L-3/T-1/NAME

Date : ~~25/04/2024~~ 13/05/2024

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2021-2022

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

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** questions.

The symbols have their usual significance.

1. (a) Using circulation theory show that the ideal efficiency of the blade section at radius r can be expressed as $\eta_i = \frac{tan\beta}{tan\beta_1}$

where β and β_1 are the hydrodynamic pitch angles excluding and including the induced velocities respectively.

(b) A propeller of 2.0 m diameter produces a thrust of 30.0 KN when advancing at a speed of 4.0 m per sec in a sea water. Determine the power delivered to the propeller, the velocities in the slipstream at the propeller disc and at a section for astern, the thrust loading coefficient and the ideal efficiency. **(15)** **(20)**

2. (a) Show that the propulsive efficiency and the open water efficiency can be expressed as $\eta_D = \eta_0 \times \eta_H \times \eta_R$ and $\eta_0 = \frac{J}{2\pi}\frac{K_T}{K_Q}$ **(15)**

(b) A ship with a propeller of diameter 5.0 m has a speed of 11.66 knots with the propeller running at 90 rpm. The propulsion factors based on torque identity are: wake fraction 0.250, thrust deduction fraction 0.190, relative rotative efficiency 1.060 and shafting efficiency 0.970. The open water characteristics of the propeller are as follows: **(20)**

J	:	0	0.200	0.400	0.600	0.800
K_T	:	0.342	0.288	0.215	0.124	0.028
$10K_Q$	:	0.402	0.350	0.276	0.195	0.108

Determine the brake power of the engine and the effective power of the ship at this speed.

3. (a) What do you mean by cavitation? How can you classify the cavitation according to the region on the propeller where it occurs and also to the nature of cavities or its appearance? **(15)**

(b) The service delivered power P_D for a ship travelling at an estimated speed of 17 knots is 12500 kW at 110 rpm. Using Fig. for Q. No 3(b) calculate the optimum propeller diameter, propeller pitch and efficiency. Given $w_T = 0.25$, $t = 0.15$ and $\eta_R = 1.01$. If the propeller diameter is limited to 6.3 m, determine the new pitch ratio and the loss of efficiency as compared with the optimum screw. **(20)**

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4. (a) State the assumptions you made for determination of the propeller blade strength. **(15)**

(b) A three-bladed propeller of 3.0 m diameter has a thrust of 360 KN and a torque of 30 KN-m. Determine the bending moments due to thrust and torque in the root section at 0.3 m radius, assuming the thrust and torque are uniformly distributed between this radius and the propeller blade tip. **(20)**

SECTION - B

There are **FIVE** questions in this section. Answer to Question No. **5** is compulsory and Answer any **THREE** questions from the rest.

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

5. (a) What do you understand by resistance of ship motion? Point out the significance for the study of ship resistance. **(10)**

(b) Explain different empirical formulae used for the calculation of ship frictional resistance. **(15)**

(c) Consider a 150-m long ship with a wetted surface area of 3800 m^2 and a design speed of 15 knots. A 5.2-m long geometrically similar model runs at a corresponding speed from 2.0 to 15.0 knots in fresh water. The force measured to tow the model at a speed corresponding 15 knots is 50 N and at the corresponding speed 2 knots is 1.10 N respectively. For convenience, take density $\rho = 1000$ kg/m^3 and kinematic viscosity $\nu = 1.1\ 120 \times 10^{-6}$ m^2/s for both model and ship. **(20)**

(i) Find the form coefficient of the ship

(ii) Estimate the resistance of the ship

(iii) Determine the effective power of the full-sized ship at 15 knots speed.

6. (a) Distinguish between Towing Tank and Ship Model Basin. **(10)**

(b) Develop the dynamical similarity relationship between the ship and the model in case of incompressible fluid with a free surface. **(10)**

7. (a) What is hump and hollows in the resistance curve of ship? Why the designer at the design stage choose the design ship length and/or speed to avoid resistance curve humps? Explain briefly. **(10)**

(b) Write short notes on wave breaking and added wave resistance of ships. **(10)**

8. (a) State the condition for deep water, medium deep, shallow and very shallow water with respect to water depth to ship draft ratio. **(5)**

(b) A cargo vessel has Length, L = 112.8 m, Breadth, B = 19.5 m, Depth, D = 9.0 m, Draft, T = 5.3 m, and midship area, A_x = 103.2 m^2. For a given power, the vessel travels at 15 knots in deep water. When the vessel is travelling in a canal whose sectional view is shown in Figure for Question No. 8(b), determine the speed loss, (i) In case of water of infinite breadth but limited depth of water and, (ii) in case of water of finite breadth and limited depth of water. **(15)**

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

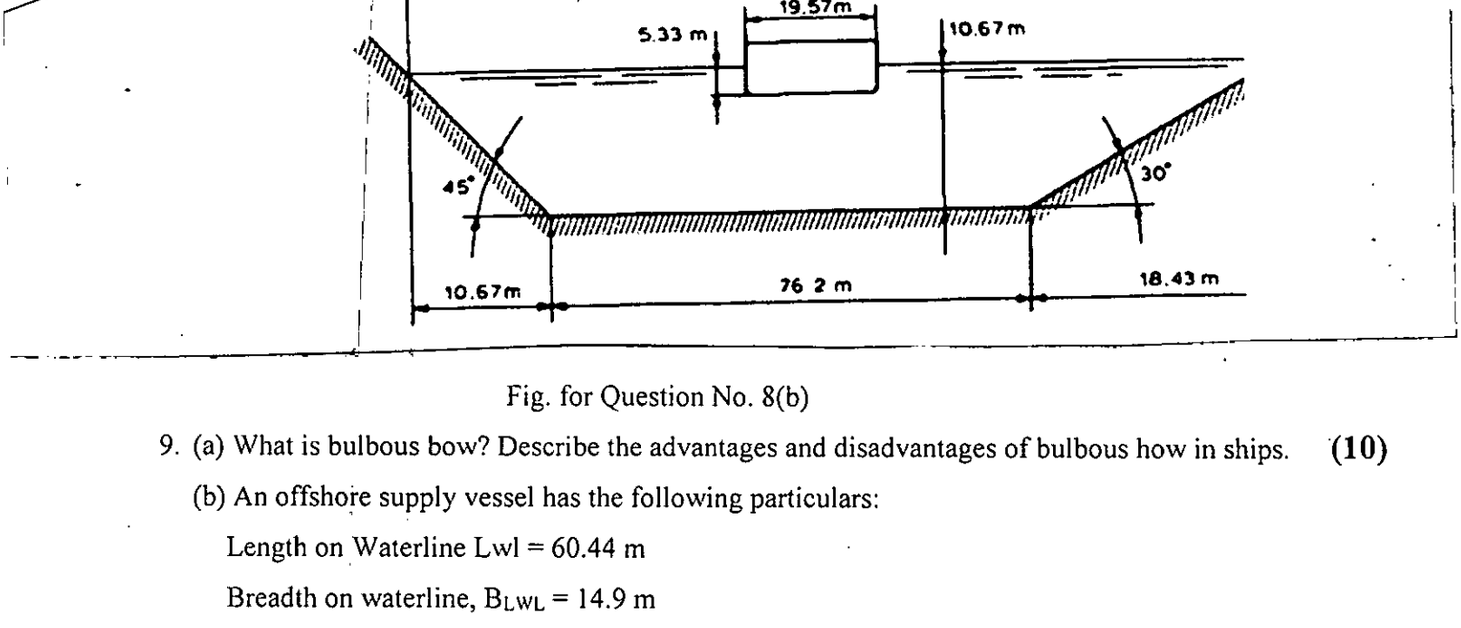

Fig. for Question No. 8(b)

9. (a) What is bulbous bow? Describe the advantages and disadvantages of bulbous how in ships. **(10)**

(b) An offshore supply vessel has the following particulars:

Length on Waterline Lwl = 60.44 m

Breadth on waterline, B_{LWL} = 14.9 m

Draft, T = 5.5 m

C_B (for L=Lwl) = 0.69

C_P (for L=Lwl) = 0.705

Displacement, ∇ = 3447.45 m^3

Wetted Surface Area, S_{wett} = 1205.98 m^2

LCB = 2.8% (half-length of ship) aft of amidships

Find the residuary resistance (including B/T correction and LCB correction) at speed of 12 and 15 knots using Harvald and Guldhammer method. **(10)**

$$\left[\left(B/T\right)_{correction} \quad 10^3 C_R = 10^3 C_{R(\text{standard})} + 0.16\left(B/T - 2.5\right),\right.$$

$$\left.\left(LCB\right)_{correction} \quad 10^3 C_R = 10^3 C_{R(\text{standard})} + \frac{\partial\left(10^3 C_R\right)}{\partial\left(LCB\right)}\left|\Delta LCB\right|\right]$$

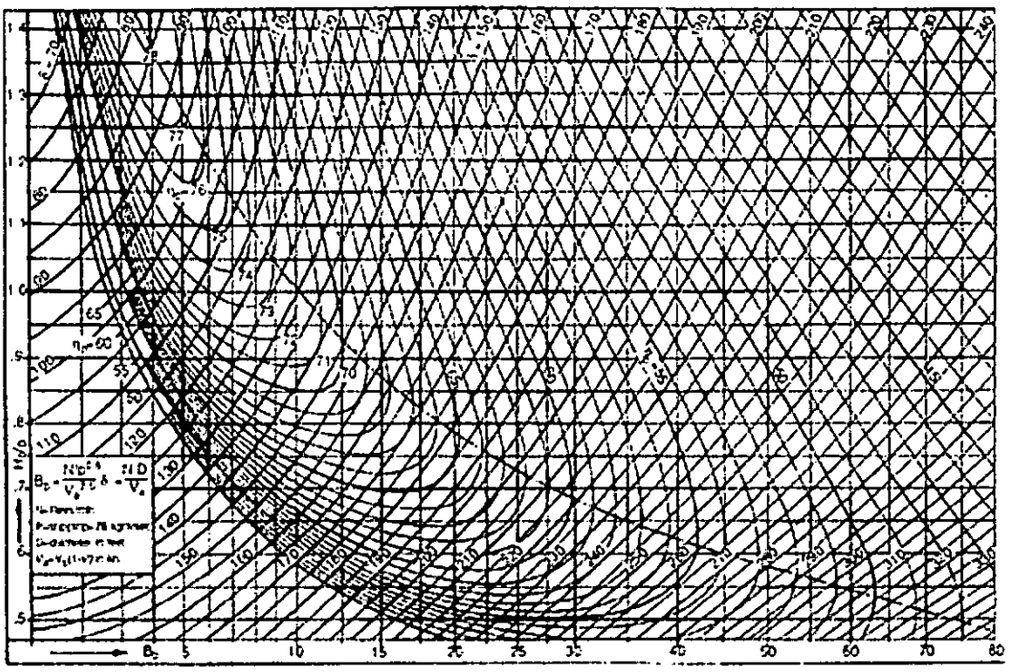

Figure 16.5. Bp-δ characteristics for Wageningen B4.40 propeller (Courtesy of MARIN).

Fig. for Q. No. 3(b)

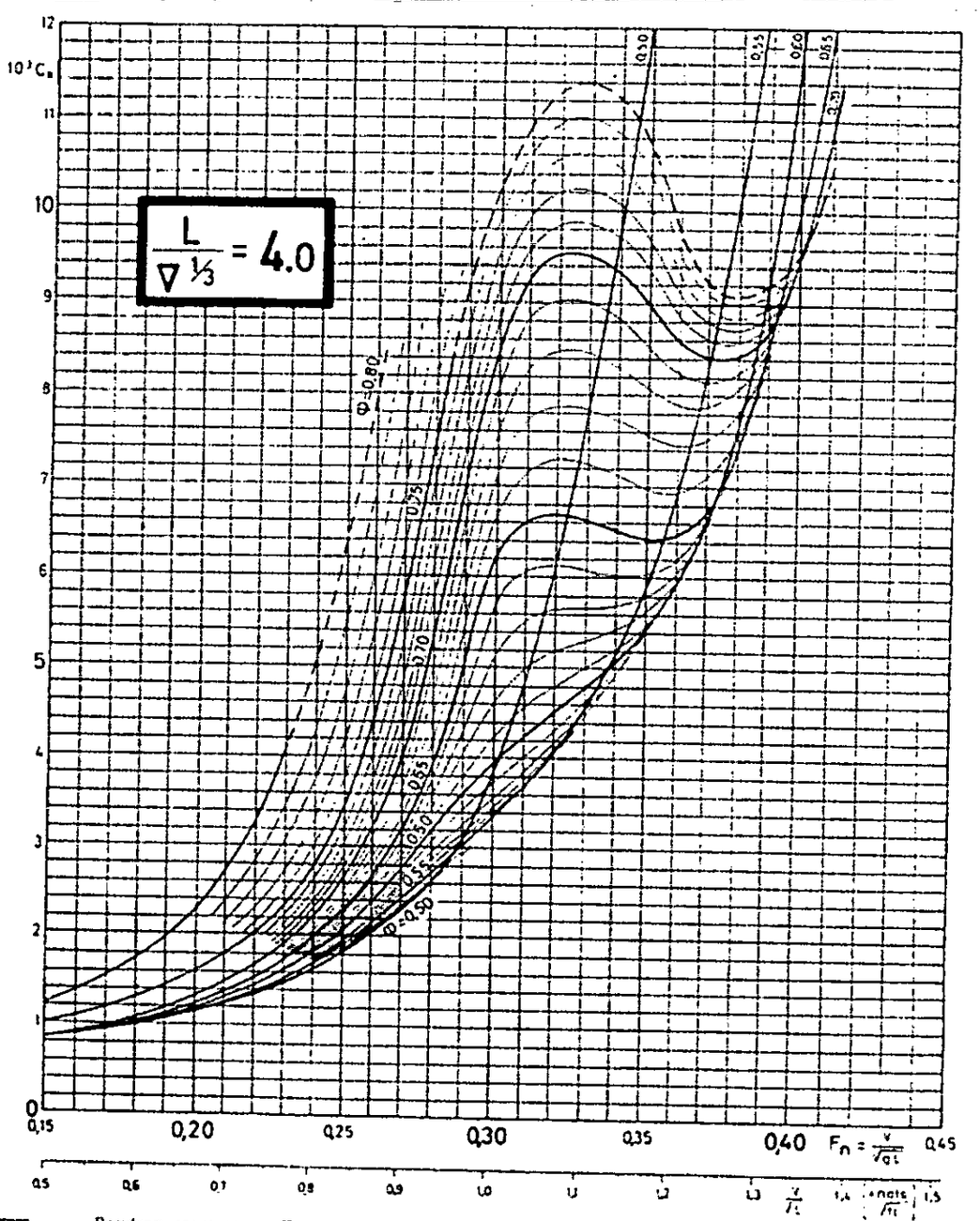

Figure Residuary resistance coefficient versus speed–length ratio for different values of longitudinal prismatic coefficient $L/\nabla^{1/3} = 4.0$.

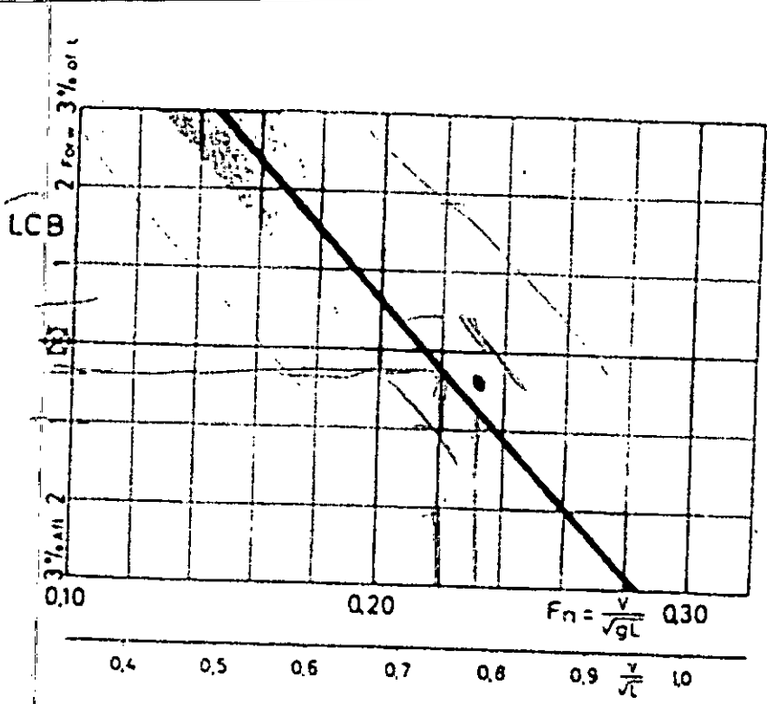

Figure Standard LCB. The longitudinal position of the center of buoyancy that is considered the best possible.

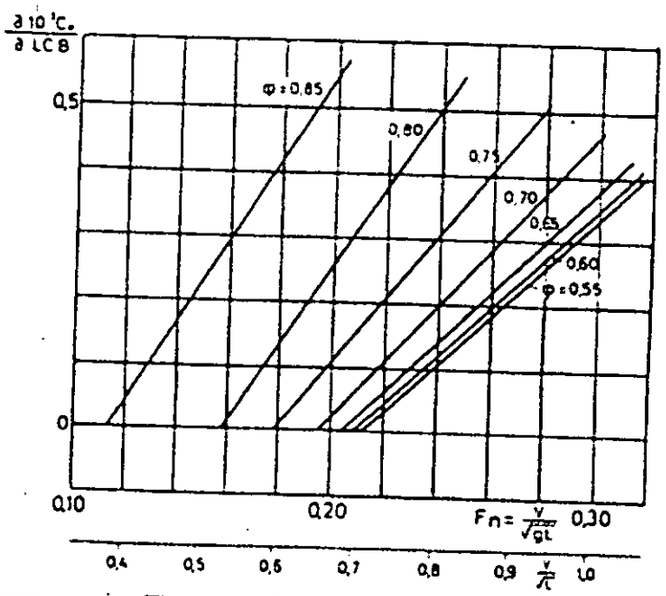

Figure The correction of the residual resistance coefficient for LCB 1% forward of standard. The correction is thus $(\partial 10^3 C_R/\partial LCB)|\Delta LCB|$, where ΔLCB is the longitudinal distance between actual and standard LCB in percent of L. There is no correction for LCB aft of standard. The correction is always positive.

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20/05/2024

Date : ~~30/04/2024~~

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2022-2023

Sub : **NAME 345** (Welding 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 **THREE** questions. Question No. 1 is compulsory.

1. (a) Define 'Tig Welding'. Describe the 'Arc Starting' techniques for TIG Welding with necessary figures. **(7)**

(b) Explain 'Cushioning Effect' of molten pool of metal. Describe the effect of arc voltage variations on weld bead and fusion zone shape with necessary figures. Assume all the other parameters involved are constant. **(6)**

(c) Sketch and explain how the welds would appear as specified by the symbols as shown in Fig. for Questions No. 1(c). Use a cross-sectional view if needed. **(12)**

(d) Consider a case of root run of a butt welding of 12 mm thick steel plate with the following parameters: **(10)**

Arc voltage = 28 V, Welding current = 300 A, Welding speed = 11 mm/s, Arc efficiency = 0.9, Ambient temperature = 24°C. The limiting cooling rate for satisfactory performance is 6°C/s, at a temperature of 550°C. Assume, λ = 0.028 J/mm s°C and ρC_p = 0.0044 J mm^3 °C. Determine:

(i) The cooling rate when the base metal is not preheated

(ii) The cooling rate when the base metal is preheated to 29°C.

2. (a) The penetration pattern of a weld is determined by the electron flow in Direct Current Straight Polarity, Direct Current Reverse Polarity or, Alternating Current High Frequency – Justify with necessary figures. **(5)**

(b) If you are to perform 'Shielded Metal Arc Welding', which type of power supply will you choose? Give reasoning behind your answer with appropriate figures. **(8)**

(c) Sketch and explain how the welds would appear as specified by the symbols in Fig. for Question No. 2(c). Use a cross-sectional view if needed. **(8)**

(d) For a case of single side submerged arc welding of 6 mm thick steel plate at an ambient temperature of 30°C, with arc voltage of 28 V and welding current 400 A, estimate the heat affected zone. The welding speed is 10 mm/s. The arc efficiency is 0.8 and the melting temperature of steel is 1510°C. Consider, λ = 0.028 J/mm s °C abd ρC_p = 0.0044 J mm^3 °C. **(14)**

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3. (a) Describe the following with necessary figures: **(25)**

(i) Projection Welding, (ii) Backstep Welding, (iii) Marangoni Convection

(b) If you are to perform MIG Welding for a thick plate, which mode of metal transfer will you use to avoid spatter and why? Explain with necessary figures. **(10)**

4. (a) What is 'Arc Blow'? How does magnetic and thermal arc blow occur? Explain with necessary figures. **(15)**

(b) Describe different types of 'Tee joints'. Sketch the edge preparation for 'Tee Joints' with appropriate dimensions. **(10)**

(c) Since the1930s, the rivets in ships were started to be replaced by welding. What advantages do welding provide over riveting? Distinguish between 'Welding Rod' and 'Welding Electrode' with necessary figure. **(10)**

SECTION - B

There are **FOUR** questions in this section. Answer to Question No. **5** is compulsory and Answer any **TWO** from the rest.

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

5. (a) There is an internal crack in the deck plate of a ship. To measure the depth of the crack and also the size of the crack which method you will prefer? Justify your answer. Describe this method with suitable sketches. **(15)**

(b) A welding equipment can be used for the surface preparation. Explain the process of this surface preparation method. **(5)**

(c) What is hydrogen embrittlement? Why is it called cold crack? **(5)**

(d) In electroslag welding why copper shoes are used? And why is it cooled periodically? **(5)**

(e) Can we use oxy-acetylene cutting for all metal and also for underwater cutting? Justify your answer. **(5)**

6. (a) In a ship, shell plate and frame are to be connected using fillet weld. The leg size of fillet is same as the plate thickness. Some different combinations of plate thickness and frame spacing is considered here to find the optimum combination. For 4 mm plate thickness the frame spacings are 300 mm plate thickness the frame spacings are 300 mm, 400 mm, 500 mm, and 600 mm. The welding speed is 150 mm/s. Welding process factor, c = 33. The buckling constant, k = 5.5. Modulus of elasticity = 210 GPa. Poisson's ratio = 0.3. Determine the heat input during welding. Also find the optimum frame spacing based on buckling and weight consideration. **(18)**

(b) Draw different types of drag line produced after oxy-fuel cutting and explain their characteristics in brief. **(12)**

(c) Write down the differences between the arc welding and electroslag welding. **(5)**

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7. (a) To control distortion during welding the heat input has to be reduced. Describe 3 ways of reducing heat along with the corresponding welding method. **(10)**

   (b) With suitable sketches describe the thermo-mechanical tensioning method. **(15)**

   (c) Describe the effects of welding variables in submerged arc welding. **(10)**

8. (a) Show the defects mentioned below with suitable sketches. Also mention their cause, prevention and repair technique. **(16)**

   (i) Undercut

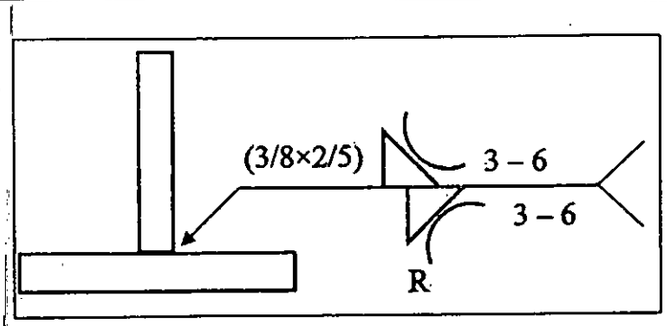
   (ii) Excessive reinforcement.

   (iii) Incomplete fusion.

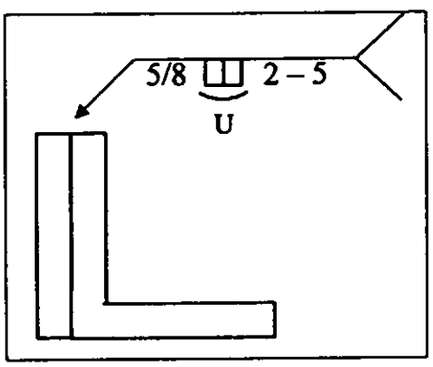
   (iv) Throat crack

   (b) Write down the limitations and advantages of non-destructive test. **(9)**

   (c) Describe 2 types of CO_2 blasting method. Do you prefer CO_2 blasting over wet blasting for ship repairing? Justify your answer. **(10)**



(i)



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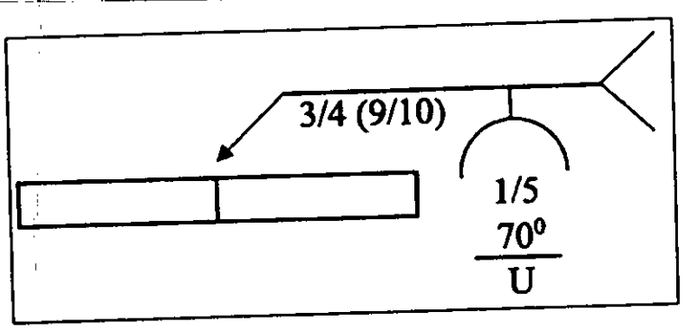
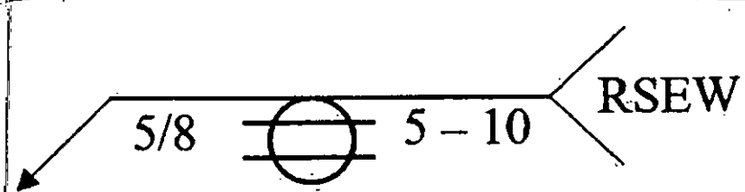
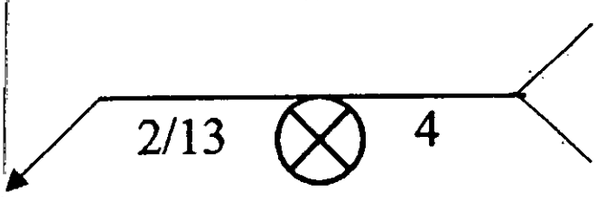


(iii)

Figures for Question No. 1 (c)



(i)



(4)

(ii)

Figure for Question No. 2 (c)

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L-3/T-1/NAME Date : ~~31/03/2024~~

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2022-2023

Sub : **NAME 351** (Ship Structures)

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 reasonable values for any missing data.

1. (a) Schematically explain the characteristics of shearing force and bending moment curves. **(7)**

   (b) Explain the buoyancy moment method. Applying this method, derive the expression of bending moment about amidship in case of a ship structure. **(15)**

   (c) Define – **(13)**

   (i) Still water bending moment

   (ii) Wave bending moment

   Explain the procedures for determining the still water bending moment and wave bending moment.

2. (a) Discuss the significance of shear stress in case of a ship structure. Hence, derive the following expression – **(14)**

$$E\frac{\partial e}{\partial x} = \frac{E}{N} W \int \frac{m}{Ib} dz$$

   where the symbols have their usual meanings.

   (b) What do you mean by shear deflection? Determine the procedure for calculating the shear deflection of a beam, with suitable schematic representation. **(13)**

   (c) Explain the variation of stresses when a ship is in an inclined condition. **(8)**

3. (a) Briefly describe the influence of heaving motion amongst waves on the longitudinal strength of a ship structure. Hence, deduce the expression – **(18)**

$$y = \frac{Y}{\sqrt{\left(1 - A^2\right)^2 + (2kA)^2}} \cos\left(\frac{2\pi t}{T_E} + \delta\right)$$

   where the symbols have their usual meanings.

   (b) A vessel 450 ft. long by 60 ft. beam has a constant rectangular section. The weight of the hull is 4500 tons, and may be considered to be distributed uniformly over the entire length. The machinery and fuel together weight 3000 tons and these are distributed uniformly over a length of 100 ft. amidships. Draw the curves of shearing force and bending moment when the vessel is poised statically on a wave having sine profile and height of 15 ft. the wave crests being at perpendiculars. State the maximum values of shearing force and bending moment and positions in the length where these occur. **(17)**

Contd P/2

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4. (a) Determine the expression for deflection and bending moment, for a simply supported plate subjected to uniformly distributed load. **(20)**

(b) Describe Murray's method of estimating longitudinal bending moments amidships, and use the method and the following data to find the still water bending moment amidships and the total bending moments amidships for a standard wave height of $1.1\sqrt{L}$ with its crest amidships, and alternatively with its trough amidships. **(15)**

Length = 448 ft.; C_b = 0.75; Beam = 62 ft.

Item	Weight (tons)	LCG from amidships (ft)
Machinery	1050	21A
No. 1 Hold	1510	155F
No. 2 Hold	3305	77F
Deep Tank empty	--	--
No. 4 Hold	1941	80A
No. 5 Hold	1210	150A
Oil Fuel	120	25A
Fresh Water	105	18F
Fresh Water	60	27A

The mean LCG from amidships of the Hull and Outfit Weight of the fore and aft bodies may be assumed at 0.2229L. The total Hull and Outfit weight = 3974 tons. The mean LCB of the fore and aft bodies is $L(0.174C_b + 0.057)$ from amidships. Values of b′ are: hogging 51.0, sagging 57.4 in the relationships,

$$W.B.M. = b' \times L^{2.5} \times B \times 10^{-5}$$

SECTION – B

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

5. (a) For a hinged-ended uniform column, derive the expression of the critical load of buckling using the strain energy method. **(15)**

(b) For a sheet of plating, simply supported round its edges, length l and breadth b, as shown in Fig. for Q. No. 5(b), derive the expression of the critical load of buckling. **(20)**

Fig. for Q. No. 5(b)

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6. (a) In a calculation of the longitudinal strength for the sagging condition, the following mean ordinates in tonnef/m were found for sectional lengths of a ship each 12 m long, starting from forward and balanced on a sea wave whose profile gives draughts, symmetrical about amidships, as follows: **(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

Draw the shearing force and bending moment diagrams and state the positions and values of the maxima.

(b) Consider a fixed-ended beam with any distribution of loading which may or not may be symmetric about the middle of the length. Derive the expression of total bending moment. **(15)**

7. (a) Consider the bending of panel of plating and derive the equation of equilibrium for the plate. **(20)**

(b) Discuss what will happen when the upper and lower parts of a ship are built with higher tensile steel and the remainder of the ship is built with mild steel. **(15)**

8. (a) Derive Perry's formula of buckling of the column with initial curvature and use it for a solid pillar of 8 ft in length and 6-inch diameter. **(20)**

(b) Derive the following relationship where the symbols have their usual meanings: **(15)**

$$P_{cr} = \frac{\pi^2 D}{b^2 t}\left(m\frac{b}{l} + \frac{1}{m}\frac{l}{b}\right)^2$$
