing facilities at various levels of activity:

(15)

Month	Unit processed	Total cost (Tk.)
January	8000	14,000
February	4500	10,000
March	7000	12,500
April	9000	15,500
May	3750	10,000
June	6000	12,500

Requirements:

- Using the high-low point method, determine the cost formula for processing cost of the company.

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Contd... Q. No. 4(b)

- (ii) What will be the total processing cost, if the company processed 3000 units during the month of July (use the cost formula you derived above).
- (c) Haaki Shop Inc., is a large retailer of water sports equipment. An income statement for the company's surfboard department for the most recent quarter is presented below:

(6)

Sales		Tk 800,000
Less: Cost of goods sold		300,000
Gross profit		<u>500,000</u>
Less: Operating expenses		
Selling expenses	Tk 250,000	
Administrative expenses	160,000	410,000
Net income		<u>90,000</u>

The surfboards sell for Tk. 400 each. The departments' variable selling expenses are Tk. 50 per surfboard sold. The remaining selling expenses are fixed. The administrative expenses are 25% variable and 75% fixed. The company purchases its surfboards from a supplier at a cost of Tk. 150 per surfboard.

SECTION – B

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

5. (a) What are the different types of financial statements that are usually published in the annual report?

(5 $\frac{1}{3}$)

- (b) Mr. Shamim started his business "Shamim Enterprise" on July 1, 2014. During his first month of operation he had the following transaction in July:

(18)

- July 1: Started his business investing Tk. 960,000 cash and an equipment of Tk. 60,000
- July 2: Paid office rent in advance for next two months Tk. 60,000 in cash.
- July 4: Purchase supplies on credit Tk. 10,000.
- July 6: Provide services and billed the client for Tk. 500,000.
- July 8: Purchase a car for office purpose for Tk. 1000,000. Paid Tk. 300,000 in cash and signed a notes payable for the remaining amount.
- July 9: Provide services to the client and received Tk. 500,000 in cash.
- July 12: Payment of notes payable Tk. 300,000 in cash related to transaction July 8.

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Contd... Q. No. 5(b)

- July 15: Made an additional investment by Mr. Shamim for Tk. 400,000 in cash.
July 20: Owner withdrew Tk. 70,000 in cash from business for his personal needs.
July 22: Paid utility Tk. 10,000 on cash.
July 25: Paid salary for the employees Tk. 20,000 in cash.
July 28: Received Tk. 100,000 in cash from the clients related to transaction July 6.

Required:

- (i) Prepare a tabular summary for the month of July.
(ii) Also prepare an income statement for the month.

6. (a) What are the advantages of using a journal in the recording process? (5 $\frac{1}{3}$)

(b) Mr. "X" started a bakery shop. It has the following events for August, 2013: (18)

- August 1: Mr. "X" invested Tk. 1,100,000 cash in his business.
August 2: Bought some furnitures from Navana Furniture for interior decoration for Tk. 200,000 in cash.
August 5: Paid advertisement expense in cash for Tk. 40,000.
August 7: Received an electricity bill for the month Tk. 6,000 but it will not be paid until next month.
August 10: Provide services to a client for Tk. 50,000 in cash.
August 12: Hired a manager at a salary Tk. 10,000 per month.
August 15: Earned revenue for Tk. 20,000 by providing services. Tk. 10,000 is received in cash and the amount is due for next month.
August 20: Took a loan from "NCC Bank" for Tk. 500,000 in cash by signing a 3 years notes payable.
August 22: Received Tk. 10,000 in cash from the client related to transaction 15.
August 28: Mr. "X" withdrew Tk. 20,000 cash from the business.

Required:

- (i) Journalize the above transactions.
(ii) Prepare the Ledger of "Cash Account".

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7. (a) Why do we need adjusting entries?

(3 1/3)

(b) The Trial Balance of "Rangs Electronics" on June 30, 2014 is given below-

(20)

Rangs Electronics

Trial Balance

June 30, 2014

Accounts Title	Debit (Tk.)	Credit (Tk.)
Cash	26,500	
Supplies	2,500	
Prepaid insurance	30,000	
Office equipment	10,000	
Notes payable		50,000
Furniture	20,000	
Accounts payable		1,000
Unearned revenue		12,000
Capital		21,000
Drawings	500	
Service revenue		12,500
Salary expense	5,000	
Utility expense	1,000	
Interest expense	1,000	
Total	96,500	96,500

Other Information:

- Insurance policy is for 5 years.
- One third of the unearned revenue is earned at the end of the period.
- Supplies on hand at June 30, 2014 Tk. 1200.
- Service provided to the customers but not recorded amount Tk. 2,000.
- Depreciation is Tk. 500 per month.
- Interest accrued at June 30, Tk. 2,500.

Required:

- (i) Prepare necessary adjusting entries.
- (ii) Prepare an adjusted trial balance as at June 30, 2014.

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8. (a) Why may a trial balance not contain up-to-date and complete financial information? (3 1/3)
 (b) The following accounts are taken from the ledger balances of "Brothers Furniture's Ltd" on 31st December, 2013: (20)

"Brothers Furniture's Ltd"
 Trial Balance
 31 December, 2013

Accounts Title	Debit (Tk.)	Credit (Tk.)
Cash	50,000	
Equipment	35,000	
Accounts receivable	20,000	
Accounts payable		10,000
Capital		50,000
Supplies	1200	
Trademark	25,000	
Tax payable		18,200
Salary expense	9,000	
Sales salary expense	3,000	
Notes payable		12,000
Store machinery	30,000	
Unearned revenue		20,000
Sales		150,000
Cost of goods sold (COGS)	50,000	
Prepaid insurance	4,000	
Rent expense	25,000	
Utility expense	8,000	
Drawings	2000	
Long term investment	18,000	
Noncurrent liability		20,000
Total	280,200	280,200

Adjustments data:

- (i) Depreciation is @10% on store machinery.
- (ii) Two-thirds of the supplies were used during the period.
- (iii) 60% of rent expense is relates to office and remaining to sales.

Required:

- (i) Prepare a multiple step (classified) income statement for the year ended December, 2013.
- (ii) Prepare an owners' equity statement and a classified balance sheet at 31 December, 2013.

SECTION – A

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

Symbols used have their usual meaning.

1. (a) If a , b and c are the lengths of the opposite sides respectively to the angles A , B and C of a triangle ABC , then prove by vector method that $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$. (15)
 (b) If \mathbf{a} , \mathbf{b} , \mathbf{c} are the position vectors of the non-collinear points A , B , C respectively in space, show that $\mathbf{a} \times \mathbf{b} + \mathbf{b} \times \mathbf{c} + \mathbf{c} \times \mathbf{a}$ is perpendicular to the plane ABC . (10)
 (c) Show that $\nabla \times (\mathbf{A} \times \mathbf{B}) = \mathbf{A}(\nabla \cdot \mathbf{B}) - \mathbf{B}(\nabla \cdot \mathbf{A}) - (\mathbf{A} \cdot \nabla)\mathbf{B} + (\mathbf{B} \cdot \nabla)\mathbf{A}$. (10)

2. (a) If $\mathbf{r} = \mathbf{A}\cos kt + \mathbf{B}\sin kt$, where \mathbf{A} and \mathbf{B} are constant vectors and k , a constant scalar, then find $\frac{d^2\mathbf{r}}{dt^2} + k^2\mathbf{r}$. (10)
 (b) Show that acceleration of a particle along a curve is a vector in the plane of the tangent and the normal with $\frac{dv}{dt}$ and $v^2\kappa$ as its tangential and normal components respectively. (15)
 (c) Solve the vector equation $\mathbf{x} + \mathbf{x} \times \mathbf{a} = \mathbf{b}$ for the vector \mathbf{x} . (10)

3. (a) Find the angle of intersection at the point $(-3, 0, -5)$ of the spheres (10)

$$x^2 + y^2 + z^2 + 6x - 5y + 2z - 6 = 0 \text{ and } x^2 + y^2 + z^2 - 34 = 0.$$
 (b) Show that the gradient of a scalar function f is a vector along the normal to the level surface whose magnitude is the greatest rate of change of f . (15)
 (c) Find curl of \mathbf{F} where $\mathbf{F} = (x^2 - y^2 + 2xz)\mathbf{i} + (xz - xy + yz)\mathbf{j} + (z^2 + x^2)\mathbf{k}$. Also comment on the orthogonality of the vectors given by curl \mathbf{F} at the points $P(1, 2, -3)$ and $Q(2, 3, 12)$ respectively. (10)

4. (a) (i) Prove that $\mathbf{F} = (y^2 \cos x + z^3)\mathbf{i} + (2y \sin x - 4)\mathbf{j} + (3xz^2 + 2)\mathbf{k}$ is a conservative force field. (18)
 (ii) Find the scalar potential for \mathbf{F} .
 (iii) Find the work done in moving an object in this field from $(0, 1, -1)$ to $(\pi/2, -1, 2)$.
 (b) Is the vector field $\mathbf{F} = (x^3z - 2xyz)\mathbf{i} + (xy - 3x^2yz)\mathbf{j} + (yz^2 - xz)\mathbf{k}$ solenoidal? If so, find a vector function \mathbf{V} such that $\mathbf{F} = \nabla \times \mathbf{V}$. (17)

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SECTION – B

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

Symbols used have their usual meaning.

5. (a) Verify Green's theorem in the plane for $\oint_C (y - \sin x)dx + (\cos x)dy$, where C is the triangle having vertices at $(0,0)$, $\left(\frac{\pi}{2}, 0\right)$ and $\left(\frac{\pi}{2}, 1\right)$. (18)

- (b) State the divergence theorem and verify, for $\vec{F} = 2x^2y\hat{i} - y^2\hat{j} + 4xz^2\hat{k}$ taken over the region in the first octant by $y^2 + z^2 = 9$ and $x = 2$. (17)

6. (a) If $L\{F(t)\} = f(s)$, then show that $L\left\{\frac{F(t)}{t}\right\} = \int_s^\infty f(u)du$ and hence find $L\left\{\frac{e^{bt} - e^{at}}{\sqrt{\pi t^3}}\right\}$. (15)

- (b) Show that $L\left\{\left[1 + \frac{t}{h}\right]\right\} = \frac{1}{2s}\left\{1 + \coth\left(\frac{hs}{2}\right)\right\}$. (10)

- (c) Evaluate $\int_0^\infty te^{-t} \sin^3 t \, dt$. (10)

7. (a) Evaluate $L^{-1}\left\{\frac{1}{(s-2)(s+2)^2}\right\}$ by using Heaviside's expansion formula. (18)

- (b) Show that $\frac{1}{\sqrt{s-1}} = \frac{1}{s-1}\left(1 - \frac{1}{s-1}\right)\frac{1}{\sqrt{s}}$ and hence find $L^{-1}\left\{\frac{1}{\sqrt{s-1}}\right\}$. (17)

8. (a) Solve $tY''(t) + (2t+3)Y'(t) + (t+3)Y(t) = 3e^{-t}$, $Y(0) = 2$, $Y'(0) = -1$ by using Laplace transform. (17)

- (b) Evaluate: $\int_0^\infty \cos x^2 dx$ by using Laplace transform. (18)

SECTION – A

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

1. (a) Highlight the importance of Geology through a discussion of its various applications. (12)
 (b) "Geological Time takes you back on a ride to the past of the history of earth" —
 Give your comments. Briefly discuss how dating techniques are used. (14)
 (c) Give a list of various volcanic products that may be produced during a volcanic eruption. (9)
2. (a) What do you mean by principles of geological formation. Describe three principles you consider to be important. (13)
 (b) Briefly describe classification of igneous rocks based on constituent minerals. (10)
 (c) Distinguish between (answer any two): (6×2=12)
 (i) Dyke and Sill
 (ii) Basalt and Granite
 (iii) Magnitude and Intensity of earthquake
3. (a) What do you mean by sedimentary structure? Briefly describe various sedimentary structures. Provide neat sketches. (20)
 (b) Write short notes on (answer any three) (5×3=15)
 (i) Coral Reef
 (ii) Lithification
 (iii) Shale
 (iv) Caldera.
4. (a) Draw characteristic rock outcrops (showing relative age) for the following eroded land forms: (6)
 (i) Eroded plunging anticline (ii) Eroded basin
 (b) Describe how faults may be identified in the field. (12)
 (c) Present neat sketches to show glacial valley, hanging valley and cirque. (5)
 (d) Briefly describe various factors affecting sea-erosion. (12)

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SECTION – B

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

5. (a) Explain the following terms with respect to an alluvial land formation:
(i) Meandering River, (ii) Oxbow lake, (iii) Cutoff, (iv) Natural levee. (10)
(b) Write short notes on (i) Rectangular, (ii) Trellis, (iii) Radial types of drainage patterns with diagrams. (10)
(c) 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 in the river discharge as well. (15)
6. (a) 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. (20)
(b) Explain the following terms: (i) Drainage Density and (ii) Stream Frequency. With Bangladesh context, explain (with diagram) how these parameters can vary among the different regions. (15)
7. (a) What is river transportation? 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? (18)
(b) What is longitudinal bed profile of a stream? What information does it give? Show schematically the differences between a theoretical profile and an actual one for a natural river. Derive the equation of longitudinal bed profile of a stream. (17)
8. (a) Define mineral. Classify silicate and non-silicate minerals. Briefly describe any two groups of silicate minerals. (20)
(b) Write short notes on the following properties of minerals: (5×3=15)
(i) Cleavage (ii) Hardness (iii) Crystal
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SECTION – A

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

1. (a) Write the names, abbreviations, chemical formulae and percentage composition of the four mineral constituents of OPC that form during chemical reaction of calcareous and agrilaceous ingredients and describe the functions of each. Show qualitatively in a graph the compressive strength development of each mineral component with time. (20)
(b) Write in tabular form the BS and ASTM designations of various types of Portland cement. Write short notes on rapid hardening and low heat Portland cement. (15)
2. (a) Show neat sketch of a typical ferrocement section and label the components properly. Describe the specifications for each of these components as per BNBC (1993). (20)
(b) Describe and illustrate with neat sketches how ferroement can be used to repair dampness of an exterior wall. Why this ferrocement repair is expected to be more effective than usual plaster? (10+5)
3. (a) How does proper compaction of concrete affect corrosion of steel reinforcements in a reinforced concrete member? Explain with sketches. How can such corrosion be prevented? (20)
(b) Give two examples where steel sheet piles and steel piles are used for construction. Provide necessary description. What preventive measures may be adopted for corrosion control of the steel members used in such applications? (15)
4. (a) A steel sheet pile wall was designed to withstand the force of 15 ft high backfill soil at its yield strength of 40 ksi. After a few years, the steel sheet pile became corroded and its section reduced. The wall was found to deflect excessively. Why did the wall deflect so excessively although there was no change in force from the backfill soil? (15)
The landowner decided to remove the entire backfill soil in order to recover the wall back to its original vertical position. But, the wall still remained inclined with significant amount of deflection. Why? Explain with a typical stress-strain diagram of a 40 grade steel.

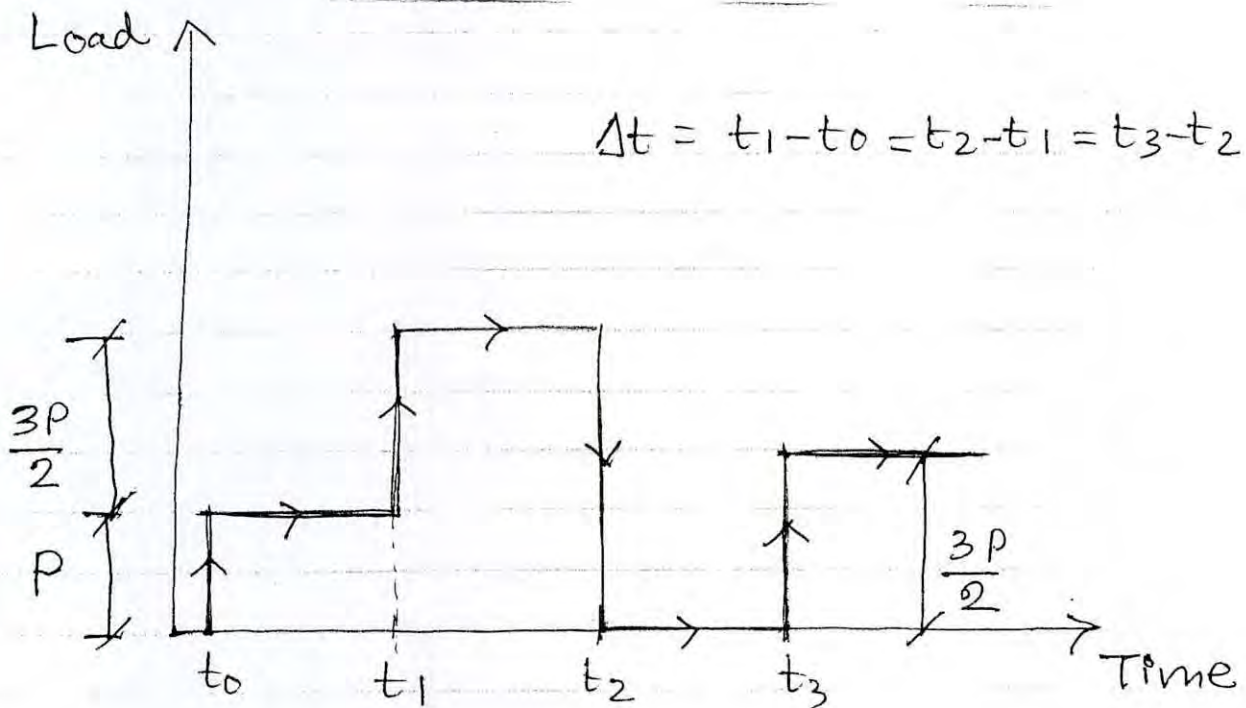
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(b) Illustrate with neat sketches how Isochronous Load-strain curves may be obtained/developed for an elasto-visco-plastic material. Explain significance of such curves.

(10)

(c) For the loading-unloading sequence given below, plot the probable response of an elasto-plastic material.

(10)



SECTION - B

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

5. (a) Write down the characteristics of good bricks. (5)
 - (b) Write short notes on FRP and CRP. (10)
 - (c) State merits and demerits of continuous kiln in brick manufacturing process. (10)
 - Mention the disadvantages of intermittent kiln. (10)
 - (d) What are the differences between plywood and fiberboard? (10)
6. (a) Design compressive strength of pile cap and pile is 4000 psi. Required slump for pile cap concrete and pile concrete is 50 – 100 mm and 150 – 200 mm respectively. If Ordinary Portland Cement is used in both cases, design the mix using volume method. Comment about the cement required in both mix. Maximum size of coarse aggregate is 38 mm and FM of fine aggregate is 2.8. Absorption capacity of fine and coarse aggregate is 1.0% and bulk specific gravity (OD basis) is 2.60. Assume any missing data. (30)
 - (b) Define bulk specific gravity and dry rodded bulk density. (5)

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7. (a) What are factors that must be considered to make durable concrete? (10)
- (b) Following masses were specified for a batch of concrete. Calculate the adjusted batch masses, w/c ratio and density of compacted concrete if air content is 3% of compacted concrete. Mixing Water: 200 kg, Cement: 400 kg, OD FA: 700 kg (site Moisture Content = 4%, absorption capacity = 1.5%, Bulk specific gravity (OD basis) = 2.55), OD CA: 1100 kg (site Moisture Content = 0.5%, adsorption capacity = 1.5%, Bulk specific gravity (OD basis) = 2.55). (25)
8. (a) "Compressive strength, water-cement ratio and workability are interrelated" — explain. (15)
- (b) Draw gradation curve of three Sylhet sand samples having same FM 2.5. (10)
- (c) Two concrete mixes, one having local river sand of FM 1.2 and other having Sylhet sand of FM 2.8. All other ingredients are same for both concrete mixes. Which mix will have more workability and 28 days compressive strength? Explain. (10)
-

Table 1: ACI recommended w/c ratio for normal strength concrete

Mean target strength		w/c ratio
psi	MPa	
6000	41	0.41
5000	34	0.48
4000	28	0.57
3000	21	0.68
2000	14	0.82

Table 2: ACI recommended dry rodded bulk volume of coarse aggregate per unit volume of concrete

max size of agg mm	FM of fine aggregate			
	2.40	2.60	2.80	3.00
9.5	0.50	0.48	0.46	0.44
12.5	0.59	0.57	0.55	0.53
19	0.66	0.64	0.62	0.60
25	0.71	0.69	0.67	0.65
37.5	0.75	0.73	0.71	0.69
50	0.78	0.76	0.74	0.72
75	0.82	0.80	0.78	0.76
150	0.87	0.85	0.83	0.81

Table 3: ACI recommended mixing water content for 1 m³ fresh concrete

Max size of aggregate (mm)	10	12.5	20	25	40	50	70	150
Slump value (mm)	Amount of mixing water in kg per 1 m ³ 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	-
Entrapped air (%)	3	2.5	2	1.5	1	0.5	0.3	0.2

Table 4: **-REQUIRED AVERAGE COMPRESSIVE STRENGTH WHEN DATA ARE NOT AVAILABLE TO ESTABLISH A STANDARD DEVIATION**

Specified compressive strength, f'_c , psi	Required average compressive strength, f_{cr} , psi
Less than 3000	$f'_c + 1000$
3000 to 5000	$f'_c + 1200$
Over 5000	$1.10f'_c + 700$

SECTION – A

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

1. A beam is loaded as shown in Fig. 1. Determine the reactions and then draw axial force, shear force and bending moment diagrams. (26 ¼)

2. A cantilever beam, 4 feet long supports a point load of 1536 lbs at 2.0 feet from the free end. It has the cross section as shown in Fig. 2. Determine shear stresses at the levels shown and plot the shear stress distribution across the depth of the section. Where does the maximum shear stress occur? Is it the neutral axis? (26 ¼)

3. A cylindrical steel pressure vessel has a wall thickness of 22 mm and internal diameter of 480 mm.
 - (a) Calculate the longitudinal and transverse (hoop) stress in the steel shell if it is subjected to an internal pressure of 7.7 MN/m^2 . (10)
 - (b) To what value may the internal pressure be raised if maximum steel stress is limited to 180 MN/m^2 ? (5)
 - (c) Determine the change in length and diameter of the vessel for the second case (case b). Given: the initial length of cylinder is 4.0 metre and $E = 200 \text{ GPa}$. (11 ¼)

4. A symmetric I-section carries distributed load of 5 kN/m and a concentrated load 'P' as shown in Fig. 3. Determine the maximum value of 'P' if maximum allowable shearing stress is limited to 15 MPa . What is the corresponding minimum shear stress in the web? (26 ¼)

5. Compute the reactions for the frame ABCDE shown in Fig. 4. Find the axial force, shear and bending moment at the two sections a-a and b-b. The first (a-a) is just left of point F and second is at mid-point of DG. Finally draw axial force, shear force and bending moment diagrams for the segment ABC. (26 ¼)

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SECTION – B

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

6. (a) Derive the elastic torsion formula for solid circular shafts. State the limitations of this formula. (10)
 (b) A 100-hp motor is driving a line shaft through gear A at 26.3 rpm (Fig. 5). Bevel gears 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. (16 ¼)

7. A rod consisting of two cylindrical portion AB and BC (as shown in Fig. 6) is restrained at both ends. Portion AB is made of steel ($E = 200 \text{ GPa}$, $\alpha = 11.7 \times 10^{-6}/^{\circ}\text{C}$) and portion BC of brass ($E = 105 \text{ GPa}$, $\alpha = 20.9 \times 10^{-6}/^{\circ}\text{C}$). Knowing that the rod is initially unstressed, determine, (26 ¼)
 (a) the normal stresses induced in portions AB and BC by a temperature rise of 50°C .
 (b) the corresponding deflection of point B.

8. (a) A force $P = 1 \text{ kN}$ is applied to a rigid bar suspended by three wires, as shown in Fig. 7. All wires are of equal size and the same material. For each wire, $A = 80 \text{ mm}^2$, $E = 200 \text{ GPa}$, and $L = 4 \text{ m}$. Knowing that the wires were initially taut, determine the tension in each wire caused by the applied load. (16 ¼)
 (b) A circle of diameter 200 mm is scribed on an unstressed 18 mm thick aluminium plate as shown in Fig. 8. Forces acting in the plane of plate later cause normal stresses $\sigma_x = 85 \text{ MPa}$ and $\sigma_z = 150 \text{ MPa}$. Determine, the change in volume of the plate. (10)
 Given: $E = 70 \text{ GPa}$, $\nu = 1/3$.

9. A rectangular beam with a circular hole is subjected to two vertical forces as shown in Fig. 9. Determine, (16 ¼)
 (a) The maximum tensile and compressive stresses in portion BC of the beam. (10)
 (b) The resultant compressive and tensile forces acting in the cross-section. Also find the moment arm of the couple.

10. (a) Determine the allowable bending moment around horizontal neutral axis for the composite beam of wood and steel plates having the cross-sectional dimensions shown in Fig. 10. Materials are fastened so that they act as a unit. $E_{st} = 30 \times 10^6 \text{ psi}$ and $E_w = 1.2 \times 10^6 \text{ psi}$. The allowable bending stresses are, $\sigma_{st} = 20 \text{ ksi}$ and $\sigma_w = 1.2 \text{ ksi}$. (16 ¼)
 (b) A thin walled cross-section in the form of a simplified air foil as shown in Fig. 11. Determine the torque it would carry at a maximum shear stress of 20 MPa. Neglect the effect of stress concentration. (10)

NO.

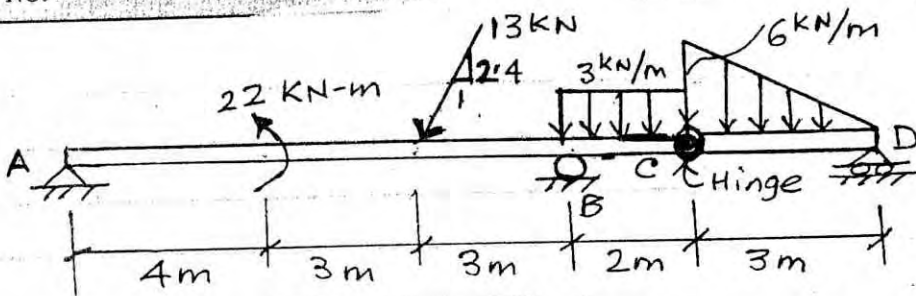


FIG. 1

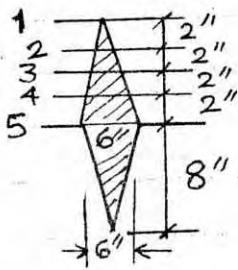
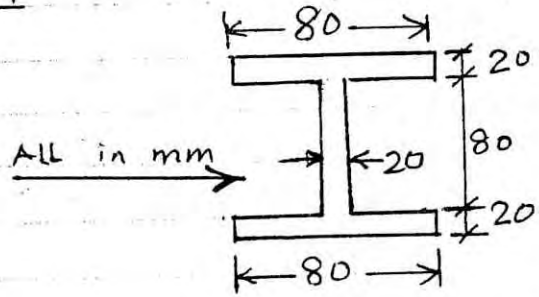


FIG. 2



SEC. X-X

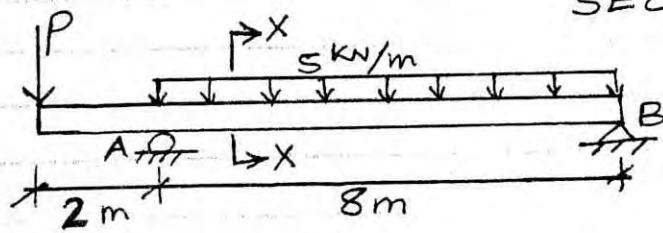


FIG. 3

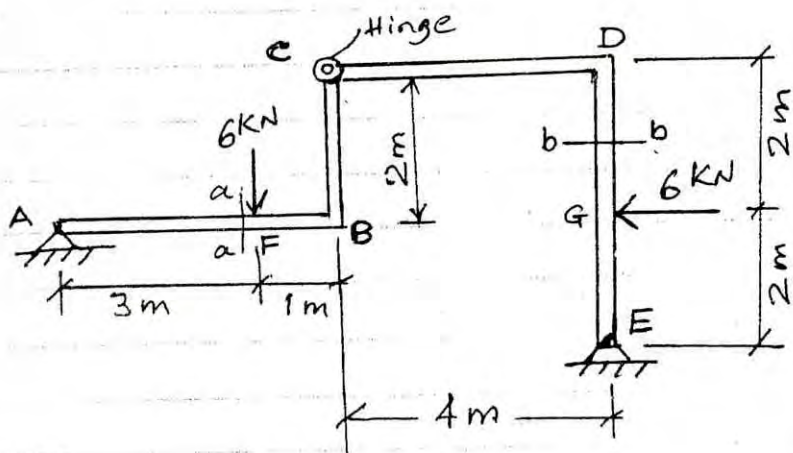


FIG. 4

= 4 =

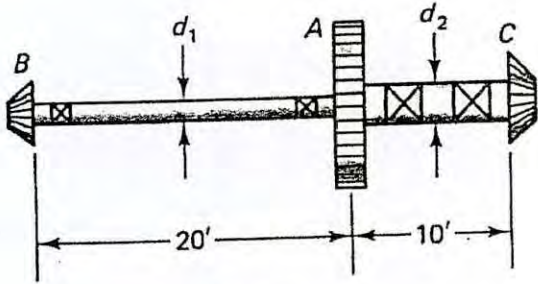


Fig. 15

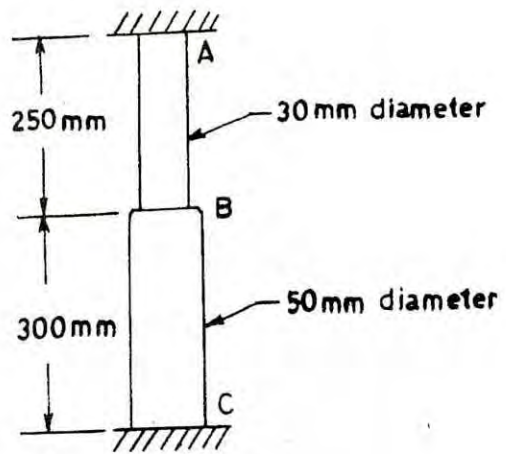


Fig. 7 b

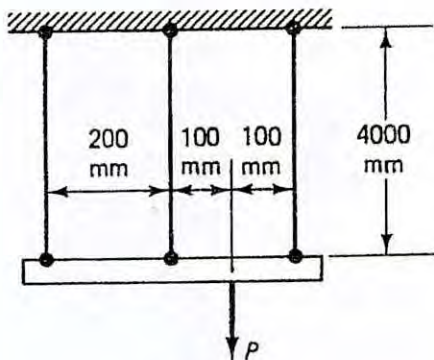


Fig. 3 7

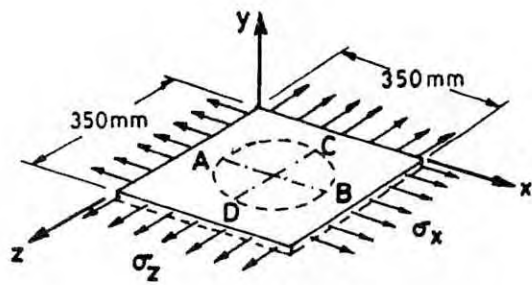


Fig. 4 8

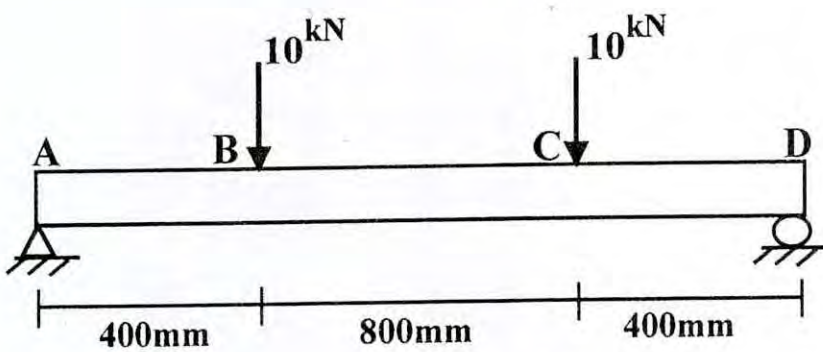


Fig. 5 9

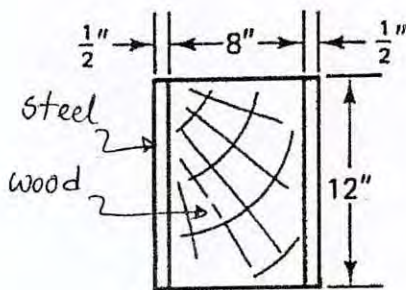
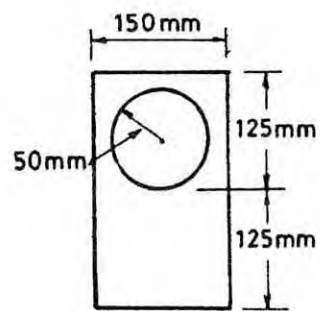


Fig. 6 10

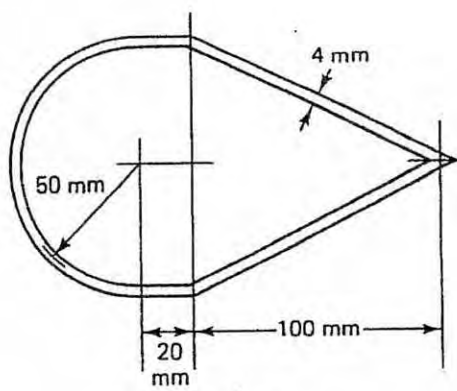


Fig. 7 11