

SECTION – A

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

1. (a) Differentiate between thin plate and thick plate. (5)
 (b) Derive the thin plate equilibrium equation. Hence find the end moments of a simply supported rectangular plate of length a and breadth b subjected to rate of loading given by (30)

$$P = P_0 \sin \frac{\pi x}{a} \sin \frac{\pi y}{b}$$

2. (a) What is equivalent steel area? Derive the bending moments and stresses of a composite bar consisting of steel and aluminum using concept of equivalent steel area. (15)
 (b) The forecastle of a destroyer is to be extended in aluminum alloy, over the midship area by the structure shown in Fig. for Q. No. 2(b). Details of the existing steel structural midship section are as follows: (20)

Depth, Keel to upper deck = 6.1 m

Neutral axis below upper deck = 3.85 m

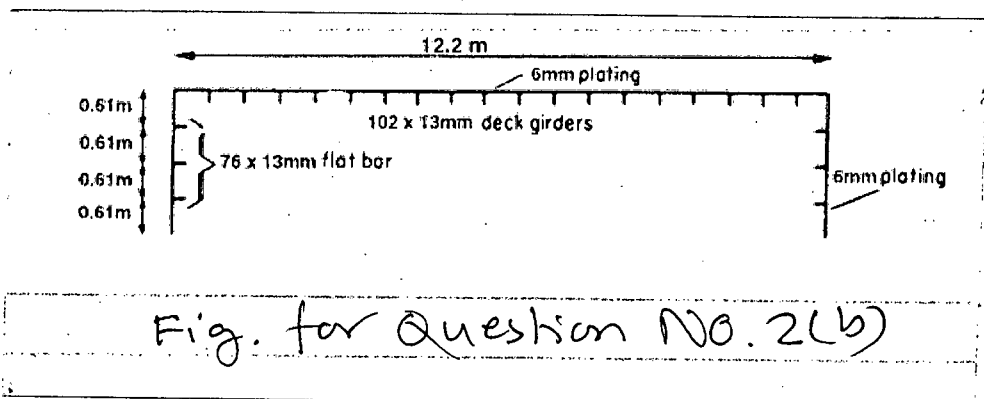
Total area of section = 4840 cm²

Second moment of area about NA = 4.85 m⁴

Calculated upper deck hogging stress = 106 MPa

Calculate the stress in the deck of the alloy extension and the new Keel stress for the same bending moment.

[$E_{st} = 207$ GPa and $E_{al} = 69$ GPa]



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3. (a) What is grillage? Find the reaction at the intersection point of a simple grillage consisting of two beams of length l_1 , and l_2 & moment of inertia I_1 and I_2 respectively. Hence explain the value of reaction when the length of a beam is very rigid and very flexible. (20)

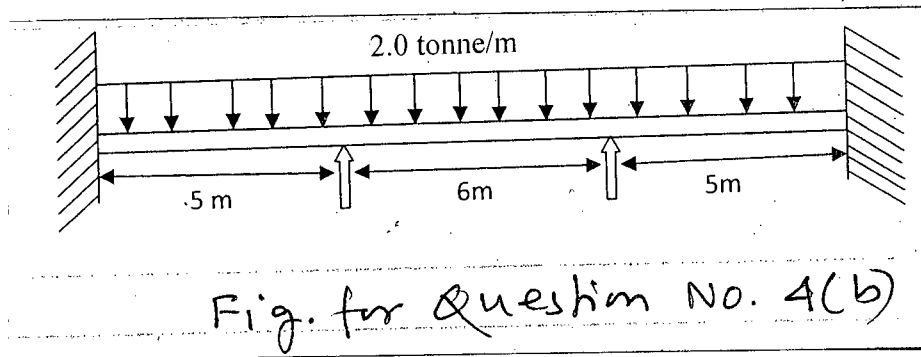
(b) What do you mean by stress concentration? Explain the following structural discontinuities of ships. (15)

- (i) Deck openings and
- (ii) End of girders and other structural members.

4. (a) What is watertight bulkhead? A bulkhead is 'l' deep from tank top to second deck and it is capable of with standing 'h' head of water above the top of the bulkhead. The stiffness are spaced 's' apart. Find the expressions for the shear force, bending moment, slope and deflections when (20)

- (i) ends are fixed and
- (ii) ends are free.

(b) A fixed ended deck beam is 16 m long between the sides of a ship. The beam is supported by two pillars at a distance 5 m from either end and shown in Fig. for Q. No. 4(b). The beam is uniform over the entire length. The beam carries uniformly distributed load of intensity 2.0 tonne/m over the full length. Find the bending moment at position of each span by moment distribution method. (15)



SECTION - B

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

Assume reasonable value for missing data if any.

5. (a) What is quasistatic load? List various slowly varying loads. (15)

(b) A rectangular barge is 80 m long and has a beam of 14 m. The weight distribution of the partially loaded barge is shown in the Fig. for Q. 5(b). The barge is floating at rest in still water. Draw the curves of loading, shearing force and bending moment. (20)

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6. (a) Describe mathematically Murray's method to calculate bending moment of ship. (10)

(b) In a calculation of the longitudinal strength for the sagging condition, the following mean ordinates in tonne/m were found for sectional lengths of a ship each 12 m long, straight from forward: (20)

Section	1	2	3	4	5	6	7	8	9	10	11
Weight	8.3	12.6	24.2	48.2	66.2	70.0	65.1	40.7	23.3	13.0	6.0
Buoyancy	24.8	40.6	39.2	33.6	28.2	30.0	39.6	48.7	47.4	36.0	9.5

Find the bending moment at amidship.

(c) State the characteristics of shearing force and bending moment curves. (5)

7. (a) Find the shear deflection of a simply supported beam with uniformly distributed load 'W' per unit length by J.L. Taylor method. Assume the beam section is rectangular of breadth 'b' and depth 'd'. (20)

(b) Discuss the general conclusion from the static tests on longitudinal strength of ships. (15)

8. (a) A wave of trochoidal form is represented by the following expression: (25)

$$r = r_0 \cos \frac{2\pi x}{L} - \frac{\pi r_0^2}{L} \left(1 - \cos \frac{\pi x}{L} \right)$$

Show that the orbit radius of subtrochoid is :

$$r_{os} = \frac{r_0 \left\{ 1 - \frac{r_0 - r_{od}}{r_0 d} (z - r) \right\}}{1 + \frac{r_0 - r_{od}}{d} \cos \frac{2\pi x}{L}}$$

State any assumptions you made.

(b) Sketch two figures to show the influence of heaving and pitching on weight and buoyancy curves. (6)

(c) Briefly describe the characteristics of Aluminium as shipbuilding material. (4)

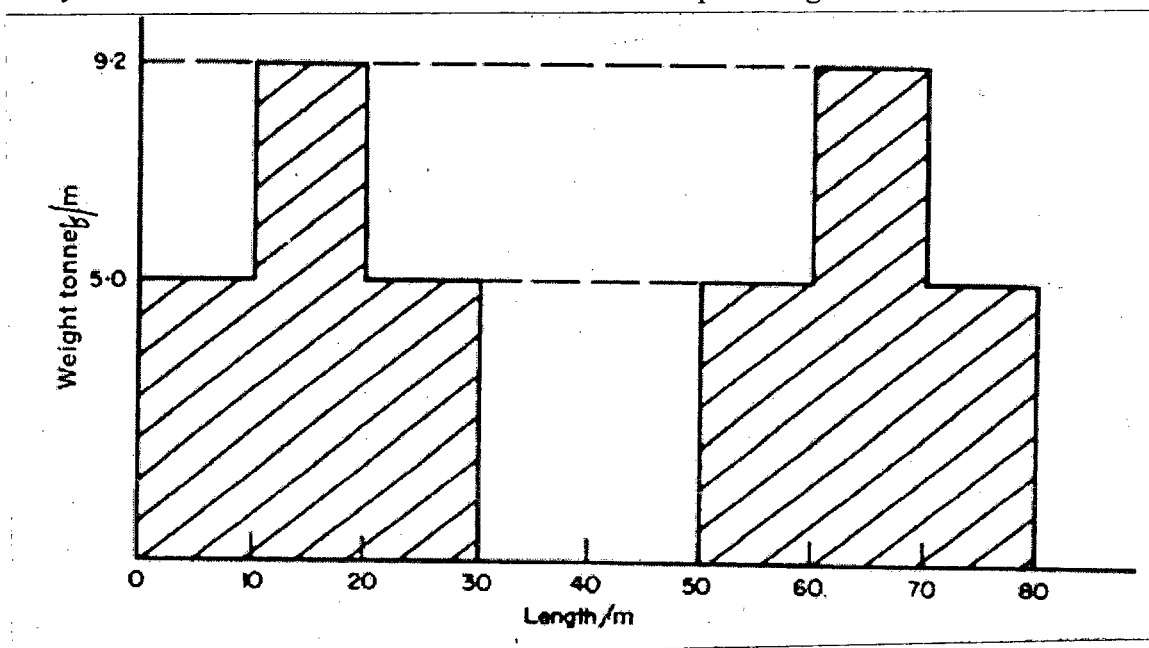


Figure for Q. No. 5(b)

SECTION – A

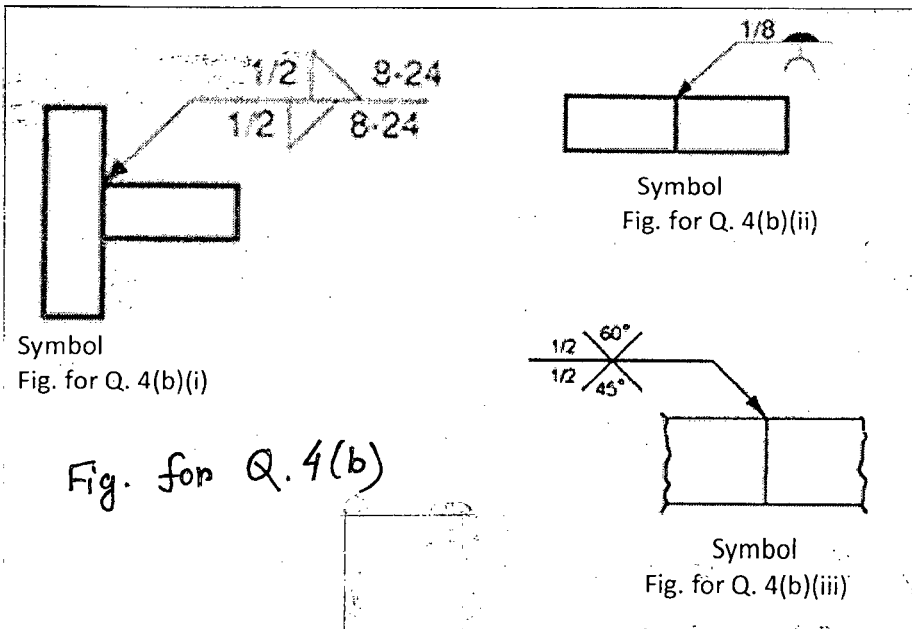
There are **FOUR** questions in this section. Answer any **THREE**.

- 1. (a) Describe the types of electrode and their selection criteria. (15)
- (b) What is Plasma Arc Cutting? Explain the working procedure of plasma cutter with system components. (15)
- (c) Differentiate between cutting and welding torch with figure. (5)

- 2. (a) Why TIG welding is used? Describe with figure the torch movement during TIG welding process. (8)
- (b) Draw GMAW component diagram. Discuss the characteristics of different types of shielding gas used in GMAW. (20)
- (c) What is special features of "Pulsed-Arc" metal transfer process in GMAW? Explain with figure. (7)

- 3. (a) Write short notes on following: (21)
 - (i) Magnetic Arc Blow
 - (ii) Electro-Slag Welding
 - (iii) Welding Defects in GTAW
- (b) What are the basic welding positions? Describe in detail how welding joint is designed. (14)

- 4. (a) How the types of current is chosen in SMAW? Explain the following symbols of electrode specification according to AWS for SMAW process: (17)
E 44044 – W
- (b) Sketch how the welds would appear as specified by the symbols in Fig. for Q. 4(b). Use a cross sectional view if needed. (18)



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SECTION – B

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

5. (a) Compare between radiographic testing and ultrasonic testing of weld.? (10)
(b) Discuss the basic principle and major steps required in ultrasonic testing. (15)
(c) Which NDT you think is the best suited for ship inspection? Give reason. (10)
6. (a) Discuss the important of underwater welding. (12)
(b) Classify underwater welding and briefly describe each type. (12)
(c) Discuss the danger and difficulties involved in underwater welding process. (11)
7. (a) Discuss different rust and scale removal processes used in ships. (12)
(b) Write short notes on oxygas cutting of (12)
(i) Mild carbon steel
(ii) Cast iron and
(iii) Thick and thin steel
(c) Discuss the characteristics and use of different oxy-acetylene welding flames. (11)
8. (a) Explain an oxy-acetylene welding system with figure. (10)
(b) Discuss the term 'backfire' and 'flashback'. (5)
(c) What are the functions of coating of electrodes and what are these made of? (10)
(d) Discuss the working principle of pressure reduction regulator. (5)
(e) What are backhand and forehand welding? (5)
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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 323** (Resistance and Propulsion of Ships)

Full Marks : 210

Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

Reasonable value can be assumed for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – AThere are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Describe different components of ship resistance. (25)
 (b) Calculate the economical speed of a ship of length 115 m and displacement 10,000 ton. (10)
2. A destroyer has length, breadth and draft of 120 m, 12.5 m and 4.2 m respectively. The displacement in salt water is 3200 tonne and the wetted surface area is 1600 m². At a speed of 34 knots the effective power is 2200 kW. If the ship model is 6.2 m long, calculate: (35)
 (i) the ratio of viscous resistance to total resistance for the ship
 (ii) the ratio of viscous resistance to total resistance for the model
 (iii) the total resistance in Newton of the model at the corresponding speed.
- Assume:
- $$C_t = C_v + C_w ; \quad C_v = C_{f0} \left[1 + 19 \left(C_B \cdot \frac{B}{L} \right) \right];$$
- $$C_{f0} = \frac{0.0075}{(\log_{10} R_n - 2)^2}$$
- $$\rho_m = 1000 \text{ kg/m}^3, \quad \rho_s = 1025 \text{ kg/m}^3$$
- $$v_m = 1.126 \times 10^{-6} \text{ m}^2/\text{s}, \quad v_s = 1.192 \times 10^{-6} \text{ m}^2/\text{s}$$
3. (a) What is Kelvin wave system? How Kelvin wave pattern illustrates and explains many of the features of the ship-wave system? (13)
 (b) Describe (P) theory. (10)
 (c) A ship has length of 125 m, breadth of 15.5 m, draft of 5.2 m, midship section coefficient of 0.93. The displacement of the ship is 6800 tonne in salt water. When the ship obtains speed of (i) 13.5 knots (ii) 15 knots and (iii) 19 knots, will the ship be considered operating in favourable condition in respect of wave-making resistance? If not, what measures should be taken to make it operating in favourable condition. (12)

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4. (a) Describe ship squat and derive its formulae. (10)
 (b) What are the factors governing ship squat? (7)
 (c) What is bulbous bow? Why it is used in ship? (8)
 (d) A supertanker is operating in open water conditions. Her breadth (mld) is 55 m, C_B is 0.84, static even keel draft is 13.2 m and forward speed is 12 knots. If the water depth is 16 m, calculate the maximum squat for this vessel by two methods and her remaining UKC at this speed. (10)

SECTION – B

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

5. (a) In a propeller of 4 m diameter and 3 m constant pitch, each blade face coincides with its defining helicoidal surface. The distance of the blade tip face from a plane normal to the axis is 260 mm, while the distance of a point on the face at the root section (radius 400 mm) from the same plane is 55 mm, both distance being measured in a plane through the propeller axis. The midpoint of the root section is 70 mm towards the leading edge from a plane through the propeller axis, while the blade tip is 1300 mm towards the trailing edge from the same plane. Determine the rake and skew angle of the propeller. (10)
 (b) In a four bladed propeller of 5 m diameter, the expanded blade widths at the different radii are as follows: (25)

r/R	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
C (mm)	1477	1658	1808	1917	1976	1959	1834	1497	0

The thickness of the blade at tip is 15 mm and at $r/R = 0.25$, it is 190 mm. The propeller boss is shaped like the frustum of a cone with a length of 900 mm, and has forward and aft diameters of 890 mm and 800 mm. The propeller has a rake of 15 degrees aft and the reference line intersects the axis at the mid length of the boss. Calculate:

- (i) the boss diameter ratio of the propeller
 (ii) the expanded blade area ratio
 (iii) the blade thickness fraction
6. (a) Describe the momentum theory of propeller action where both axial and angular acceleration to the fluid flowing through the propeller disc is considered. (20)
 (b) A propeller of diameter 4 m has an rpm of 210 when advancing into sea water at a speed of 6 m/sec. The element of the propeller at 0.7 R produces a thrust of 220 kN/m. Determine the axial and rotational inflow factors, the torque and the efficiency of the element. (15)

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7. (a) A four bladed propeller of diameter 3 m and constant pitch ratio 1.0 has a speed of advance of 4 m/s. when running at 130 r.p.m. The blade section at 0.7 R has a chord of 0.5 m, a no-lift angle of 2 degrees, a lift-drag ratio of 25 and a lift coefficient that increases at the rate of 6.0 per radian for small angle of attack. The axial and rotational inflow factors are 0.20 and 0.025 respectively. Calculate the thrust, torque and efficiency of the blade element at 0.7 R. (20)

(b) A propeller of diameter 5.5 m and pitch ratio 1.0 has its axis 4.0 m below the waterline. The propeller has a speed of advance of 7.0 m/s when running at 130 r.p.m. and produces a thrust of 500 kN. Determine the expanded blade area ratio of the propeller using the Burnill criteria for merchant ship propellers. The Burnill criteria for the merchant ship propeller is represented quite accurately by the following equation. (15)

$$\tau_c = 0.0321 + 0.3886 \sigma_{0.7R} - 0.1984 \sigma_{0.7R}^2 + 0.0501 \sigma_{0.7R}^3$$

8. (a) A three bladed propeller of diameter 3 m has a thrust of 350 kN and a torque of 300 kN.m at 175 rpm. The thrust and torque may be assumed to be linearly distributed: (20)

$$\frac{dK_T}{dx} = K_1 \cdot x \quad \text{and} \quad \frac{dK_Q}{dx} = K_2 \cdot x$$

between the root section at $x = 0.2$ and $x = 1.0$.

Calculate the bending moments due to thrust and torque at the root section.

(b) The areas of blade section at various radii of a propeller of 3 m diameter are as follows: (15)

r/R	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Area (m ²)	.0651	.0802	.0843	.0807	.0691	.0538	.0358	.0168	0

The propeller runs at 180 rpm. The propeller is made of Manganese Bronze with a density of 8500 kg/m³. Determine the centrifugal force on the blade if the root section is at 0.2 R. If the centroid of the section is at distances of 0.15 m and 0.05 m from the line of action of the centrifugal force measured parallel and perpendicular to the propeller axis, determine the bending moments due to rake and skew.

SECTION – AThere are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What are the differences between product cost and period cost? (5)
- (b) Define the following cost concept with examples (**any two**): (4)
- (i) Relevant range.
- (ii) Conversion cost.
- (iii) Committed fixed cost.
- (c) The "Red View Company" makes art print. The following details are available for the year ending 31st December, 2013. (14 $\frac{1}{3}$)

Particulars	Amount (Tk.)
Opening Stock:	
Direct material	26,000
Work-in-process	74,000
Finished goods	120,000
Direct material purchased	436,000
Direct labor	12,000
Indirect labor	44,000
Administrative expense	160,000
Depreciation on factory building	70,000
Selling expense	140,000
Factory power, heat and light	20,000
Sales manager's salary	10,000
Building rent (factory uses 70% of spaces, administration and sales uses the rest)	50,000
Sales promotion	10,000
Sales	150,000
Utility, factory	5,000
Closing Stock:	
Direct material	42,000
Work-in-process	54,000
Finished goods	80,000

Required:

- (i) Prepare a cost of goods sold statement.
- (ii) Prepare an income statement.

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2. (a) What is meant by product's CM ratio? How is this ratio helpful in planning business operations? (3)

(b) "Quality products Company" has the following information related to cost structure and other data: (20 1/3)

Cost Data	Amount (Tk.)
Direct material	115
Direct labor	10
Variable manufacturing overhead	5
Total variable cost per unit	130
Total fixed cost	180,000
Selling price (per unit)	150
Number of units produced and sold	30,000

Required:

- (i) Calculate break-even-point in units and in amounts.
- (ii) Compute degree of operating leverage.
- (iii) Prepare a contribution margin format income statement if selling price increases by Tk. 2 per unit, fixed cost increases by Tk. 15,000 and sales volume decreases by 10%.
- (iv) Calculate break-even-point in units if selling price increase by 10% and variable cost increases by 20%.
- (v) Compute margin of safety in units and value. (Consider original data).
- (vi) Calculate break-even-points in units if target profit is Tk. 5000,00. (Consider original data).
- (vii) The company estimates that sales will increase by Tk. 45,000 next year due to increased demand. By how much should net operating income be increase? (Use CM ratio to calculate your answer).

3. (a) Differentiate between variable costing and absorption costing method. (3)

(b) Explain the criteria for allocating indirect cost to the cost object. (4)

(c) Following data relates to a Manufacturing Company (16 1/3)

Variable cost per unit:	
Direct materials	Tk.2
Direct labor	Tk.4
Variable manufacturing overhead	Tk.1
Variable selling and administrative expenses	Tk.3
Fixed cost per year:	
Fixed manufacturing overhead	Tk.30,000
Fixed selling and administrative expenses	Tk.10,000
Units in beginning inventory	0
Units produced	6,000
Units sold	5,000
Selling price per unit	Tk.20

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Contd ... Q. No. 3(c)

Required:

- (i) Calculate the product cost per unit under absorption costing system and variable costing system.
- (ii) Prepare income statement using under absorption costing system and variable costing system.
- (iii) Reconcile the amount of profits under two costing systems.

4. (a) Write down the methods of mixed cost analysis. (5)

(b) The Lakeshore Hotels guest-days and custodial supplies expenses over the last seven months were as follows: (5)

Month	Guest-days occupancy	Custodial supplies expenses
March	4,000	7,500
April	6,500	8,250
May	8,000	10,500
June	10,500	12,000
July	12,000	13,500
August	9,000	10,750
September	7,500	9,750

Guest day is a measure of the overall activity of the hotel.

Required: Use High low method to estimate a cost formula for custodial supplies expense.

(c) Berger Company has two supports departments – Administrative services (AS) and Information Systems (IS) and two operating departments – Government Consulting (GOVT) and Corporate Consulting (CORP). For the first quarter of 2015, the following records are available-

(13 1/3)

Berger Company
for the first quarter, 2015

Budgeted overhead before allocation	Support Dept.		Operating Dept.		Total
	AS	IS	GOVT	CORP	
	600,000	24,00,000	87,56,000	124,52,000	
Support work supplied by AS	-	25%	40%	35%	100%
Support work supplied by IS	10%	-	30%	60%	100%

Required:

Allocate two supports departmental cost to the two operating department by using-

- (i) Direct method
- (ii) Step-down method

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SECTION – B

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

5. (a) What do you mean by double entry system? (3 1/3)

(b) Desire Clark is a licensed Certified Public Accountant (CPA) during the first month of operations of her business, the following events and transactions occurred (20)

- May 1 Clark invested \$20,000 cash in her business
- May 2 Hired a secretary-receptionist at a salary of \$2,000 per month
- May 3 Purchased \$2,500 of supplies on account from Read Supply Company
- May 7 Paid office rent of \$900 cash for the month
- May 11 Completed a tax assignment and billed client \$3,200 for services provided
- May 12 Received \$3,500 advance on a management consulting engagement
- May 17 Received cash of \$1,200 for services completed for C. Desmond Co.
- May 31 Paid secretary-receptionist \$2,000 salary for the month
- May 31 Paid 60% of balance due Read Supply Company

Desire Clark uses the following accounts: Cash, Accounts Receivable, Supplies, Accounts Payable, Unearned Service Revenue, Owner's Capital, Service Revenue, Salaries and Wages Expense, and Rent Expense.

Requirements:

- (i) Journalize the transactions
- (ii) Post to the ledger accounts.
- (iii) Prepare a trial balance on May 31, 2015

6. Ramona Castro opened a veterinary business in Nashville, Tennessee, on August 1. On August 31, the balance sheet showed Cash \$9,000, Accounts Receivable \$1,700, Supplies \$600, Equipment \$6,000, Accounts Payable \$3,600, and Owner's Capital \$13,700.

During September, the following transactions occurred: (23 1/3)

- (i) Paid \$2,900 cash on accounts payable.
- (ii) Collected \$1,300 of accounts receivable.
- (iii) Purchased additional office equipment for \$2,100, paying \$800 in cash and the balance on account.
- (iv) Earned revenue of \$7,800, of which \$2,500 is received in cash and the balance is due in October.
- (v) Withdrew \$1,100 cash for personal use.
- (vi) Paid salaries \$1,700, rent for September \$900, and advertising expense \$450.
- (vii) Incurred utilities expense for month on account \$170.
- (viii) Received \$10,000 from Capital Bank (money borrowed on a note payable).

Requirements:

- (i) Prepare a tabular analysis of the September transactions beginning with August 31 balances. The column heading should be as follows: Cash, Accounts Receivable, Supplies, Equipment, Notes Payable, Accounts Payable, Owner's Capital, Owner's Drawings, Revenues, Expenses.
- (ii) Prepare an income statement for the month of September 30.

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7. Tony Masasi started his own consulting firm, McGee Company, on June 1, 2012. The trial balance on June 30 is shown below:

(23 1/3)

McGee Company
Trial Balance
June 30, 2012

Accounts	Debit (Tk)	Credit (Tk)
Cash	8000	
Accounts Receivable	6000	
Supplies	2000	
Prepaid Insurance	3000	
Equipment	15000	
Accounts Payable		4500
Unearned Service Revenue		4000
Owner's Capital		22600
Service Revenue		7900
Salaries and Wages Expense	4000	
Rent Expense	<u>1000</u>	
Total	<u>39000</u>	<u>39000</u>

In addition to those accounts listed on the trial balance, the chart of accounts for McGee Company also contains the following accounts: Accumulated Depreciation – Equipment, Salaries and Wages Payable, Supplies Expense, Depreciation Expense, Insurance Expense, and Utilities Expense.

Other Data:

- Supplies on hand on June 30 are Tk 750.
- A utility bill for Tk 150 has not been recorded and will not be paid until next month.
- The insurance policy is for a year.
- Tk 2,800 of unearned service revenue has been earned at the end of the month.
- Salaries of Tk 1,900 are accrued on June 30.
- The equipment has a 5-year life with no salvage value. It is being depreciated at Tk 250 per month for 60 months.
- Invoices representing Tk 1,200 of service performed during the month have not been recorded as on June 30.

Requirements:

- (i) Prepare the adjusting entries for the month of June.
- (ii) Post the adjusting entries to the ledger accounts (Use T-account). Enter the totals from the trial balance as beginning account balances.
- (iii) Prepare an adjusted trial balance on June 30, 2012.

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8. Following is the trial balance of Cadbury Company Ltd.

(23 1/3)

Cadbury Company Ltd.
Trial Balance
31st December, 2105

Accounts Name	Debit (Tk)	Credit (Tk)
Cash	40000	
Accounts Receivable	20500	
Accounts Payable		21000
Owner's Equity		100800
Office Equipment	25000	
Service Revenue		30000
Salary	12000	
Prepaid Rent	4000	
Miscellaneous Expense	1000	
Commission Expense	3000	
Supplies	700	
Notes Payable		6400
Drawings	2000	
Trade Mark	20000	
Building	150000	
Long Term Investment	50000	
Bond Payable		155000
Interest Payable		15000
Total	<u>328200</u>	<u>328200</u>

Adjustments:

- Salary were unpaid Tk 3000 during the period 2015
- Annual Depreciation rate on Equipment is 10%
- Supplies on hand on 31 December Tk 300
- Prepaid Rent were expired Tk 1000

Requirement:

- (i) Prepare Income Statements
- (ii) Prepare Owners Equity Statements
- (iii) Prepare a Classified Balance Sheet on 31 December 2015

The figures in the margin indicate full marks.

The symbols have their usual meanings.

In case of missing data, assume any reasonable values.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. Evaluate the stiffness matrix for the element shown in Fig. for Q. No. 1. The coordinates are in units of inches. Assume plane stress conditions. Let $E = 30 \times 10^6$ psi, $\nu = 0.25$ and thickness $t = 1$ in. (35)

For the element, the nodal displacements are given as:

$$\begin{array}{lll} u_1 = 0.0 \text{ in.}, & v_1 = 0.0025 \text{ in.}, & u_2 = 0.0012 \text{ in.}, \\ v_2 = 0.0 \text{ in.}, & u_3 = 0.0 \text{ in.}, \text{ and} & v_3 = 0.0025 \text{ in.} \end{array}$$

Determine the element stresses σ_x , σ_y and τ_{xy} .

2. (a) A uniformly varying normal pressure is applied on an edge of a CST element as shown in Fig. for Q. No. 2(a). Derive the expression of load vector. (20)

(b) Determine the shape functions of a quadrilateral plane stress element in ξ, η space. Derive the expression of Jacobian matrix of the element. (15)

3. For the beam shown in Fig. for Q. No. 3, determine (35)

- (i) Geometric information
- (ii) Element connectivity table
- (iii) Boundary conditions in terms of degree of freedom
- (iv) Global load vector
- (v) Element stiffness matrices
- (vi) Global stiffness matrix
- (vii) Nodal slope and deflections.

4. (a) For a tetrahedral element, (25)

(i) Write the shape functions.

(ii) Prove that $V_e = \frac{|\det \bar{J}|}{6}$.

(iii) Derive the expression of strain-displacement matrix and comment on it.

(iv) Derive the expression of element stiffness matrix.

(v) Derive the expression for element body force vector.

(b) Derive the expression of transformation matrix for a plane frame element. (10)

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SECTION – B

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

5. (a) When there are several FEM tools available in the market, is there any need for the Engineers to study this method? Justify your answer regarding its impact on Engineering decision. (15)
- (b) List the desirable features of FEA packages. (10)
- (c) Explain how multipoint constraints are handled in Finite Element Method. (10)
6. (a) State and explain the principle of minimum potential energy. (10)
- (b) Discuss 'plane stress' and 'plane strain' with examples. (12)
- (c) In a plane strain problem, (13)
- $\sigma_x = 20000$ psi
- $\sigma_y = -10000$ psi
- $E = 30 \times 10^6$ psi
- $\nu = 0.3$
- Determine the value of the stress σ_z .
7. (a) What do you mean by 'isoparametric formulation'? State the conditions which must be satisfied by shape functions. (10)
- (b) Derive the expression of the transformation matrix for plane trusses and hence describe how to find out the element stiffness matrix in the global co-ordinate system. (25)
8. (a) Distinguish between linear and quadratic shape function. (7)
- (b) A load $P = 60 \times 10^3$ N is applied as shown in Fig. for Q. No. 8(b). Determine the displacement field, stress and support reactions in the body. Take $E = 20 \times 10^3$ N/mm². (28)
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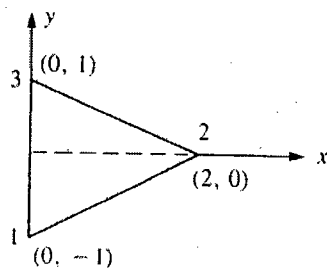


Figure for Q. No. 1

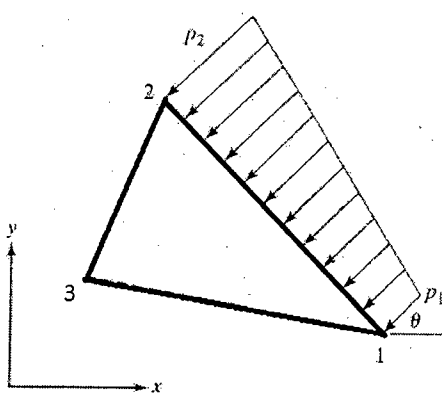


Figure for Q. No. 2(a)

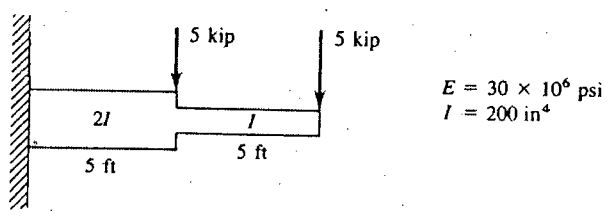


Figure for Q. No. 3

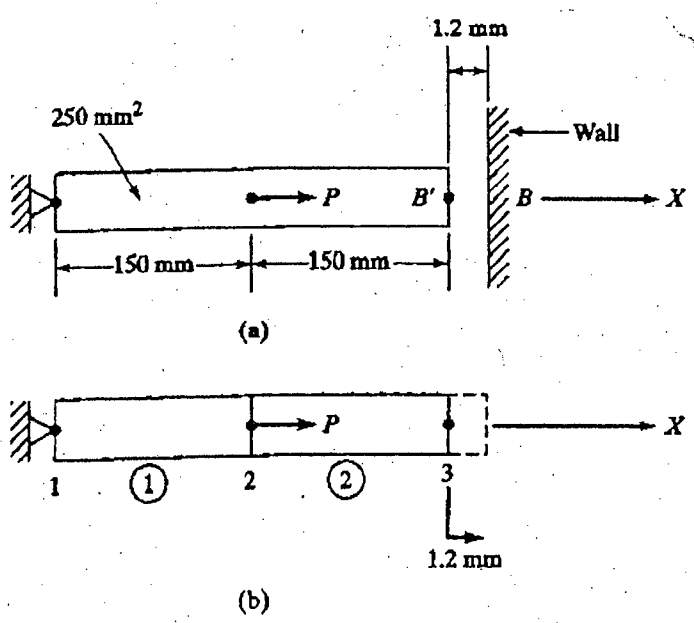


Fig. for Q. No. 8(b)

SECTION – A

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

1. (a) What is marine environment? What are the major sources of pollution in the marine environment? (10)
- (b) What is a contaminant? Is there any difference between a contaminant and a pollutant? (12)
- (c) What are the major ways that land-based pollutants enter the marine environment? (7)
- (d) Can objects in the water cause pollution? (6)

2. (a) Why is marine debris so abundant? Where does marine debris come from? (10)
- (b) Why does debris accumulated in large patches in the middle of the ocean? (12)
- (c) Can marine debris harm people? (5)
- (d) What are the major constituents of debris? (8)

3. (a) What problems are happening or expected to happen in the marine environment because of climate change? (12)
- (b) Why is sea level rising faster than was predicted? (5)
- (c) What is ocean acidification? What effects are produced by ocean acidification? (13)
- (d) What economic effects could result from ocean acidification? (5)

4. (a) What is ocean Health Index? (10)
- (b) What is the London Convention? (10)
- (c) What actions can individual citizens take to reduce marine pollution? (15)

SECTION – B

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

5. (a) In recent times, a number of oil spill incidents occurred within the water routes through the Sundarbans. Discuss how a contingency plan can be applied to mitigate the environmental disasters in the Sundarbans following this type of incidents. (15)
- (b) Discuss the effect of oil pollution on 'Mangroves'. (10)
- (c) Write a short not on 'MARPOL 73/78 Convention'. (10)

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6. (a) Describe the important aspects for the followings: **(15)**
 (i) International convention on oil pollution preparedness, response and co-operation, 1990.
 (ii) International convention on civil liability for oil pollution damage, 1969.
(b) Briefly discuss the four stage components of a comprehensive and well-designed contingency plan for accidental oil spill at sea. **(20)**
7. (a) What are 'dispersants'? Discuss dispersants' classification. **(10)**
(b) With a neat sketch describe the chemical dispersion process. **(15)**
(c) Explain why environmental impact of dispersants need to be taken into consideration before taking decision to apply it. **(10)**
8. (a) What are the objectives of monitoring programmes following a spill of oil at river or, sea? **(10)**
(b) Explain the working principle of 'Weir Skimmer'. **(7)**
(c) Why booms are used after oil spill at sea or, river? With neat sketches discuss the failure modes of booms. **(10)**
(d) Write a short note on 'Effect of oil pollution on social and economic activities'. **(8)**
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