L-4/T-1/NAME **Date : 01/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 415** (Marine Maintenance and Repair)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

All the symbols have their usual meanings. Assume reasonable values for missing data.

1. (a) Write a short note on plant fouling. Differentiate between self–polishing and controlled depletion polymer antifouling coatings. **(15)**

   (b) Write down the functions of a caulking tool. Classify butt welding based on the length of the seam and describe by drawing necessary figures. **(13)**

   (c) Define corrosion and erosion. How the propeller blade is affected by corrosion? **(7)**

2. (a) A ship has been brought to a dry dock and the condition of the components of the shafting has been determined by a preliminary survey. Now, it is required to dismantle shafting. Illustrate the method of dismantling along with the preparatory works to be performed before dismantling. **(10)**

   (b) List the factors on which fouling type, extent, and severity depend. Demonstrate how the severity of fouling on a ship's hull tends to be a seasonal phenomenon governed by geographical location. **(13)**

   (c) What do you understand by cavitation in a propeller? To protect the tailshaft from corrosion, which process would you recommend between a coat of stainless – steel deposition and fitting sleeves? Describe the recommended process showing necessary diagrams. **(12)**

3. (a) Discuss about sand blasting and tack welding. Using schematic diagrams formulate the mathematical expressions for measuring misalignment of shaft couplings from the perspective of simplicity and accuracy. **(15)**

   (b) A passenger vessel was suddenly sunk last week due to storm and overloading. So, it is immediately necessary to repair the vessel and the owner is interested to repair his vessel at your dry dock. The owner provides the following particulars of the vessel: **(20)**

   LOA = 75 m

   LBP = 72.5 m

   BM = 10.75 m

   Draft maximum = 3.5 m

   Displacement = 7000 tons.

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Height of boot – top = 0.4 m

Height of topside = 1.5 m

Height of bulwark = 1.0 m

Estimate:

(i) Man-hour required for berth preparation.

(ii) Man-hour required for dock services for 10 days.

(iii) Total painting area of the ship's hull.

(iv) Required weight of zinc anode and man-hour to cut off and replace.

4. (a) Suppose, you are inspecting a propeller where the position of the center of gravity is not lying on the axis of rotation. In this case, using neat sketches describe two methods to find the blade of the propeller from which metal has to be removed to make the propeller balanced. Also, choose the most effective method from these two and explain the reason behind choosing. **(15)**

(b) A ship after colliding with an iceberg has been brought to your dockyard for repair works. The types and description of damages found in the ship's hull is given below: **(20)**

(i) Damage of external shell plate of dimension 2m × 2m × 10 mm thickness with double curvature located some 10-20 m aft the ship and three in number with one below the waterline and the rest above.

(ii) Damage of the midship includes shell plate flat vertical of dimension 3 m × 2m × 10 mm thickness and two in number, one keel plate of dimension 1.5 m × 1.5m × 12 mm thickness with single curvature, and three bottom shell of dimension 2 m × 2m × 12 mm thickness with double curvature.

(iii) Damage of internal bulkhead of dimension 12 m × 12m × 7 mm thickness positioned at 14 m aft of midship.

(iv) Damage of four transverse internal T members of length 12 m each above the double bottom of dimension 80 mm × 80 mm × 7 mm thickness with double curvature.

Calculate the net amount of steel required and the amount of repair needed in terms of man-hour for removal, fairing, and re-fitting of the damaged plates, bulkheads, and members in place.

Contd P/3

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SECTION – B

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

5. (a) Explain various methods of detecting surface cracks. **(18)**

   (b) Describe the procedure for replacement of a shell plate in a welded hull. **(10)**

   (c) Define absolute wear of a specimen and wearing intensity. Discuss the preliminary operations (hull side and machinery side) which are performed before a defect survey. **(7)**

6. (a) What are the different methods of docking a ship in a dry dock and a floating dock? What are the necessary preparations? Explain with figures. **(23)**

   (b) Compare different methods of hull clearing with merits and demerits. **(12)**

7. (a) What are the causes of dents in plating? How dents are measured? How dents are rectified? Explain. **(15)**

   (b) Explain the following repair works with necessary figures: **(12)**

   (i) Elimination of leaks in shell plates.

   (ii) Repair of shell plating in the presence of cracks.

   (c) How the contact continuity tests are carried out for fixed and movable joints? **(8)**

8. (a) Describe different methods for determination of wear of machine parts. Which method would you choose and why? Explain. **(20)**

   (b) Why welding in cast iron is significantly difficult? Describe the method of measuring corrosion damage in the shell plating, double bottom, and bulkheads using necessary diagrams. **(15)**

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Tables for Question No. 3(b)

❖ Shifting of blocks after docking vessel

DWT	*Man-hours*	
	Keel block	*Side block*
< 20000	5	3
20000-100000	10	5
100000-200000	16	8
> 200000	20	12

❖ Dock services

Service	*Man-hours*	
	<100 LOA	*>100 LOA*
Fire and Safety watchman per day	8/shift	8/shift
Garbage skip per day	2	4
Electrical shore power connection and disconnection	4	5
Electrical shore power per unit	Variable	Variable
Temporary connection of fire main to ship's system	5	6
Maintaining pressure to ship's fire main per day	3	3
Sea circulating water connection	3	4
Sea circulating water per day	4	4
Telephone connection on board ship	3	3
Supply of ballast water per connection	6	8
Supply of fresh water per connection	3	5
Connection and disconnection of compressed air	3	5
Gas-free testing per test/visit and issue of gas-free certificate	8	10
Electric heating lamps per connection.	4	5
Ventilation fans and portable ducting each	5	5
Wharfage:	Variable	Variable
Cranage:	Variable	Variable

❖ Anodes on hull and in sea chests

Weight (kg)	*Man-hours*
3	1
5	1
10	1.5
20	2

[Necessary data: Constant for vessel shape, p = 0.8, numbers of years between dry docks for zinc = 3 years, for zinc anode replacements use the manufacturer supplied information: current density 20 mA/m², capacity = 781 amp-hours/kg]

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Tables for Question No. 4(b)

❖ Steel works renewals

Plate thickness (mm)	*Man-hours per tonne*
Up to 6	250
8	245
10	240
12.5	230
16	220
18	210
20	200

Correction for curvature	*Factor increase*
Single	1.2
Double	1.3

*Correction for location – **external***	*Factor increase*
Flat vertical side above 2 metres in height and requiring staging for access	1.1
Bottom shell, accessible areas (i.e., no removals of keel blocks)	1.12
Keel plate	1.4
Garboard plate	1.25
Bilge strake	1.25
Deck plating	1.15

*Correction for location – **internal***	*Factor increase*
Bulkhead	1.2
Longitudinal/transverse above DB areas	1.25
Longitudinal/transverse below DB areas	1.35

Other adjustment factors	*Man-hour adjustment*
For fairing works:	
Remove, fair and refit	80% of renewal price
Fair in place (if practicable)	50% of renewal price

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L-4/T-1/NAME **Date : 25/09/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 419** (Motion and Control)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for any missing data. Symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Define wave spectrum and energy spectrum. What are significances of them for the analysis of irregular seaways? What information can be derived from a wave spectrum? **(12)**

   (b) Explain the physical significance of m_0 and m_2. **(8)**

   (c) What are the factors determining the shape of wave spectrum? From a wave spectrum analysis, the following information are given: $m_0 = 21.564$ ft^2, $m_2 = 10.91$ ft^2/sec^2, $m^4 = 9.52$ ft^2/sec^4, total number of waves, n = 1000. Find the most probable largest wave amplitude. **(15)**

2. (a) Develop relationship among the wave spectrum at frequency of encounter, the wave spectrum at absolute frequency, ship speed, encountering frequency and heading angle. Hence, find the condition of maximum encountering frequency and discuss the results. **(15)**

   (b) A wave spectrum is defined by the following table:

Circular frequency, (ω)(1/s)	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2
Wave spectrum $S_\xi(\omega)$(m^2.s)	0.00	7.94	11.68	5.56	2.30	0.99	0.45	0.23	0.12	0.07	0.00

   Calculate the significant wave height, average wave height and mean of tenth highest waves. **(20)**

3. (a) What information may be listed in the dynamic effects with ship motions? What are the general investigations to be considered in studying the dynamic effects? **(10)**

   (b) What is threshold velocity? Develop a mathematical expression of no dimensional threshold velocity and hence show that it is dependent on Froude number. **(15)**

   (c) A ship has the following information:

   Length, L = 550 ft; Draft, T = 17.1 ft; ship speed, V = 10 knots, $m_{os} = 302.5$ft^2; $m_{o\dot{s}} = 152.5$ ft^2/sec. Sea state value is severe 7, and the wind velocity is 41 knots. Assume that the significant wave height is 35.0 ft and the threshold velocity for a ship of 520 ft is about 12 ft/sec. Predict the number of slums for this ship during a 45-minute operation. **(10)**

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4. (a) What is meant by hydrodynamic derivatives of ship maneuvering? Briefly describe. Two designs posses the following values of hydrodynamic derivatives: **(15)**

Design	Y'_v	N'_v	Y'_r	N'_r	m'
A	–0.36	–0.07	0.06	–0.07	0.12
B	–0.26	–0.10	0.01	–0.03	0.10

Comment on the straight-line motion stability of the two designs.

(b) How would you measure to improve ship maneuverability, explain from viewpoint of a ship designer? **(20)**

SECTION – B

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

5. (a) How is the group velocity of wave defined and how does it relate the phase velocity in deep and shallow water? **(10)**

(b) Show that a combination of two standing waves out of phase by $\frac{\pi}{2}$ produces a progressive wave. **(10)**

(c) (i) What is the speed and period of a deep-sea wave 305 m long?

(ii) A wave is 305 m long and 12.2 m high and the depth of water is 45.7 m. Calculate the velocity of the wave and the amplitudes of the water particles at the bottom of the channel. Compare the speed of the wave with that of a deep-sea wave of the same dimensions. **(15)**

6. (a) A barge has the following dimension L = 50 m B = 10 m d = 3 m, KG = 1 m the cross section added mass for the barge is assumed to be $a_n = 0.8\rho Bd$. Calculate: **(20)**

(i) Undamped heave period for the barge

(ii) Stiffness co-efficient C_{33}, C_{35}, C_{53} C_{44} and C_{55}.

(b) A 152.4 m long ship is moving in a regular train of waves at an angle of 40° to the wave crests. Every 15 sec the bow meets a wave crest and it takes the wave 10 sec to move from the bow to the stern. Find the ship speed in knots. **(15)**

7. (a) A ship has the following data: **(25)**

L = 500 ft, K_{yy} = 0.25 L, GM_L = 500 ft, Δ = 15,000 tons

(i) If the added mass moment of inertia is about 90% of the mass moment of inertia of the ship, find the natural pitching period.

Contd P/3

NAME 419

Contd ... Q. No. 7(a)

(ii) Find the pitching motion at t = 0 sec and exactly after 1, 2, and 3 periods, if the coefficient for the damping moment during pitching motion is known to be 2,500,000 ft-ton-sec and the initial conditions are specified as

$\theta = 5°$ and $\frac{d\theta}{dt} = 0$ at t = 0 sec.

(b) Write short notes on 'pitching periods'. **(10)**

8. (a) Given: **(20)**

Ship length L = 128 m

Beam B = 17.07 m

Draft T = 6.09 m

$C_B = C_{wp}$

Added mass = 90% of ship mass

Assuming that there is no damping:

(i) Calculate the heaving period in still water

(ii) Derive the expression for heaving oscillation in still water if the initial displacement from the equilibrium position and the velocity of the heaving motion at the instant of time t = 0 are 0 and 1.68 m/s respectively.

(iii) Calculate the maximum force exerted on the deck of a ship by a winch that weighs 4 MT.

(b) A what heading angle against the waves, the largest rolling is expected, if a ship with a natural roll period of 15 sec is sailing with a speed of 35 knots and length of waves is 274.3 m. **(10)**

(c) How rolling motion in a seaway can be reduced? Briefly explain. **(5)**

L-4/T-1/NAME **Date : 26/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 439** (Ship Vibration)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Symbols have their usual meaning

1. (a) With necessary figures explain the typical extent of measurement positions for global ship vibration. **(17½)**

   (b) Discuss the vibration acceptance criteria according to International Standard Organization (ISO). Draw necessary diagrams and explain accordingly. **(17½)**

2. (a) In the case of a machine on an elastic mounting with out-of-balance force, prove that the natural frequency of the machine on the elastic mounting must be less than seventy percent of the forcing frequency so that the force transmitted by the spring mounting is to be less than that transmitted through a rigid mounting. Also, find the maximum force transmitted to the foundation using elastic mounting considering damping effect. **(25)**

   (b) Consider a machine having a weight of 2000 lb running at 1800 rpm and supported on eight helical steel springs each having 10 coils 4 incehs in diameter. The diameter of the steel material being half an inch. Calculate the force transmitted to the foundation and the transmissibility. Assume the unbalanced centrifugal force at an angular speed of 1 rad/sec to be 0.02 lb. [Given, $G = 12\times10^6$ lb/in^2 and $2n = 1$] **(10)**

3. (a) How propeller excited vibration is developed in a typical ship? What are the problems associated with this type of vibration? How can this type of vibration be managed? Explain. **(25)**

   (b) A ship of fine form has a length of 360 ft, displacement 3000 tons and moment of inertia of the midship section of 58,500 sq.inch sq.ft. Calculate the frequency of vertical vibration of the ship using the Schlick's formula. Use, $\phi = 157{,}000$. **(10)**

4. (a) A ship has the following particulars: **(20)**

   Length = 475 ft
   Breadth = 55 ft
   Depth = 30 ft
   Draft = 25 ft
   $C_B = 0.75$

   Assuming that the maximum bending moment is WL/30 ft-tons, the maximum stress due to bending is 5 tons/in^2 and neutral axis is 15 ft above the keel. Determine the frequency of vertical vibration by Schlick's (ϕ = 125,000) formula and Burrill's (ϕ = 200,000) formula.

Contd P/2

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Contd...Q. No. 4

(b) In the Question No. 4(a), if the length of the ship is increased 3, 5, and 7 percent gradually (rest of the parameters remain the same) what will be the changes in the natural frequencies according to Schlick and Burrill? Plot the results and discuss. **(15)**

SECTION – B

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

Symbols have their usual meaning.

5. (a) What are the causes of ship vibration? **(10)**

(b) A thin plate of area A and weight w is attached to the end of a spring and is allowed to oscillate in a viscous fluid. If τ_1 is the natural period of undamped oscillation (i.e. with the system oscillating in air) and τ_2 the damped period with the plate immersed in the fluid. Show that:

$$\mu = \frac{2\pi w}{gAT_1T_2}\sqrt{\tau_2^2 - \tau_1^2}$$

where the damping force on the plate is $F_d = 2A\mu v$, 2A is the total surface area of the plate and v is its velocity. **(15)**

(c) Find the natural frequency of the system shown in Fig. for Q. No. 5(c). The mass of the beam is negligible in comparison to the suspended mass ($E = 2.2 \times 10^5\ N/mm^2$). **(10)**

6. Derive the expression of the amplitude of forced vibration with damping and hence explain the magnification factor for different cases. **(35)**

7. (a) How the vibration in a ship is related to the transverse vibration of a beam? **(10)**

(b) Show that for a simple free-free beam, of constant cross-section and weight per unit length, the transverse natural frequency can be expressed as: **(25)**

$$f = \frac{(ml)^2}{2\pi}\sqrt{\frac{EIg}{wl^4}}$$

where f is the frequency per second and other symbols have usual meaning.

8. (a) What is the 'virtual mass' or 'virtual-weight' effect? **(10)**

(b) Discuss Lewis method regarding computation of added weight coefficient. **(15)**

(c) Explain the work of Wendel regarding the effect of bilge keel on ship vibration. **(10)**

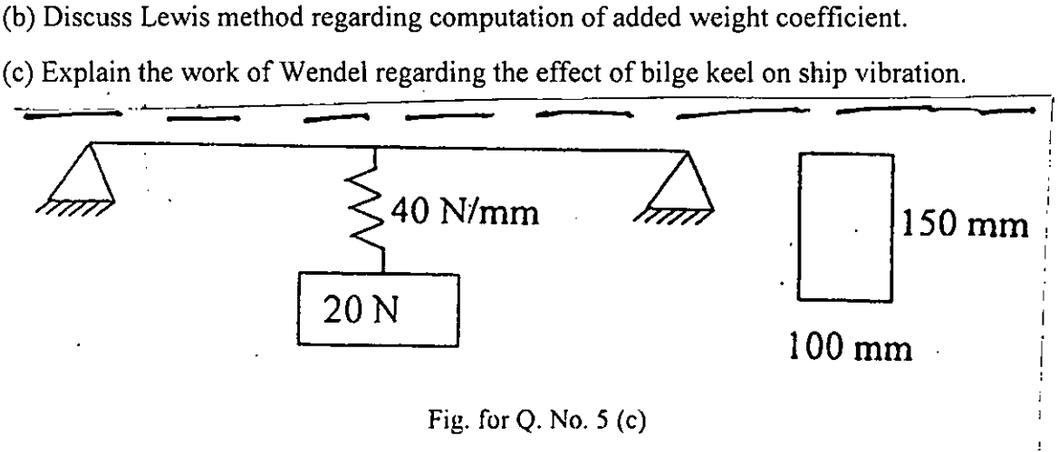

Fig. for Q. No. 5 (c)

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L-4/T-1/NAME Date : 16/10/2022

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 451** (Advanced Ship Structure)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

All the symbols have their usual meanings. Assume reasonable values for missing data.

SECTION – A

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

1. (a) Derive the expression of energy release rate of a DCB specimen. Determine the critical energy release rate of a DCB specimen loaded in a tensile testing machine. The thickness of the DCB specimen is 30 mm, depth of each cantilever 12 mm and crack length 50 mm. It is made of a hardened steel with the modulus of 207 GPa and the crack is about to propagate at 15405 N pulling load. **(12)**

(b) A polystyrene component must not fail when a tensile stress of 1.25 MPa is applied. Determine the maximum allowable surface crack length if the surface energy of polystyrene is 0.50 J/m^2. Assume a modulus of elasticity of 3.0 GPa. **(5)**

(c) A fatigue test was conducted in which the mean stress was 50 MPa and stress amplitude was 225 MPa. **(6)**

(i) Compute the maximum and minimum stress level.

(ii) Compute stress ratio

(iii) Compute the magnitude of stress range.

(d) The fatigue data for a ductile cast iron are given as follows: **(12)**

Stress Amplitude (MPa)	Cycles to failure (N)
248	1×10^5
236	3×10^5
224	1×10^6
213	3×10^6
201	1×10^7
193	3×10^7
193	1×10^8
193	3×10^8

(i) Make an S-N plot (stress amplitude versus logarithm cycles to failure, log N) using these data.

(ii) What is the fatigue limit for this alloy?

(iii) Determine fatigue life times at stress amplitude 230 MPa and 175 MPa

(iv) Estimate fatigue strengths at 2×10^5 and 2×10^6 cycles.

Contd P/2

NAME 451

2. (a) Derive biharmonic equation using plane stress condition. Show that $\varphi = -x_2 \, Re\, \overline{Z}_{11}$, chosen for Mode 11 problems, satisfies biharmonic equation. For a centre crack in an infinite plate loaded in Mode 11, determine stress components near the vicinity of a crack tip in terms of k_{11}. **(20)**

   (b) Why is it necessary to evaluate SIF for a crack in a component? How does it help a designer? **(10)**

   (c) A structural component in the form of a wide plate is to be fabricated from a steel alloy that has a plane strain fracture toughness 77.0 MPa$\sqrt{m}$ and a yield strength 1400 MPa. The flaw size resolution limit of the flaw detection apparatus is 4.1 mm. If the design stress is one half of the yield strength and the value of geometric factor is 1.0, determine whether or not a critical flaw for this plate is subject to detection. **(5)**

3. (a) Derive the expression of approximate plastic zone shape around a crack tip in an infinite plate for plane stress and plane strain in condition for Mode 1 crack using Mises yield criterion with necessary figures. **(20)**

   (b) Briefly discus Irwin plastic zone correction. **(7)**

   (c) A steel plate (σ_{ys} = 350 MPa) of width 80 mm and thickness 5 mm has a center-crack 2a = 40 mm length. If the far field stress is 150 MPa, determine the SIF and the length of the effective crack using Irwin's correction. The configuration is shown in Figure for Q. No. 3(c). **(8)**

4. (a) Derive Perry-Robertson formula for strut and explain necessary assumptions. **(15)**

   (b) Two 300 mm × 120 mm I-section joints are united by 12 mm thick plates as shown in Figure for Q. No. 4(b) to form a 7 m long stanchion. Given a factor of safety of 3, a compressive yield stress of 300 MN/m^2 and a constant 'a' of 117500, determine the allowable load which can be carried by the stanchion according to the Rankine-Gordon formulae. **(20)**

SECTION – B

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

5. (a) Derive the expression for element stiffness matrix of a beam element by direct stiffness approach with necessary figures. **(15)**

   (b) Determine the reaction components of the following beam using the flexibility matrix method. **(20)**

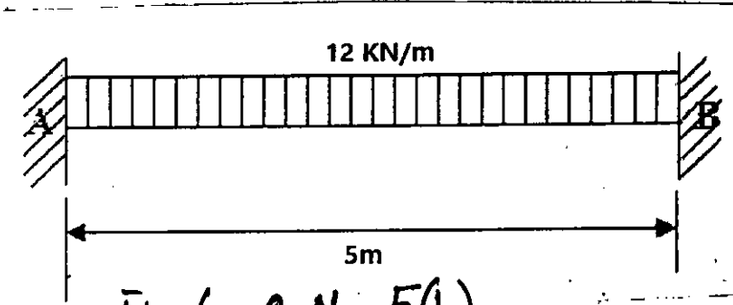


Fig. for Q. No. 5(b)

Contd P/3

NAME 451

6. (a) An I-Section beam has 200 mm wide flanges and an overall depth 500 mm. Each Flange is 25 mm thick and the web is 20 mm thick. At a certain Section the bending moment is M. Find what percentage of M is resisted by flanges and web. **(15)**

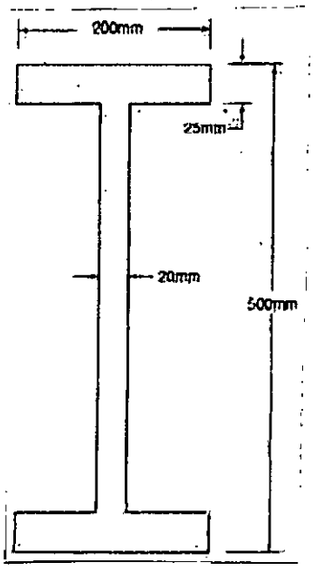


Fig. for Q. No. 6(a)

(b) Analyze the following beam by finding the Support reactions using the method of Consistent deformations. **(20)**

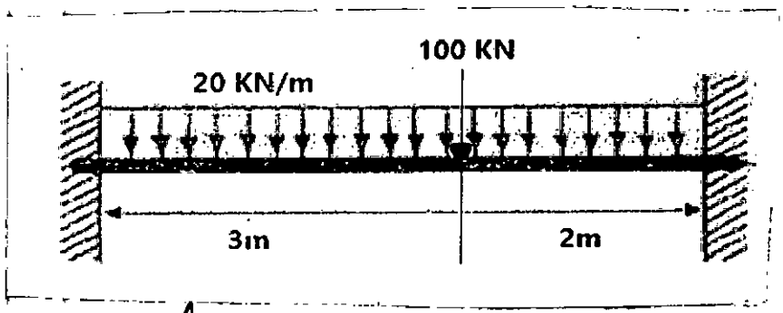


Fig for Q. No. 6(b)

7. (a) Explain the shape factor and load factor on the basis of plastic Analysis. **(10)**

(b) Find the Critical value of M_{pl} for the following continuous beam using kinematic method. **(25)**

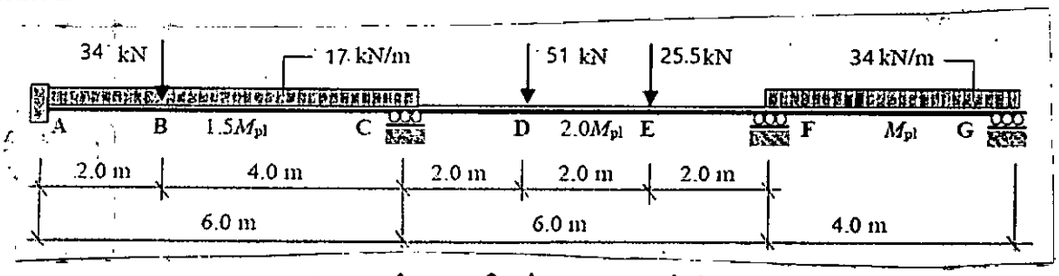


Fig. for Q. No. 7(b)

Contd P/4

NAME 451

8. (a) Mathematically show that "The fully plastic torque for a solid shaft is 33% greater than the maximum elastic torque. **(10)**

(b) Determine the "shape factor" of a T-Section beam of dimensions 100 mm × 150 mm × 12 mm as shown in the following figure. Now a cantilever is to be constructed from a beam with this section and is designed to carry a uniformly distributed load over its complete length of 2 m. Determine the maximum u.d.l. that the cantilever can carry if yielding is permitted over the lower part of the web to a depth of 25 mm. The yield stress of the material of the Cantilever is 225 MN/m^2. **(25)**

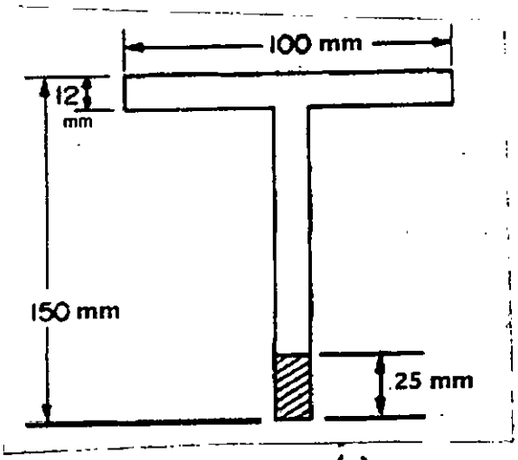
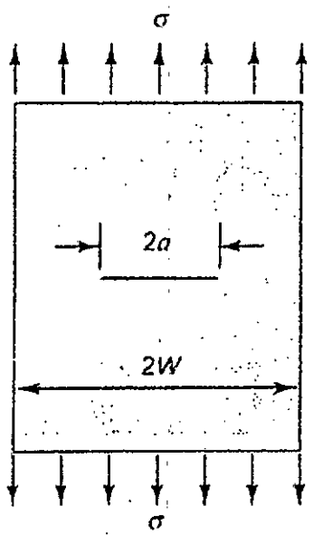


Figure for Q. No. 8(b)



$$K_I = \sigma\sqrt{\pi a} f(\alpha)$$

$$\alpha = \frac{a}{W} \quad \text{for } 0 < \alpha < 0.7$$

$$f(\alpha) = 1.0 + 0.128\alpha - 0.288\alpha^2 + 1.523\alpha^3$$

Figure for Q. No. 3(c)

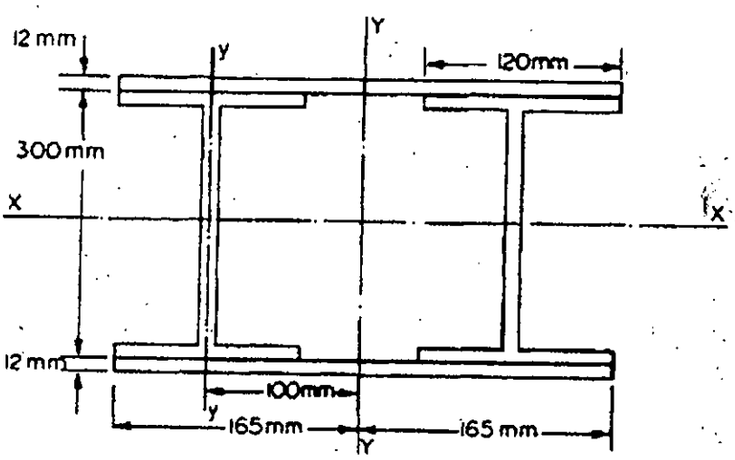
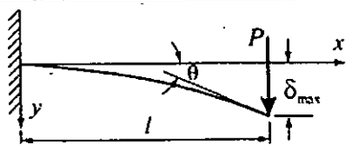
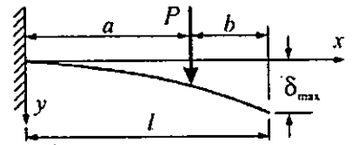
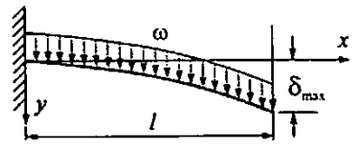
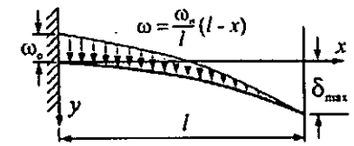
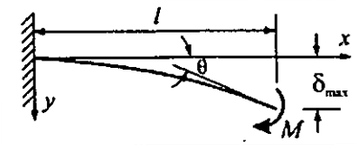


Figure for Q. No. 4(b)

Cont... P/5

NAME 451

BEAM DEFLECTION FORMULAE

BEAM TYPE	SLOPE AT FREE END	DEFLECTION AT ANY SECTION IN TERMS OF x	MAXIMUM DEFLECTION
1. Cantilever Beam – Concentrated load P at the free end			
	$\theta = \frac{Pl^2}{2EI}$	$y = \frac{Px^2}{6EI}(3l - x)$	$\delta_{max} = \frac{Pl^3}{3EI}$
2. Cantilever Beam – Concentrated load P at any point			
	$\theta = \frac{Pa^2}{2EI}$	$y = \frac{Px^2}{6EI}(3a - x)$ for $0 < x < a$ $y = \frac{Pa^2}{6EI}(3x - a)$ for $a < x < l$	$\delta_{max} = \frac{Pa^2}{6EI}(3l - a)$
3. Cantilever Beam – Uniformly distributed load ω (N/m)			
	$\theta = \frac{\omega l^3}{6EI}$	$y = \frac{\omega x^2}{24EI}(x^2 + 6l^2 - 4lx)$	$\delta_{max} = \frac{\omega l^4}{8EI}$
4. Cantilever Beam – Uniformly varying load: Maximum intensity ω_o (N/m)			
	$\theta = \frac{\omega_o l^3}{24EI}$	$y = \frac{\omega_o x^2}{120lEI}(10l^3 - 10l^2x + 5lx^2 - x^3)$	$\delta_{max} = \frac{\omega_o l^4}{30EI}$
5. Cantilever Beam – Couple moment M at the free end			
	$\theta = \frac{Ml}{EI}$	$y = \frac{Mx^2}{2EI}$	$\delta_{max} = \frac{Ml^2}{2EI}$

Contd.. P/6

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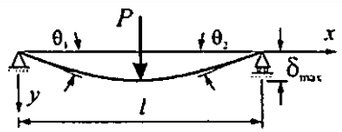
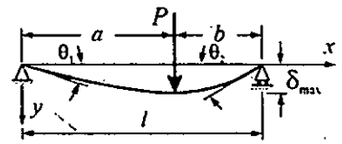
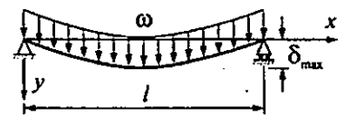
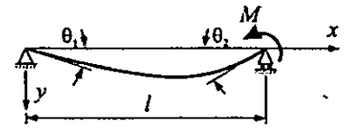
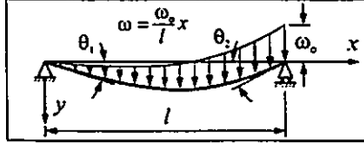
BEAM DEFLECTION FORMULAS

BEAM TYPE	SLOPE AT ENDS	DEFLECTION AT ANY SECTION IN TERMS OF x	MAXIMUM AND CENTER DEFLECTION
6. Beam Simply Supported at Ends – Concentrated load P at the center			
	$\theta_1 = \theta_2 = \frac{Pl^2}{16EI}$	$y = \frac{Px}{12EI}\left(\frac{3l^2}{4} - x^2\right)$ for $0 < x < \frac{l}{2}$	$\delta_{max} = \frac{Pl^3}{48EI}$
7. Beam Simply Supported at Ends – Concentrated load P at any point			
	$\theta_1 = \frac{Pb(l^2 - b^2)}{6lEI}$ $\theta_2 = \frac{Pab(2l - b)}{6lEI}$	$y = \frac{Pbx}{6lEI}\left(l^2 - x^2 - b^2\right)$ for $0 < x < a$ $y = \frac{Pb}{6lEI}\left[\frac{l}{b}(x-a)^3 + \left(l^2 - b^2\right)x - x^3\right]$ for $a < x < l$	$\delta_{max} = \frac{Pb\left(l^2 - b^2\right)^{3/2}}{9\sqrt{3}\,lEI}$ at $x = \sqrt{\left(l^2 - b^2\right)/3}$ $\delta = \frac{Pb}{48EI}\left(3l^2 - 4b^2\right)$ at the center, if $a > b$
8. Beam Simply Supported at Ends – Uniformly distributed load ω (N/m)			
	$\theta_1 = \theta_2 = \frac{\omega l^3}{24EI}$	$y = \frac{\omega x}{24EI}\left(l^3 - 2lx^2 + x^3\right)$	$\delta_{max} = \frac{5\omega l^4}{384EI}$
9. Beam Simply Supported at Ends – Couple moment M at the right end			
	$\theta_1 = \frac{Ml}{6EI}$ $\theta_2 = \frac{Ml}{3EI}$	$y = \frac{Mlx}{6EI}\left(1 - \frac{x^2}{l^2}\right)$	$\delta_{max} = \frac{Ml^2}{9\sqrt{3}\,EI}$ at $x = \frac{l}{\sqrt{3}}$ $\delta = \frac{Ml^2}{16EI}$ at the center
10. Beam Simply Supported at Ends – Uniformly varying load: Maximum intensity ω_o (N/m)			
	$\theta_1 = \frac{7\omega_o l^3}{360EI}$ $\theta_2 = \frac{\omega_o l^3}{45EI}$	$y = \frac{\omega_o x}{360lEI}\left(7l^4 - 10l^2x^2 + 3x^4\right)$	$\delta_{max} = 0.00652\frac{\omega_o l^4}{EI}$ at $x = 0.519l$ $\delta = 0.00651\frac{\omega_o l^4}{EI}$ at the center

L-4/T-1/NAME **Date : 26/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 475** (Dredger and Dredging Technology)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Symbols have their usual meaning. Assume reasonable values for missing data if any.

1. (a) Define the following terms: **(10)**

   Dead time, bulking factor, capital dredging, dike, maintenance dredging.

   Dike, maintenance dredging.

   (b) With reference to the measurement of production for TSHD, elaborately explain the following methods: **(25)**

   (i) in – situ measurement

   (ii) measurement in the pipeline

   (iii) measurement in means of conveyance

2. (a) List the advantages and disadvantages of a TSHD. **(10)**

   (b) A heavy duty slurry pump is used as a dredge pump of a dredger for the following duty: **(25)**

   70 MT/Hr of sand, specific gravity of solids = 2.65,

   average particle size d_{50} = 0.211 mm

   Concentration of solids C_w = 30% by weight

   Static discharge head = 10.81 m

   Suction head = 0.91 m (positive)

   Length of pipeline = 100 m

   Valves and fittings = 5×90° long radius bends

   Calculate:

   (i) The quantity of slurry

   (ii) The slurry mixture velocity

   (iii) The limiting setting velocity

   (F_L = 1.04, pipe dia = 150 mm)

   (iv) Total dynamic head of the pump (consider for each values and fittings, head loss is 3.4 m and f = 0.016)

   (v) Pump power.

3. (a) Mention the purpose of geotechnical site investigation of any dredging project. Also mention the possible consequences in case of an inaccurate and incomplete geo-technical investigation of any dredging project. **(10)**

Contd P/2

NAME 475
Contd...Q. No. 3

(b) List the potential short term and long term impacts of dredging. **(10)**

(c) Briefly discuss different types of transportation process used for dumping dredge materials. **(15)**

4. (a) A TSHD has the following data: **(20)**

Yearly dredge output = 5 Mm^3

Material type: Coarse sand and gravel ($\rho = 2000$ kg/m^3)

Distance of the dumping site 100 Nautical Miles

Ship speed 20 knot,

The dredger has to work 168 hours/week,

Overhaul 2 weeks,

Weather delay 3 weeks

Eid vacations 1 week

Loading and unloading time 3 hours

Maxm. Filling of hopper = 90%

Workability = 95%

Calculate the required hopper volume and hopper density.

(b) Distinguish between followings: **(15)**

(i) Draghead and swell Compensator

(ii) Shore pipeline and floating pipline

(iii) Hopper self discharge: rainbow and pump ashore.

SECTION – B

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

Symbols have their usual meaning. Assume reasonable values for missing data if any.

5. (a) Describe the function of following components used in Cutter Suction Dredger (CSD). **(15)**

(i) Anchor boom

(ii) Cutter head

(iii) Ladder winch

(iv) Dredge pump and

(v) Spud

(b) Briefly describe the following types of advancement mechanism of Cutter Suction Dredger (CSD) with advantages and disadvantages. **(20)**

(i) Christmas Tree system (ii) Walking Spud system (iii) Spud carriage system and (iv) Fixed spud system.

Contd P/3

NAME 475

6. (a) Using a Tabular form, show the classification of Mechanical, Hydraulic and Pneumatic dredgers considering individual type, method of extraction, method of transportation and Method of disposal. **(15)**

   (b) Give a brief description of physical mechanism involved in the dredging process. **(20)**

7. Write short notes on the following: **(5×7=35)**

   (a) Jet pump dredger
   (b) Air lift dredger
   (c) Pneumatic dredger
   (d) Amphibious dredger
   (e) The backhoe dredger
   (f) The bucket dredger and
   (g) The dipper dredger.

8. (a) The lightship of a Cutter Suction Dredger (CSD) is 147 M.Ton. with a center of gravity at the middle of the length. Fuel Oil (FO) capacity 40 M.Ton. and ballast 50 M.Ton. You have to design a 20 inch CSD which shall have three pontoons of equal breadths. Length of the middle pontoon shall have a length half of side pontoons. Ratio of length to breadth of each pontoon shall not be greater than10. Freeboard of CSD shall not be less than 450 mm. Dredging depth of the pontoon to be 15 m @ 60 deg. The spud shall be attached at the aft of the pontoon as shown in Figure for Question No. 8(a). Find the following. **(25)**

   (i) The draft at which the CSD will float;
   (ii) Cutting width of the CSD and
   (iii) The variation of cutting width for the swing angles 30 deg., 60 deg. and 90 deg.

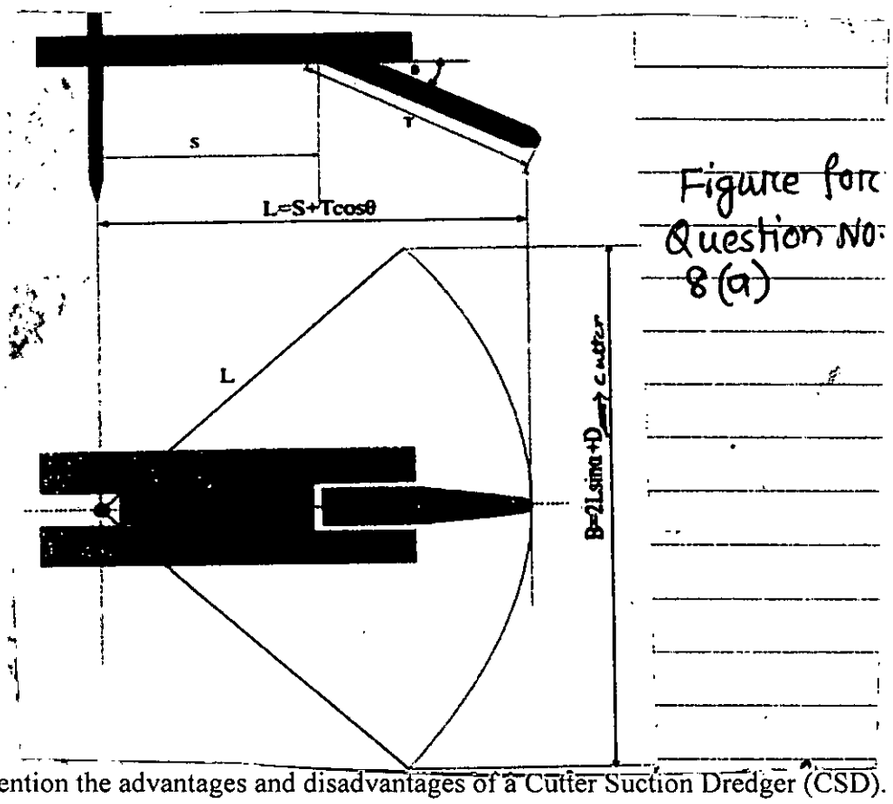


Figure for Question No. 8(a)

   (b) Mention the advantages and disadvantages of a Cutter Suction Dredger (CSD). **(10)**

L-4/T-1/NAME **Date : 16/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 477** (Optimization Methods in Ship Design)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What do you mean by optimization? Write the dual of the following primal problem. **(15)**

Maximize

$z = 5x_1 + 6x_2$

s. t.

$x_1 + 2x_2 = 5$

$-x_1 + 5x_2 \geq 3$

$4x_1 + 7x_2 \leq 8$

x_1 **unrestricted and** $x_2 \geq 0$

(b) Consider the following LP **(20)**

Maximize $z = 5x_1 + 2x_2 + 3x_3$

s. t.

$x_1 + 5x_2 + 2x_3 = 30$

$x_1 - 5x_2 - 6x_3 \leq 40$

$x_1, x_2, x_3 \geq 0$

The optimal solution yields the following objective equation:

$z + 0.\, x_1 - 23x_2 + 7x_3 + (S + M)x_4 + 0.\, x_4 = 150$

Whose artificial x_4 and slack x_5 are the starting basic variables. Determine the associated optimal dual solution.

2. (a) State the optimality and feasibility conditions of dual simplex method. **(5)**

(b) Show that the Taylor series expansion for a function $f(x_p + \Delta x,\ \ y_p + \Delta y)$ can be expressed as **(10)**

$$f(X_p + \Delta X) = f(X_p) + \nabla f(X_p)^T + \frac{1}{2}\Delta X^T H(X_p)\Delta X$$

(c) Solve the following LP by the Jacobian method **(20)**

Maximize $z = 5x_1 + 3x_2$

s. t.

$x_1 + 2x_2 + x_3 - 6 = 0$

$3x_1 + x_2 \quad + x_4 - 9 = 0$

$x_1, x_2, x_3, x_4 \geq 0$

Contd P/2

NAME 477

3. (a) What do you mean by Sensitivity? Draw an expression for sensitivity co-efficient. **(15)**

(b) Solve the following NLP by the Lagrangean method

Maximize $z = x_1^2 - 10x_1 + x_2^2 - 6x_2 + x_3^2 - 4x_3$

s.t.

$x_1 + x_2 + x_3 = 7$

$x_1, x_2, x_3, \geq 0$

4. (a) Consider the following quadratic program **(15)**

Maximize $z = CX + X^T DX$

s.t.

$AX \leq b$

$X \geq 0$

Show that the Kuhn-Tucker conditions can be expressed as

$$\begin{bmatrix} -2D & A^T & -I & 0 \\ A & 0 & 0 & I \end{bmatrix} \begin{bmatrix} X \\ \lambda \\ \mu \\ s \end{bmatrix} = \begin{bmatrix} C^T \\ b \end{bmatrix}$$

$$\lambda_i \, s_i = \mu_j \, s_j = 0$$

$$X, \lambda, \mu, s \geq 0$$

(b) Solve the following problem using the method of steepest ascent. **(20)**

Minimize $z = (x_2 - x_1)^2 + (1 - x_1)^2$

With $X_0 = (0, 0)$

SECTION – B

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

Symbols have their usual meaning. Reasonable values can be assumed for any missing data.

5. Two cargo vessels will be built to carry both grain and fruit. The following table provides the basic data of the problem: **(35)**

	Weight of cargo (ton) per ton deadweight of		Maximum daily availability (ton)
	Cargo vessel 1	Cargo vessel 2	
Grain	0.6	0.2	240
Fruit	0.4	0.8	60
Profit per ton (BDT 1000)	5	4	

A market survey indicates that the daily carrying demand for Cargo vessel 1 cannot exceed that for Cargo vessel 2 by more than 100 tons. Also, the maximum daily carrying demand for Cargo vessel 1 is 200 tons. Derive an LP model for the optimum (best) deadweight capacity for two vessels that maximizes the total daily profit and then solve it graphically.

Contd P/3

NAME 477

6. (a) Use M-method to solve the following problem: **(25)**

Minimize $z = 4x_1 + x_2$

subject to,

$3x_1 + x_2 = 3$

$4x_1 + 3x_2 \geq 6$

$x_1 + 2x_2 \leq 4$

$x_1, x_2 \geq 0$

(b) Define Integer Programming Algorithm and describe its steps. **(10)**

7. (a) Describe selection, crossover and mutation processes for genetic algorithm. **(10)**

(b) Using genetic algorithm, solve the following problem: **(25)**

$$\textit{Maximize } z = f(x) = x^2, \ 0 \leq x \leq 31$$

8. Find the maximum of the function **(35)**

$f(x) = -x^2 + 5x + 20$ with $-10 \leq x \leq 10$

using the PSO algorithm. Use 9 particles with the initial positions

$x_1 = -9.6$, $x_2 = -6$, $x_3 = -2.6$, $x_4 = -1.1$, $x_5 = 0.6$, $x_6 = 2.3$, $x_7 = 2.8$, $x_8 = 8.3$, and $x_9 = 10$.

Show the detailed computations for iterations 1, 2 and 3.

L-4/T-1/NAME **Date : 20/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **IPE 479** (Engineering Management)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Assume appropriate values for any missing data.

1. (a) Compare "Batch" and "Mass" production system based on their applications, advantages and limitations. **(10)**

   (b) Below are the actual demands for an item for a six-month period: **(8+17)**

Month	Period	Actual demand
January	1	120
February	2	130
March	3	150
April	4	170
May	5	160
June	6	180

   (i) Forecast the demand for April, May and June with the weighted three-month moving average method with weights 0.6, 0.3 and 0.1 (put more weights to the most recent demand).

   (ii) Forecast the demand for April, May and June using least square regression method.

2. (a) Andrew and Julie work together to write reports for projects. Julie starts her work on a report as soon as Andrew finishes his part. Times for the reports (in hours) are as follows. By using Johnson rule, find optimal sequence of writing reports to reduce the total time. Also find idle time for Andrew and Julie. **(15)**

Project	Andrew	Julie
A	4	2
B	3	5
C	5	1
D	7	3
E	8	6

   (b) What are the different costs associated with quality? **(10)**

   (c) Describe the main distinguishing characteristics of TQM. **(10)**

Contd P/2

IPE 479

3. (a) Rosenberg Computing wants to establish an assembly line for producing a new product, the Personal Digital Assistant (PDA). The tasks, task times, and immediate predecessors for the tasks are as follows: **(17)**

Task	Time (sec)	Immediate Predecessors
A	12	-
B	15	A
C	8	A
D	5	B,C
E	20	D

Rosenberg's goal is to produce 180 PDAs per hour.

(i) What is the cycle time?

(ii) What is the theoretical minimum for the number of work-stations?

(iii) Compute the resulting efficiency of the system.

(b) The material X is used uniformly throughout the year in a factory. The data about annual requirement, ordering cost and holding cost of this material is given below: **(18)**

Annual requirement: 12,000 units

Ordering/setup cost: $42.5 per order

Holding cost: $2.85 per unit per year.

Working days per year: 290

Lead time for order: 3 days

For material X, determine:

(i) Economic Order Quantity (EOQ)

(ii) Total annual cost and

(iii) Re-order Point (ROP).

4. (a) In a manufacturing firm, the daily operator wage rate is 1000 tk. The standard output in a 6-day week is 900 units representing 100% efficiency. Daily output of operator X = 93 pcs, Output of operator Y = 150 pcs, Output of operator Z = 176 pcs. Calculate the total daily earnings of operator X, Y, Z using Merrick's multiple piece rate plan. **(15)**

(b) Compare Maslow's need theory and ERG theory of motivation. **(10)**

(c) Write short notes on trait, behavioral and contingency approaches of leadership. **(10)**

Contd P/3

IPE 479

SECTION – B

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

5. (a) Who are Managers? What are the functions of management? **(5)**

(b) Briefly explain the downside of Traditional Goal Setting with suitable example. **(5)**

(c) What do you understand by Management by Objectives (MBO)? List the steps involved in a typical MBO Program. **(10)**

(d) Mention Henri Fayol's and Taylor's Principles of Management. How do today's managers use Scientific Management? **(15)**

6. (a) Explain the ways to improve the group or team cohesiveness with suitable example. **(5)**

(b) A company produces and sells a consumer product and is able to control the demand for the product by varying the selling price. The approximate relationship between price and demand is **(10)**

$$p = \$38 + \frac{2{,}700}{D} - \frac{5{,}000}{D^2}, \quad \text{for } D > 1$$

where p is the price per unit in dollars and D is the demand per month. The company is seeking to maximize its profit. The fixed cost is \$1,000 per month and the variable cost is \$40 per unit.

(i) What is the number of units that should be produced and sold each month to maximize profit?

(ii) Find the breakeven point.

(c) Four mutually exclusive alternatives are being evaluated, and their costs and revenues are itemized below. If the MARR is 15% per year and the analysis period is 12 years, draw the cash-flow diagrams and use the Internal Rate of Return (IRR) method to determine which alternatives are economically acceptable. Also find out which alternative should be selected finally. **(20)**

	Mutually Exclusive Alternative			
	I	*II*	*III*	*IV*
Capital investment	\$100,000	\$152,000	\$184,000	\$220,000
Annual revenues less expenses	15,200	31,900	35,900	41,500
Market value (end of useful life)	10,000	0	15,000	20,000
Useful life (years)	12	12	12	12

7. (a) Define the broad maintenance management control indices. **(3)**

(b) Define the following costs with suitable example. **(5)**

(i) Sunk cost

(ii) Opportunity cost

Contd P/4

IPE 479

Contd...Q. No. 7

(c) List the types/elements of preventive and corrective maintenance. **(12)**

(d) For the following task table, calculate the maintenance project duration and find the critical path. **(15)**

Task	Predecessor	Duration (days)		
		Optimistic	Most Likely	Pessimistic
a	---	18	20	22
b	---	18	20	22
c	---	7	9	17
d	a	14	15	16
e	b, c	7	9	17
f	b, c	13	14	15
g	b, c	2	4	6
h	c	10	11	12
i	g, h	18	18	18
j	d, e	6	8	10

8. (a) The Shader Electronics Company produces two products: (i) the Shader Walkman, a portable CD/DVD player, and (ii) the Shader Watch-TV, a wristwatch-size internet-connected color television. The production process for each product is similar in that both require a certain number of hours of electronic work and a certain number of labour-hours in the assembly department. Each Walkman takes 4 hours of electronic work and 2 hours in the assembly shop. Each Watch-TV requires 3 hours in electronics and 1 hour in assembly. During the current production period, 240 hours of electronic time are available, and 100 hours of assembly department time are available. Each Walkman sold yields a profit of $7; each Watch-TV produced may be sold for a $5 profit. Shader's problem is to determine the best possible combination of Walkmans and Watch-TVs to manufacture to reach the maximum profit. Formulate this product-mix situation as a linear programming problem. **(10)**

(b) Solve the following problem using the Simplex method. **(25)**

Maximize $Z = 3x_1 + 5x_2$

subject to

$$x_1 \le 4$$
$$2x_2 \le 12$$
$$3x_1 + 2x_2 \le 18$$

and

$$x_1, x_2 \ge 0$$
