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**L-4/T-1/NAME** **Date: 23/04/2024**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2022-2023

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

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this section. Answer to **Question no. 1 (one) is Compulsory**. Answer any **TWO** questions from Questions 2-4.

(The symbols hare their usual meanings. Assume reasonable values for missing data, if any)

1. (a) A 100 m long ship of 3000 tonnes displacement has draft of 5.5 m. The other parameters given below:

KM = 6m, KG = 4.5 m, center of flotation = 4 m aft of amidship, Trim = 450 cm by stern, TPC = 10 tonnes, MCTC = 80 Tonnes.m

By analysis, it was found that the ship would capsize during the critical period of docking. To avoid this the dockmaster decided to reduce the trim to almost zero. But during docking process, unfortunately the ship had capsized. **(20)** (CO2)

(i) Identify the reason that would cause the ship to capsize during the critical period. Do you agree with the decision made by the dockmaster?

(ii) Also, identify the probable reason for capsizing of the ship even after reducing the trim.

(b) A ship has to the repaired at a dockyard .The dimensions are given below:

DWT = 5000 tonnes, LOA = 70 m, LPP = 68 m, BM = 10.75 m, Maximum draft = 3.5 m, Height of boot tap = 0.4 m, Height of topside = 1.5 m, Height of bulwark = 1 m and The shape constants for underwater hull, $P_{uw}$ = 0.8, for topside, $P_t$ = 0.88, for boot top, $P_b$ = 0.9, for only longitudinal portion of the topside, $P_{tl}$ = 1. **(15)** (CO3)

This ship has to be painted, The painting cost per square meter for different region is given below:

Flat bottom = 12 USD, Boot-top area = 10 USD, Underwater area (excluding flat bottom and boot-top) = 11 USD, Top-side area = 8 USD, Bulwark area (for both side) = 7 USD. Calculate the total cost to paint the whole underwater area, top-side area (only for star-board side), and the bulwark area. (If needed you may modify the basic formulas based on logical assumptions)

2. (a) Define static and dynamic balance of propeller. With necessary sketches describe the process of static balancing. **(20)**

(i) by knife edge and spindle.

(ii) by ball support.

(b) Describe the main 4 decision factors in the choice of a repair-yard by an owner. **(15)**

## NAME 415

**Contd ... Q. No. 5**

3. (a) Explain how the following 5 factors influence the ship-repair industry: **(20)**

   (i) Customers,

   (ii) Off-hire time,

   (iii)Production mix,

   (iv)Labor and steel cost,

   (v) Port authorities and regulations.

   (b) Construct a welding repair decision model for repairing deck plates in a ship. Also, illustrate this with relevant examples. **(15)**

4. (a) In a repair-yard total number of steel worker is 50. The estimated work volume for a ship is 10000 man-hours. This ship has to be repaired within 10 days. Each day has 2 shifts, 10 hours each. The chart for work-rate of marine steel worker is given in the Figure for Question No. 4(a). **(20)**

   (i) Draw a histogram plot to show the required man-hour per each shift.

   (ii) From that histogram plot determine the extra number of workers to be hired for each shift to complete the repair, within given time.

   (b) What are the reasons for which a ship's propeller has to be renewed? **(15)**

   Describe the whole process of renewal with necessary sketches.

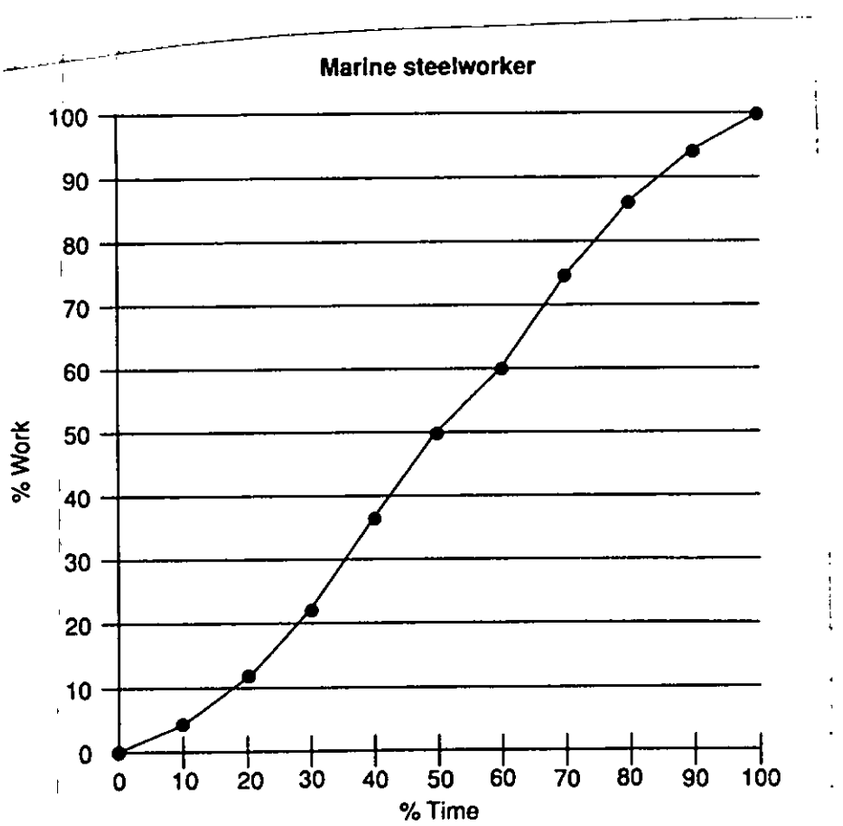


Figure for Question No. 4(a)

**NAME 415**

## SECTION – B

There are **FOUR** questions in this section. Answer to **Question no. 5 (five) is Compulsory**.

Answer any **TWO** questions from Questions 6-8.

(The symbols hare their usual meanings. Assume reasonable values for missing data, if any)

5. (a) Define "wearing process" and "wear". Briefly explain the "Radio-active isotope method" and "Profilography method" to determine the magnitude to wear. **(15)** (CO1)

   (b) What is "Bio-accumulation"? Compare between Self-Polishing Copolymer (SCP) and Controlled Depletion Polymer (CDP) to reduce marine fouling, considering cost and environmental impacts. **(18)** (CO2)

   (c) Suppose, some cast-iron components require urgent repairing and the work of repairing must be done in situ. Which repairing technique will be appropriate in this case? Explain with neat sketches. **(12)** (CO4)

6. (a) Describe various methods for detecting surface cracks. **(12)**

   (b) Define "Non-biocidal Anti-fouling coating". State the advantages of "Foul Release Coating (FRC)". **(8)**

   (c) What is "Building-up Repairing Method"? Write down the steps of built-up welding of shafts. **(10)**

7. (a) Write down the working principle of "Sputtering by Electric Arc" with necessary schematic diagram. **(10)**

   (b) Describe the repairing technique of propeller blades for the following cases: **(10)**

   (i) blades are made of steel.

   (ii) blades are made of cast iron.

   (c) Explain various methods for finding thickness reduction due to corrosion and erosion in ship's structural elements. **(10)**

8. (a) A major overhaul of shafting is required. Explain the procedure of shaft dismantling for the following cases- **(15)**

   (i) When the ship is afloat.

   (ii) When the ship is in dry dock.

   (b) For repairing work of a ship, the alignment of tailshaft and engine shaft needs to be checked without the dismantling and removal of the intermediate shaft. Which method will you choose in this case? Explain the chosen method and justify your selection. **(15)**

**Course Outcomes:**

CO-1: **Describe** various techniques for identifying different types of damages in ship hull and machineries.
CO-2: **Classify** anti-fouling paints used in ship's hull and different docking, undocking mechanisms of ships.
CO-3: **Perform** calculations for the cost of repair works in terms of man-hours.
CO-4: **Apply** knowledge to choose appropriate repair and maintenance methods based on the damages and conditions in ship hull and machineries.

19/05/2024

**L-4/T-1/NAME** **Date: ~~28/04/2024~~**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2022-2023

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

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

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

1. (a) Describe the causes of ship vibration. How to minimize vibrations of ships already built? **(20)**

   (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 $\tau_1$ is the natural period of undamped oscillation (i.e., with the system oscillating in air) and $\tau_2$ is the damped period with the plate immersed in the fluid. Show that $\mu = \frac{2\pi W}{gA\tau_1\tau_2}\sqrt{\tau_2^2 - \tau_1^2}$ 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 the velocity. **(15)**

2. (a) Derive the expression of the amplitude of forced vibration with damping and hence explain the magnification factor for different cases. **(27)**

   (b) A vibrating system has a mass of 10 kg and spring constant of 12 kN/m. The amplitude decreases to 15% of the initial value after six consecutive cycles. Find the damping coefficient of the damper. **(8)**

3. (a) How do the vibration of a ship is related with the transverse vibration of a beam? 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– **(28)**

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

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

   (b) Discuss the work of Wendel regarding the effect of bilge keel on ship vibration. **(7)**

4. (a) Discuss the method proposed by Lewis regarding computation of added weight coefficient. **(15)**

   (b) Schematically explain the effect of restricted water on added virtual weight. **(20)**

Contd ..... P/2

**NAME 439**

## SECTION – B

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

5. Calculate the added virtual weight and virtual weight factor for the natural frequency of two-node vertical vibration of the ship given in the figure for Q. No. 5. **(35)**

6. (a) Discuss the recent developments in the international standards on ship vibration. **(17)**

(b) Why are vibration limits more challenging to satisfy in large cargo ships than passenger ships? Explain. **(18)**

7. (a) Explain the method of calculating natural frequency of the two-node vertical vibration of a ship, based on the theory of bending of beam. **(20)**

(b) A single screw tanker has length B.P. = 440 ft, beam Mld. = 59 ft, depth mld. = 32 ft 9 inch, draft 25 ft 6 inch, displacement 15,190 tons. Given E = $30 \times 10^6$ lb. per inch$^2$, $\iint \frac{M}{I} dl\, dl = -8315$ tons feet per inch$^2$ at Midship with y = –0.346. Find the following: **(15)**

(i) Natural frequency for two-node vertical vibration.

(ii) Natural frequency for two-node vertical vibration considering shear effect.

8. (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 0.7 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, prove that the maximum force transmitted to the foundation using elastic mounting considering damping effect is: **(25)**

$$F = P\omega^2 \frac{\sqrt{1+\frac{4x^2\omega^2}{p^4}}}{\sqrt{\left(1-\frac{\omega^2}{p^2}\right)^2+\frac{4x^2\omega^2}{p^4}}}$$

Where, the symbols have their usual meanings.

(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 inches 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, G = $12\times10^6$ lb/in$^2$ and 2n = 1. Here, the symbols have their usual meaning. **(10)**

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# Figure for Q. No. 5

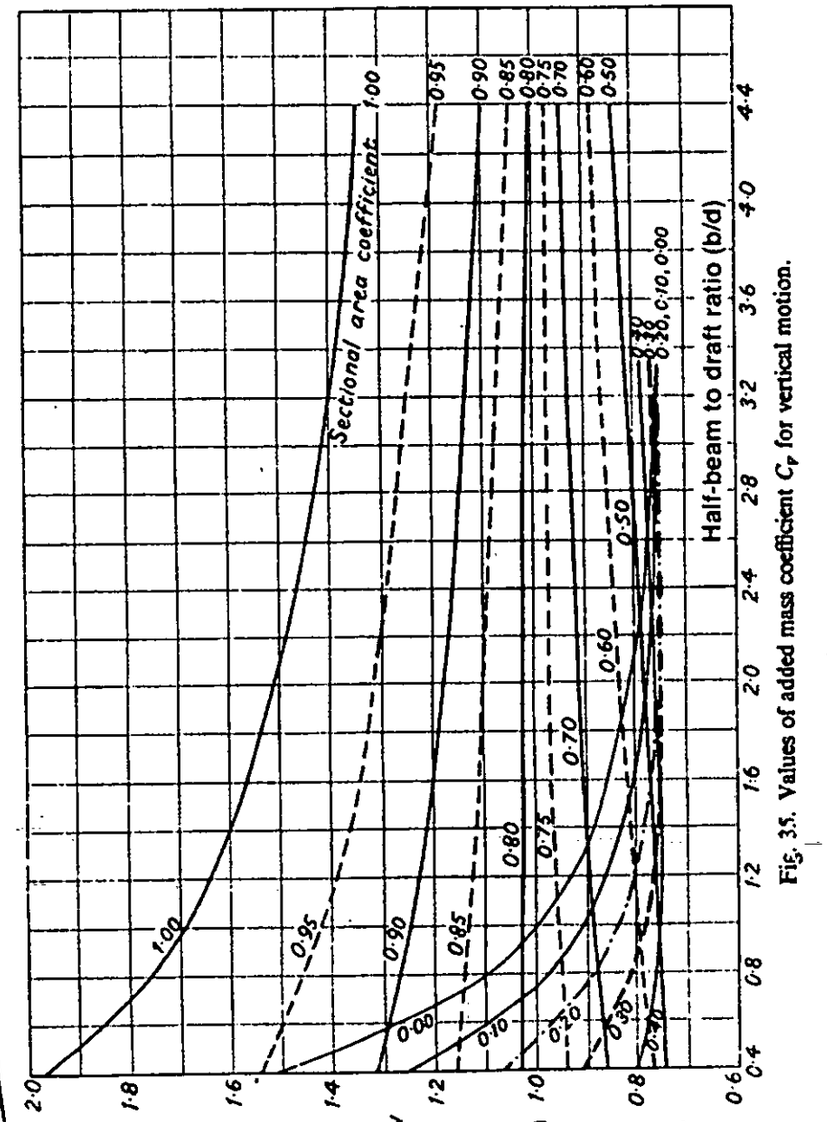


Fig. 3.5. Values of added mass coefficient $C_v$ for vertical motion.

Fig. for Q. No. 5

**Principal particulars**

L = 85 m, B = 12 m, d = 4 m, Δ = 3500 tonnes (at WL 4)

**Offset table for sectional area calculation.**

| | Half Breadth | | | | |
|---|---|---|---|---|---|
| **Station** | **WL-0** | **WL-1** | **WL-2** | **WL-3** | **WL-4** |
| 0 | - | - | - | - | - |
| 0.5 | - | 347 | 700 | 1146 | 1744 |
| 1 | 492 | 1298 | 1860 | 2740 | 3212 |
| 1.5 | 1097 | 2323 | 3553 | 4323 | 4733 |
| 2 | 1646 | 3933 | 4847 | 5314 | 5655 |
| 3 | 2314 | 5462 | 5752 | 5790 | 5790 |
| 4 | 2314 | 5462 | 5752 | 5790 | 5790 |
| 5 | 2314 | 5462 | 5752 | 5790 | 5790 |
| 6 | 2314 | 5462 | 5752 | 5790 | 5790 |
| 7 | 2314 | 5462 | 5752 | 5790 | 5790 |
| 8 | 1925 | 5132 | 5744 | 5790 | 5760 |
| 8.5 | 1283 | 4639 | 5485 | 5685 | 5685 |
| 9 | 641 | 3927 | 5048 | 5500 | 5500 |
| 9.5 | - | 2000 | 3188 | 4904 | 4904 |
| 10 | - | - | - | 3780 | 3780 |

Trapizoid may be assumed to calculate the sectional area. Half stations and Station 0 may be ignored.

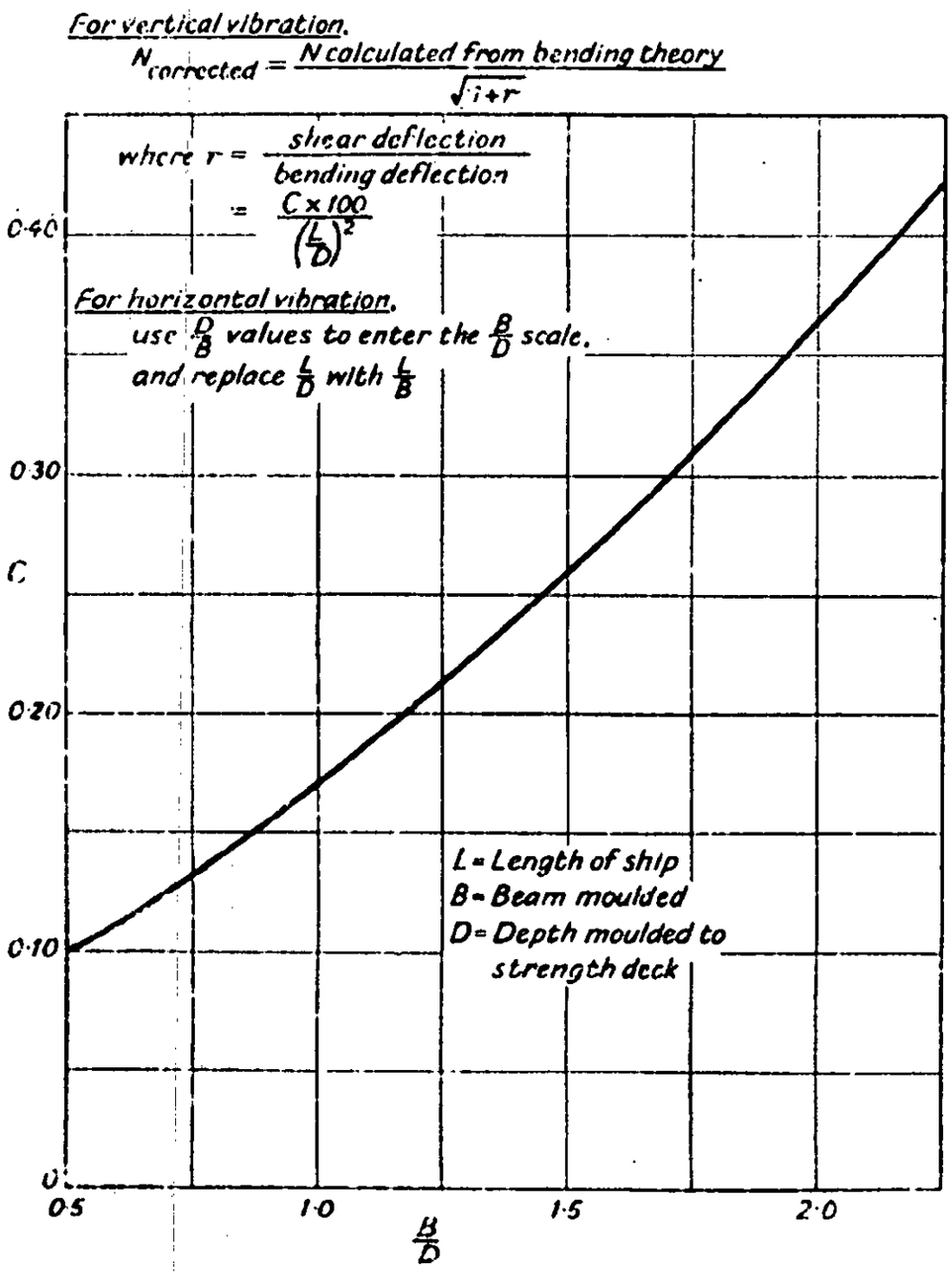


Fig. 47. Shear correction factors (J. L. Taylor[58]).

Fig. for Q. No. 7(b)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2022-2023

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

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

In case of missing data assume reasonable value. The symbols have their usual meanings.

1. (a) At a certain section, a beam has the cross-section shown in Figure for Q. No. 1(a). The beam is simply supported at its ends. It carries a central concentrated load of 500 kN together with a load of 300 kN/m uniformly distributed across the complete span of 3 m. Draw the shear stress distribution diagram for a section 1 m from the left-hand support. **(20)**

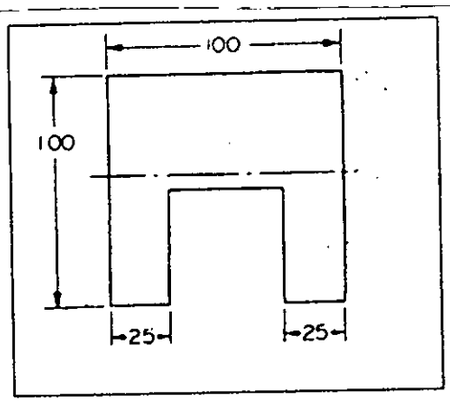


Figure for Q. No. 1(a)

(b) Determine the plastic moment $M_p$ and plastic section modulus $Z_s$ for the T section shown in Figure for Q. No. 1(b) if (i) $f_y$ = 320 MPa for the whole section and (ii) $f_y$ = 320 MPa for the top flange and $f_y$ = 250 MPa for the web. **(15)**

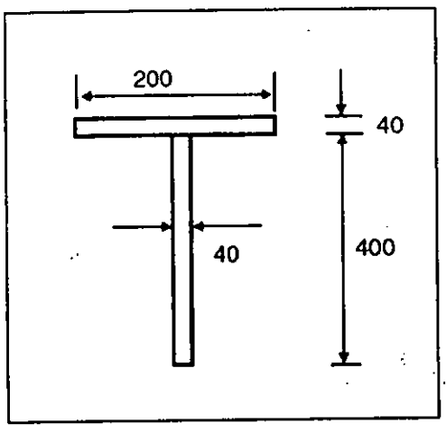


Figure for Q. No. 1(b)

Contd ..... P/2

**NAME 451**

2. (a) A hollow circular bar of 100 mm external diameter and 80 mm internal diameter shown in Figure for the Q. No. 2(a) is subjected to a gradually increasing torque $T$. Determine the value of $T$. **(20)**

   (i) when the material of the bar first yields;

   (ii) when plastic penetration has occurred to a depth of 5 mm;

   (iii) when the section is fully plastic.

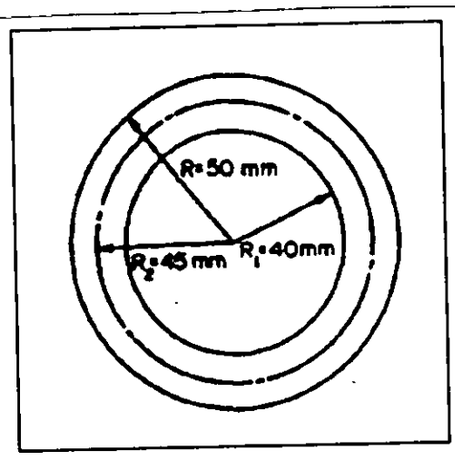


Figure for Q. No. 2(a)

(b) Determine the required values of $M_p$ for different segments of the continuous beam shown in Figure 2(b) and comment. **(15)**

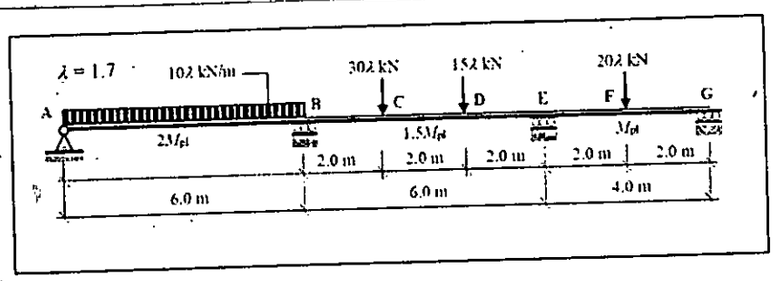


Figure for Q. No. 2(b)

3. Analyze the truss loaded as shown in Figure for Q. No. 3. Both the supports are hinged supports. ***AE*** is constant for all the members. **(35)**

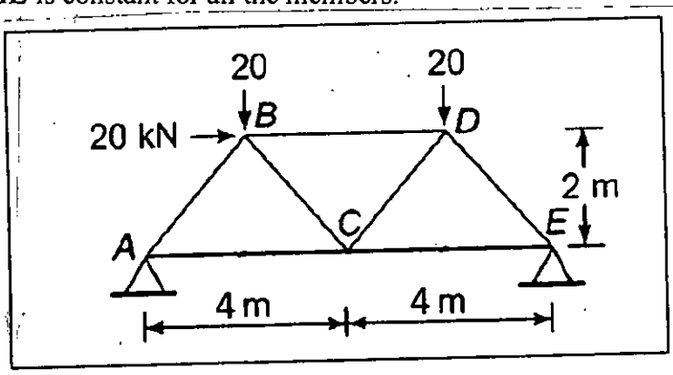


Figure for Q. No. 3

Contd ..... P/3

**NAME 451**

4. (a) Derive the element stiffness matrix of a truss element using the direct approach. **(15)**

(b) Analyze the continuous beam shown in Figure for Q. No. 4(b) by the flexibility matrix method. Take *EI* constant throughout. **(20)**

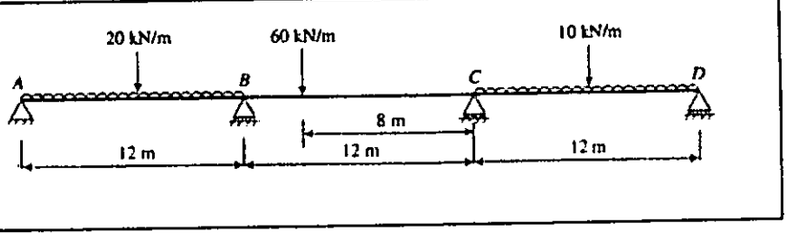


Figure for Q. No. 4(b)

## SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**. **Question No. 5** is compulsory.

All symbols have their usual meanings. Assume reasonable value for any missing data.

5. (a) In the constant load test, a cantilever specimen with a sharp notch is used as shown in Figure for Question No. 5(a). A lever arm is bolted to the far end of the specimen so as to generate high bending moment using a dead load P. The bending moment remains constant throughout the duration of an experiment.

A crack tip is prepared using fatigue load which is carefully chosen to have the SIF developed by the constant load during environment assisted testing. For this test method the followings: **(20)**

(i) Why this test requires more cost than constant displacement method, however why do we prefer this constant load method over the other?

(ii) Why resistance method is not used here to find the crack growth? How is it found?

(iii) 'Incubation time and total time-to-failure varies with the initial stress intensity factor. The threshold stress factor is difficult to determine in this method. Explain these two statements using the relevant graph.

(iv) Draw the crack growth rate vs stress intensity factor graph and describe elaborately.

(b) In a ship, a hollow circular steel strut is compressively loaded at the end by 200 KN load. It's end position is fixed and the length is 2 m, with 100 mm diameter outside and 80 mm diameter inside. There is an initial sinusoidal curvature on that strut with a maximum deflection of 8 mm. Determine the maximum stress, E = 208 GN/m$^2$. **(15)**

Contd ..... P/4

**NAME 451**

6. (a) Using relevant graph explain the stable and unstable crack growth for an infinite plate with center crack. Consider both plane strain and plane stress condition separately. **(12)**

(b) Differentiate between stress concentration factor and stress intensity factor. **(5)**

(c) A steel panel in a machine is subjected to 100 ksi tensile stress. The panel had a 1 inch diameter hole in the center that had a pin pressed into it. The interference of the pin resulted in two small cracks emanating from the 1 inch diameter hole shown in Figure for Question No. (c). The material is 18 Ni (250) maraging steel having plane-strain fracture toughness of 85 Ksi $(\text{in.})^{1/2}$. During service the pin was removed and the 1 inch hole was left open. Estimate the maximum crack length that can be allowed in the panel. How can the crack be detected? **(18)**

7. (a) Describe the limitations of Eular buckling theory using stress vs slenderness ratio graph. Also explain how the Rankine-Gordon formula overcomes the limitation. **(15)**

(b) Show that $\omega = \frac{1}{\mu} \operatorname{Im} Z_{III}$, chosen for the Mode III problem for a center-cracked infinite plate, satisfies the Laplace equation, $\nabla^2 \omega = 0$. Determine the stress components and all the displacement components in terms of $Z_{III}$. Also determine stress and displacement fields in the vicinity of the crack tip in terms of $K_{III}$. **(20)**

8. (a) "The mechanics of fracture progressed from being a scientific curiosity to an engineering discipline, primarily because of what happened to the Liberty ships during World War II'. Do you agree with this statement? **(12)**

(b) A flat plate made from a brittle material contains a macroscopic through-thickness crack with half length a, and notch tip radius $\rho$. A sharp penny-shaped microcrack with radius $a_2$ is located near the tip of the larger flaw, as illustrated in the Figure for Question No. 8 (b). Estimate the minimum size of the microcrack required to cause failure in the plate when the Griffith equation is satisfied by the global stress and $a_1$. Poisson's ratio, $\nu = 0.3$. **(13)**

(c) With necessary figures show the effect on the crack growth for an overload pulse in a constant amplitude fatigue load. **(10)**

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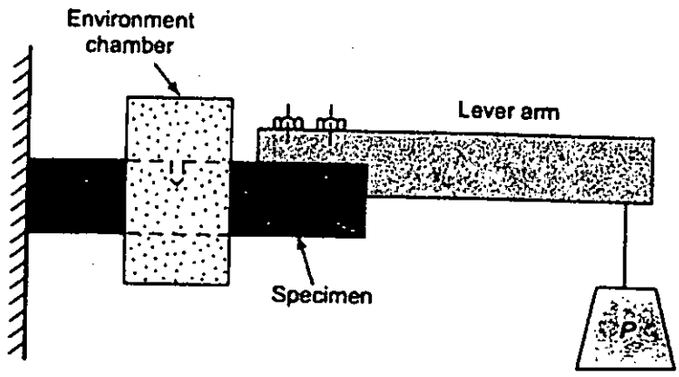
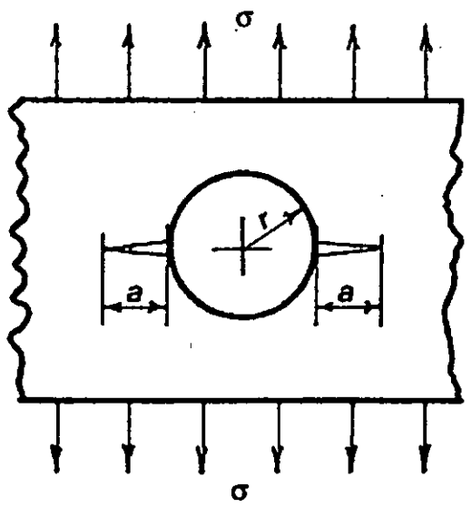
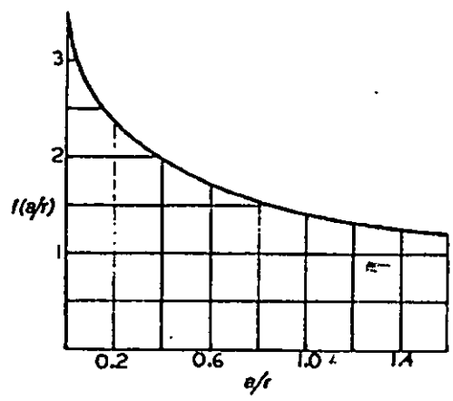



Figure for Question No. 5(a)

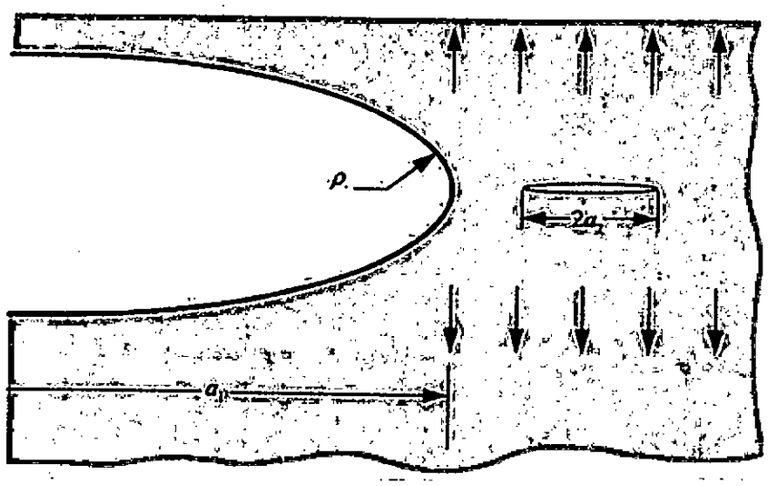
Figures for Question No. 6(c)



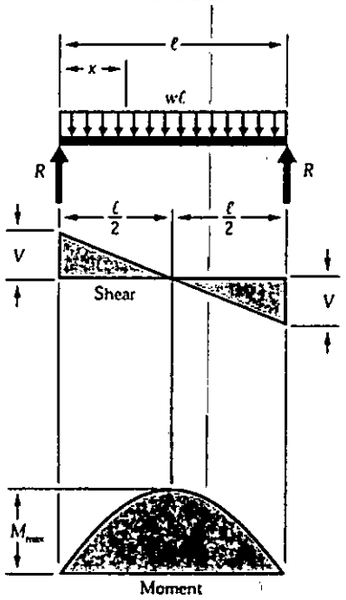




Correction for a double crack at a circular hole

Figure for Question No. 8(b)



## Figure 1 Simple Beam – Uniformly Distributed Load




$$R = V \quad = \frac{w\ell}{2}$$

$$V_x \quad = w\left(\frac{\ell}{2} - x\right)$$

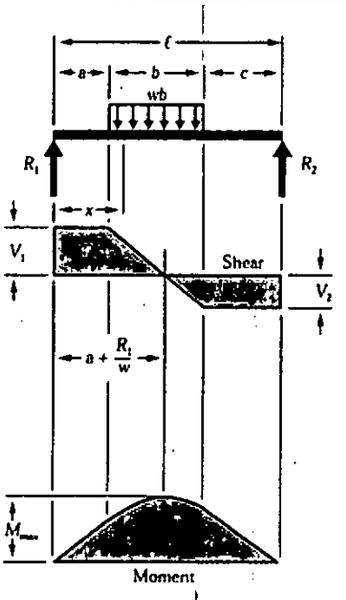
$$M_{max} \text{ (at center)} \quad = \frac{w\ell^2}{8}$$

$$M_x \quad = \frac{wx}{2}(\ell - x)$$

$$\Delta_{max} \text{ (at center)} \quad = \frac{5w\ell^4}{384\,EI}$$

$$\Delta_x \quad = \frac{wx}{24\,EI}(\ell^3 - 2\ell x^2 + x^3)$$

## Figure 2 Simple Beam – Uniform Load Partially Distributed




$$R_1 = V_1 \text{ (max when } a < c) \quad = \frac{wb}{2\ell}(2c + b)$$

$$R_2 = V_2 \text{ (max when } a > c) \quad = \frac{wb}{2\ell}(2a + b)$$

$$V_x \text{ (when } x > a \text{ and } < (a + b)) \quad = R_1 - w(x - a)$$

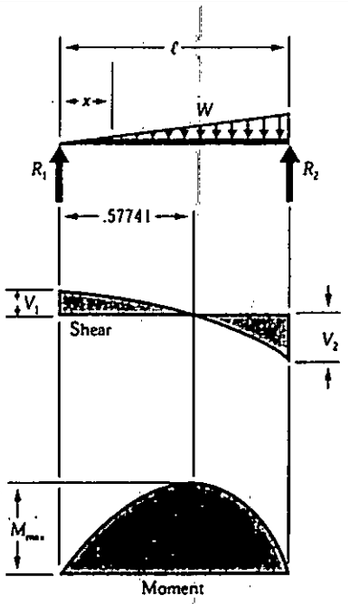
$$M_{max} \left(\text{at } x = a + \frac{R_1}{w}\right) \quad = R_1\left(a + \frac{R_1}{2w}\right)$$

$$M_x \text{ (when } x < a) \quad = R_1 x$$

$$M_x \text{ (when } x > a \text{ and } < (a + b)) \quad = R_1 x - \frac{w}{2}(x - a)^2$$

$$M_x \text{ (when } x > (a + b)) \quad = R_2(\ell - x)$$

## Figure 5 Simple Beam – Load Increasing Uniformly to One End




$$R_1 = V_1 \quad = \frac{W}{3}$$

$$R_2 = V_2 \quad = \frac{2W}{3}$$

$$V_x \quad = \frac{W}{3} - \frac{Wx^2}{\ell^2}$$

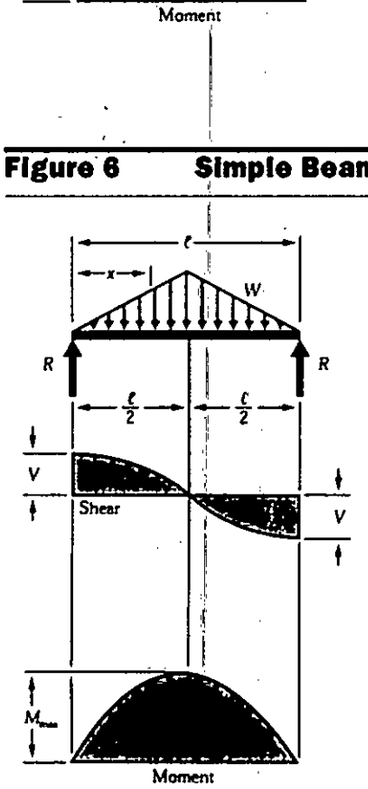
$$M_{max}\left(\text{at } x = \frac{\ell}{\sqrt{3}} = .5774\ell\right) \quad = \frac{2W\ell}{9\sqrt{3}} = .1283W\ell$$

$$M_x \quad = \frac{Wx}{3\ell^2}(\ell^2 - x^2)$$

$$\Delta_{max}\left(\text{at } x = \ell\sqrt{1 - \sqrt{\frac{8}{15}}} = .5193\ell\right) \quad = .01304\frac{W\ell^3}{EI}$$

$$\Delta_x \quad = \frac{Wx}{180EI\ell^2}(3x^4 - 10\ell^2x^2 + 7\ell^4)$$

## Figure 6 Simple Beam – Load Increasing Uniformly to Center




$$R = V \quad = \frac{W}{2}$$

$$V_x \left(\text{when } x < \frac{\ell}{2}\right) \quad = \frac{W}{2\ell^2}(\ell^2 - 4x^2)$$

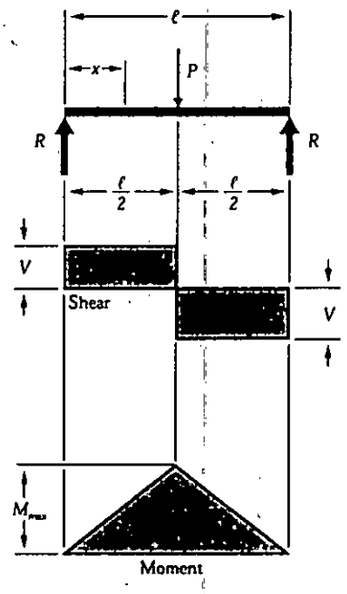
$$M_{max} \text{ (at center)} \quad = \frac{W\ell}{6}$$

$$M_x \left(\text{when } x < \frac{\ell}{2}\right) \quad = Wx\left(\frac{1}{2} - \frac{2x^2}{3\ell^2}\right)$$

$$\Delta_{max} \text{ (at center)} \quad = \frac{W\ell^3}{60EI}$$

$$\Delta_x \quad = \frac{Wx}{480EI\ell^2}(5\ell^2 - 4x^2)^2$$

## Figure 7 Simple Beam – Concentrated Load at Center




$R = V \quad \ldots\ldots\ldots\ldots = \frac{P}{2}$

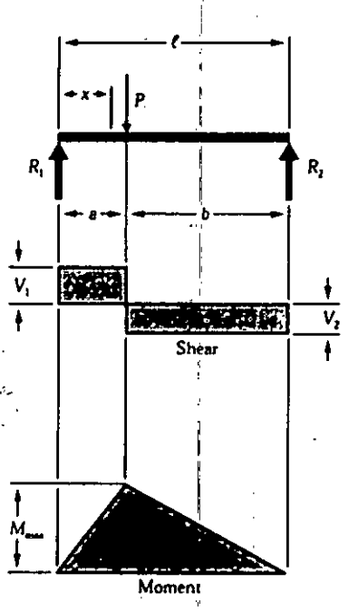
$M_{max}$ (at point of load) $\ldots\ldots = \frac{P\ell}{4}$

$M_x \left(\text{when } x < \frac{\ell}{2}\right) \ldots\ldots = \frac{Px}{2}$

$\Delta_{max}$ (at point of load) $\ldots\ldots = \frac{P\ell^3}{48EI}$

$\Delta_x \left(\text{when } x < \frac{\ell}{2}\right) \ldots\ldots = \frac{Px}{48EI}(3\ell^2 - 4x^2)$

## Figure 8 Simple Beam – Concentrated Load at Any Point




$R_1 = V_1$ (max when $a < b$) $\ldots\ldots = \frac{Pb}{\ell}$

$R_2 = V_2$ (max when $a > b$) $\ldots\ldots = \frac{Pa}{\ell}$

$M_{max}$ (at point of load) $\ldots\ldots = \frac{Pab}{\ell}$

$M_x$ (when $x < a$) $\ldots\ldots = \frac{Pbx}{\ell}$

$\Delta_{max} \left(\text{at } x = \sqrt{\frac{a(a+2b)}{3}} \text{ when } a > b\right) = \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EI\ell}$

$\Delta_a$ (at point of load) $\ldots\ldots = \frac{Pa^2b^2}{3EI\ell}$

$\Delta_x$ (when $x < a$) $\ldots\ldots = \frac{Pbx}{6EI\ell}(\ell^2 - b^2 - x^2)$

$\Delta_x$ (when $x > a$) $\ldots\ldots = \frac{Pa(\ell - x)}{6EI\ell}(2\ell x - x^2 - a^2)$

L-4/T-1/NAME Date: ~~28/04/2024~~ 19/05/2024

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2022-2023

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

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## SECTION – A

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

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

1. (a) What are the basic dredging processes? Briefly explain all hydraulic primary extraction methods with necessary figures. **(15)**

   (b) Why geotechnical site investigation is necessary for any dredging projects? Briefly discuss the guidelines for geotechnical site investigations. **(20)**

2. (a) For a Trailing Suction Hopper Dredger (TSHD) the maximum hopper capacity for soft clay is 1130 $m^3$, and the hopper filling percentage is 80. While dredging at a speed of 2 knots, the dredger takes approximately 1 hr to efficiently load soft clay. The time taken to turn the dredger at each end after dredging 2000m length area is 30 minutes. After loading the hopper it sails 3 km to discharge the dredge material with a speed of 6 knots. The time it takes to discharge the material with pump is 60 minutes. Find the output of the TSHD in this case. It is given that, the delay factor due to weather and traffic is 0.38, the operational factor due to competency of the crew is 0.84 and the dredger is 10 years old. **(20)**

   (b) For estimating the output for various types of dredging write short notes on the following **(15)**

   (i) Non-Productive Working time.

   (ii) Bulking factors

   (iii) Nominal and maximum potential output.

3. (a) Mention the salient features for selecting appropriate dredge pumps for dredgers. Explain with necessary figures how pipeline critical velocity and corresponding pressure affect hydraulic transport in dredging. **(20)**

   (b) A heavy duty slurry pump is required for the following duty: **(15)**

   70 tons per hours of sand

   Specific gravity of solid = 2.65

   Average particle size d50 = 211 microns

   Concentration of solid, $C_w$ = 30% by weight

Contd ..... P/2

**NAME 475**

**Contd... Q. No. 3(b)**

Static discharge head ($Z_d$) = 65 ft

Length of pipeline = 325 ft

Pipe diameter = 0.5 feet

$F_l$ = 1.04

Find

(i) Specific gravity of slurry mixture

(ii) Quantity of slurry

(iii) Concentration of solids by volume

(iv) Check for limiting settling velocity

4. (a) For excavating the following types of soil, construct a table and point out the advantages, challenges, rate of production and suitability of different types of dredgers. **(20)**

(i) Sand and non-cohesive silts.

(ii) Cobbles and boulders

(iii) Rock.

(b) For a TSHD, the time taken to sail to the disposal area is 1hr. Overflow commences after 10 min of the start of dredging. The percentage load in hopper vs time data is given in the table below. **(15)**

| Time (in min.) | % load in hopper |
|---|---|
| 0 | 0 |
| 10 | 30 |
| 32 | 55 |
| 46 | 72 |
| 76 | 93 |
| 106 | 99 |
| 110 | 99 |

First plot the graph for calculating Optimum Overflow duration by taking the scale for time in X axis (take 1 cm = 10 min.) and % load in Y axis (take 6 cm = 100%) and calculate the economic overflow duration for this above mentioned case.

## SECTION – B

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

5. (a) A dredging company is engaged in a dredging project to improve the navigability in the Padma river. Select suitable dredgers with ancillary equipment for this purpose and justify your selection. **(20)**

(b) With neat sketches describe the working principle of a dustpan dredger. **(8)**

(c) What is the difference between a cutterhead and a draghead? **(7)**

Contd ..... P/3

**NAME 475**

6. (a) List various types of grab buckets and discuss their important features. **(10)**

(b) With neat sketches explain the working pattern for grab hopper dredger fitted with multiple grab cranes. **(10)**

(c) What are the important factors to select dredging pipes? Compare the merits and limitations of High-Density Polyethylene (HDPE) pipes over steel pipes for dredging purpose. **(15)**

7. (a) Compare the production cycle for grab hopper dredger and grab pontoon dredger. **(10)**

(b) Briefly describe various hopper discharge mechanisms for a trailing suction hopper dredger (TSHD). **(20)**

(c) Write a short note on swell compensator. **(5)**

8. (a) Explain the importance of the overflow system in a TSHD to improve the productivity. **(5)**

(b) With neat sketches discuss the pattern of working using various spud arrangements for cutter suction dredgers. **(10)**

(c) For designing a trailing suction hopper dredger (TSHD), the following data are available: **(20)**

Yearly dredge output = $5 \times 10^6\ m^3$

Type of material: Coarse sand and gravel ($\rho = 2000\ kg/m^3$)

Distance of the site: 75 Nautical miles

Ship speed: 15 knot

Dredger working hour: 5 days at 24 hours, Overhaul 2 weeks, Weather delay 3 weeks, Christmas 1 week, Bunkers will be taken in the weekend.

Loading and unloading time: 3 hours

Sailing to the unloading area: 3 hours

Maximum Filling of hopper = 90%, Workability 95%.

Calculate the required hopper volume and hopper density.

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L-4/T-1/NAME **Date : 25/03/2024**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2022-2023

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

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## SECTION – A

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

The symbols have their usual significance.

1. (a) State the optimality and feasibility conditions of Dual Simplex method. **(10)**

   (b) Write the dual of the following primal **(10)**

   Maximize $z = 5x_1 + 12x_2 + 4x_3$

   Subject to

   $$x_1 + 2x_2 + x_3 \le 10$$
   $$2x_1 - 2x_2 + 3x_3 = 8$$
   $$x_1, x_2, x_3 \ge 0$$

   (c) Consider the following LP **(15)**

   Maximize $z = 2x_1 + 4x_2 + 4x_3 - 3x_4$

   Subject to

   $$x_1 + x_2 + x_3 = 4$$
   $$x_1 + 4x_2 + x_4 = 8$$
   $$x_1, x_2, x_3, x_4 \ge 0$$

   The optimal solution yields the following objective equation:

   $$z + 2 \cdot x_1 + 0 \cdot x_2 + 0 \cdot x_3 + 3 \cdot x_4 = 16$$

   Determine the associated optimal dual solution.

2. (a) Deduce the following expression for revised simples method matrix **(15)**

   $$\begin{bmatrix} 1 & C_B B^{-1} A - c \\ 0 & B^{-1} A \end{bmatrix} \begin{bmatrix} z \\ x \end{bmatrix} = \begin{bmatrix} C_B B^{-1} b \\ B^{-1} b \end{bmatrix}$$

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

   Maximize $z = 2x_1 + x_2$

   Subject to

   $$3x_1 + x_2 - x_3 = 2$$
   $$4x_1 + 3x_2 - x_4 = 4$$
   $$x_1 + 2x_2 + x_5 = 2$$
   $$x_1, x_2, x_3, x_4, x_5 \ge 0$$

   Compute the entire simplex tableau by revised simplex method associated with $X_B = (x_1, x_2, x_5)^T$ and determine if it is feasible and optimal.

Contd ..... P/2

**NAME 477**

3. (a) Solve the non-linear problem by the Jacobain method **(15)**

Minimize $z = x_1^2 + x_2^2 + x_3^2$

Subject to

$g_1(X) = 4x_1 + x_2 + 3x_3 - 2 = 0$
$g_2(X) = 5x_1 + 2x_2 + x_3 - 5 = 0$
$x_1, x_2, x_3 \geq 0$

(b) Solve the non-linear problem by the Lagrangean method **(20)**

Minimize $z = x_1^2 + x_2^2 + x_3^2$

Subject to

$4x_1 + x_2^2 + 2x_3 - 14 = 0$
$x_1, x_2, x_3 \geq 0$

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

Maximize (minimize) $z = CX + X^T DX$

Subject to

$AX \leq b$
$X \geq 0$

Show that the Kuhn-Tucker conditions can be expressed as

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

$$\lambda_i S_i = \mu_j x_j = 0$$
$$X, \lambda, \mu, S \geq 0$$

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

*minimize* $z = (x_2 - x_1)^2 + (1 - x_1)^2$ with an initial point $X_0 = (0,0)$.

## SECTION – B

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

Assume reasonable value for any data if missing.

5. (a) List the properties of a standard Linear programming model. Explain what do you mean by unrestricted variables. **(10)**

(b) A manufacturing firm produces two machines, parts using lathes, milling machines, and grinding machines. The different machining times required for each part, the machining times available on different machines, and the profit on each machine part are given in the following table: **(25)**

Contd ..... P/3

**NAME 477**

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

| Type of Machine | Machining time required (min) | | Max. time available per week (min) |
|---|---|---|---|
| | Machine Part 1 | Machine Part 2 | |
| Lathes | 10 | 5 | 2500 |
| Milling Machines | 4 | 10 | 2000 |
| Grinding Machines | 1 | 1.5 | 450 |
| Profit Per Unit | $50 | $100 | |

Determine the number of part 1 and 2 to be manufacturing per week to maximize the profit using graphical method.

6. (a) Explain the terms degeneracy, alternative optima and unbounded solution. **(10)**

(b) Consider the following LP problem and solve using simplex method **(25)**

$$\begin{aligned} Max\ z &= 3x_1 + 2x_2 + 5x_3 \\ x_1 + x_2 + x_3 &\le 9 \\ 2x_1 + 3x_2 + 5x_3 &\le 30 \\ 2x_1 - x_2 - x_3 &\le 8 \\ x_1, x_2, x_3 &\ge 0 \end{aligned}$$

7. (a) Suppose, you are evaluating six ship design projects on the basis of construction cost, expected revenue and what to determine which project to be executed. Discuss which method of optimization process you will use in this case. For this particular case, briefly explain the methods. **(15)**

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

$$\begin{aligned} \text{Maximize } z &= x_1 + 4x_2 + 7x_3 + 5x_4 \\ \text{Subject to} & \\ 2x_1 + x_2 + x_3 + 4x_4 &= 10 \\ 3x_1 - x_2 - 2x_3 + 6x_4 &= 5 \\ x_1, x_2, x_3, x_4 &\ge 0 \end{aligned}$$

Generate the generalized simplex tableau associated with the basis B = ($P_1$, $P_2$).

8. (a) Explain the optimality and feasibility conditions for revised simplex method. **(10)**

(b) Find the maximum of the functions **(25)**

$$f(x) = -x^2 + 2x + 11$$

in the range $-2 \le x \le 2$ using the particle Swarm Optimization Method (PSO). Use 4 particles (N = 4) with the initial positions $x_1 = -1.5, x_2 = 0.0, x_3 = 0.5, x_4 = 1.25$. Show the detailed computations only for iterations 1 and 2.

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L-4/T-1/NAME

Date: 04/05/2024

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B.Sc. Engineering Examinations 2022-2023

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

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## SECTION – A

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

1. (a) Describe the important contributions made by Frederick W Taylor and Frank and Lillian Gilbreth in Scientific management theory. **(15)**

(b) "Management was, is, and always will be the same thing: the art of getting things done." Do you agree? Why or why not? **(10)**

(c) Explain what factors influence the amount of centralization and decentralization. **(10)**

2. (a) Explain why such forecasting devices as moving averages, weighted moving averages, and exponential smoothing are not well suited for data series that have trends. **(10)**

(b) Coffee Palace's Manager, Joe Felan, suspects that demand for mocha latte coffees depends on the price being charged. Based on historical observations, Joe has gathered the following data, which show the numbers of these coffees sold over six different price values. **(25)**

| Price | Number sold |
|---|---|
| $ 2.70 | 760 |
| $ 3.50 | 510 |
| $ 2.00 | 980 |
| $ 4.20 | 250 |
| $ 3.10 | 320 |
| $ 4.05 | 480 |

Using these data, how many mocha latte coffees would be forecast to be sold according to linear regression if the price per cup were $ 1.80?

3. (a) What is Hawthorne effect and why is it important to managers? **(10)**

(b) The 'X' company makes flashing lights for toys. The company operates tis production facility 300 days per year. It has orders for about 12000 flashing lights per year and has the capability of producing 100 per day. Setting up the light production costs $50. The cost of each light is $1. The holding cost is $0.10 per light per year. **(25)**

i) What is the optimal size of the production run?
ii) What is the average holding cost per year?
iii) What is the average setup cost per year?
iv) What is the total cost per year, including the cost of the lights?

Contd..... P/2

**IPE 479**

4. (a) Explain how the contingency approach differs from the early theories of management. **(10)**

(b) A factory has six jobs awaiting processing. Processing time and dues are given in the table. Assume that job s arrive in the order shown. In what sequence would the jobs be ranked according to the following decisions rules: (i) SPT (ii) EDD. Which is better and why? **(25)**

| JOB | JOB Processing time (days) | JOB Due Date (days) |
|---|---|---|
| A | 6 | 22 |
| B | 12 | 14 |
| C | 14 | 30 |
| D | 2 | 18 |
| E | 10 | 25 |
| F | 4 | 34 |

## SECTION – B

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

Assume relevant values for any missing data.

5. (a) Edingur company is preparing budgets for the quarter ending June 30. Budgeted sales for the next five months are: **(15)**

| Month | Units |
|---|---|
| April | 20,000 |
| May | 50,000 |
| June | 30,000 |
| July | 25,000 |
| August | 15,000 |

The selling price is $10 per unit. All sales are on account.

Edingur's cash collection pattern is 70% collected in the month of sale, 25% collected in the month following sale, 5% uncollectible. The March 31 accounts receivable balance of $30,000 will be collected in full. The management at the company wants ending inventory to be equal to 20% of the following month's budgeted sales in units. On March 31, 4,000 units were on hand. Construct the sales budget and show the expected cash collections for the quarter starting from April and ending in June. Finally prepare the production budget. Assume relevant value for any missing data.

(b) A $45,000 investment in a new conveyor system is projected to improve throughput and increasing revenue by $14,000 per year for five years. The conveyor will have an estimated market value of $4,000 at the end of five years. Using FW and a MARR of 12%, evaluate if this is a good investment. **(10)**

Contd..... P/3

**IPE 479**

**(Contd ..... Q. No. 5)**

(c) Briefly describe the "Hersey and Blanchard's" Situational Leadership model. **(10)**

6. (a) Newton corporation is working on their wage and incentive plans. Worker A produces 1300 units per day and worker B produces 1500 units per day. Normal wage rate per hour is Rs 1.80. Standard time per unit is 20 seconds. Differentials are applied in the following manner: 80% of piece rate below standard, 120% of piece rate at or above standard. Calculate earnings of both the workers A and B under straight piece-rate system and Taylor's differential piece rate system. **(13)**

(b) Convert the following minimization problem into its dual. **(8)**

Minimize $z = 5x_1 + 6x_2 + 7x_3$

subject to $3x_1 + 2x_2 + 3x_3 \geq 10$

$4x_1 + 3x_2 + 5x_3 \geq 12$

$x_1, x_2, x_3 \geq 0$

(c) Niki holds two part-time jobs, Job I and Job II. She never wants to work more than a total of 12 hours a week. She has determined that for every hour she works at Job I, she needs 2 hours of preparation time, and for every hour she works at Job II, she needs one hour of preparations time, and she cannot spend more than 16 hours for preparation If she makes $40 an hour at Job I, and $30 an hour at Job II, how many hours should she work per week at each job to maximize her income? Write the objective function and the constraints. Solve the problem using simplex method. **(14)**

7. (a) Describe the advantages and disadvantages of different performance appraisal methods. **(12)**

(b) Briefly explain the classification of cost of quality. How can you differentiate between prevention cost and appraisal cost? **(11)**

(c) "The consequences of poor quality are grave and of many folds in business term." - Justify the statement. **(12)**

8. (a) The following information is known form a maintenance project of a chemical factory. **(15)**

| Activity | Immediate Predecessor | Activity completion time (days) | | |
|---|---|---|---|---|
| | | Optimistic | Most likely | Pessimistic |
| A | - | 2 | 4 | 6 |
| B | A | 3 | 7 | 10 |
| C | A | 2 | 3 | 5 |
| D | B | 4 | 7 | 9 |
| E | D | 12 | 16 | 20 |
| F | C | 2 | 5 | 8 |
| G | E, F | 2 | 2 | 2 |
| H | G | 2 | 3 | 4 |
| I | G | 2 | 3 | 5 |
| J | H, I | 2 | 4 | 6 |
| K | J | 2 | 2 | 2 |

Draw the network diagram and identify the critical path.

Contd..... P/4

**(Contd ..... Q. No. 8)**

(b) Consider a system that can either be in up (operating) or down (failed) state. Corrective maintenance is performed on the failed system to put it back into its operating state. **(15)**

The following assumptions are made:

i) System failure are statistically independent.

ii) Failure and corrective maintenance rate are constant

iii) The repaired system is as good as new.

Draw the system transition diagram. Derive the equation to evaluate the system steady-state availability.

(c) Write down the limitations of evaluating projects with the payback method. **(5)**