UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: January 2022

Module Number: ME6214 Module Name: Naval Architecture and Basics of Hull Design

[Three Hours]

[Answer **all questions**; Each question carries **ten marks**; Provide neat sketches where necessary; Make reasonable assumptions and state them clearly]

Q1. (a) Sketch in a rough diagram, the 6 basic motions of a ship.

[2.0 Marks]

(b) Distinguish between the terms, light displacement, deadweight and load displacement. Provide the mathematical relationship between the three.

[2.0 Marks]

(c) What is sagging and hogging of a ship hull? With sketches, explain the causes of both phenomena.

[3.0 Marks]

(d) Think about how you can use modern CAD and CAM tools when designing a ship. Explain your thoughts with examples.

[3.0 Marks]

Q2. (a) List six types of marine vessels used in the current maritime industrial context.

[2.0 Marks]

(b) Choose a marine vessel of your choice and explain how its unique design assists its day-to-day operation. You are expected to use rough sketches, graphs and data to reinforce your explanation.

[8.0 Marks]

Q3. (a) Consider the three midship sections given with Figure Q3-1. The hulls are made by extruding the midship section straight for 50m.

(i) Draw the Bon-Jean curves. Indicate the value of bottom and top points.

[1.5 Marks]

(ii) Find the upward thrust acting on each hull for 3m of draft.

[3.0 Marks]

Q3 is continued to page 2

(b) Consider the hull illustrated in Figure Q3-2. Calculate the following geometrical coefficients. Consider a draft of 4m.

(i) Midship section coefficient

(ii) Block coefficient

(iii) Prismatic coefficient

[3.0 Marks]

(c) There are two marine vessels (not necessarily with same dimensions) with different hull forms. The first one has a block coefficient of 0.85 and the second one has a block coefficient with 0.5. What can you say about these two ships? You can direct you answer through factors like performance and application.

[2.5 Marks]

Q4. (a) Why rolling motion is given the priority when studying ship stability?

[2.0 Marks]

(b) The vessel in Figure Q4-1 is in the form of a triangular prism. When it is floating at even keel with a draft of 4m, calculate the metacentric height of the ship. Consider KG as 3.7m.

[3.0 Marks]

(c) A ship of mass 5000 tons, 98m long, floats at draughts of 5.5m forward and 6.2m aft, being measured at the extreme ends. The longitudinal metacentric height is 104m and the center of flotation is 2.1m aft of amidships. Determine the moment to change trim 1cm and the new end draughts when a mass of 85 tons, which is already on board, is moved 30m forward.

[5.0 Marks]

Q5. (a) Briefly explain the types of resistance felt by a ship hull.

[3.0 Marks]

(b) A model testing scenario is described here. The ship is 140m long, 19m beam, 8.5m draught and has a speed of 15knots. Tests on a geometrically similar model 4.9m long, run at corresponding speed, gave a total resistance of 19N in fresh water whose density was 1000kg/m^3. Calculate the corresponding frictional resistance of the ship hull.

Q5 is continued to page 3

$$C_f = \frac{0.075}{(\log_{10} R_n - 2)^2}$$

Other details are:

Block coefficient	0.65
Midship area coefficient	0.98
Wetted surface area	3300 m²
Density of sea water	1025 kg/m³

(c) List four propeller types and explain one of them. [5.0 Marks]

[2.0 Marks]

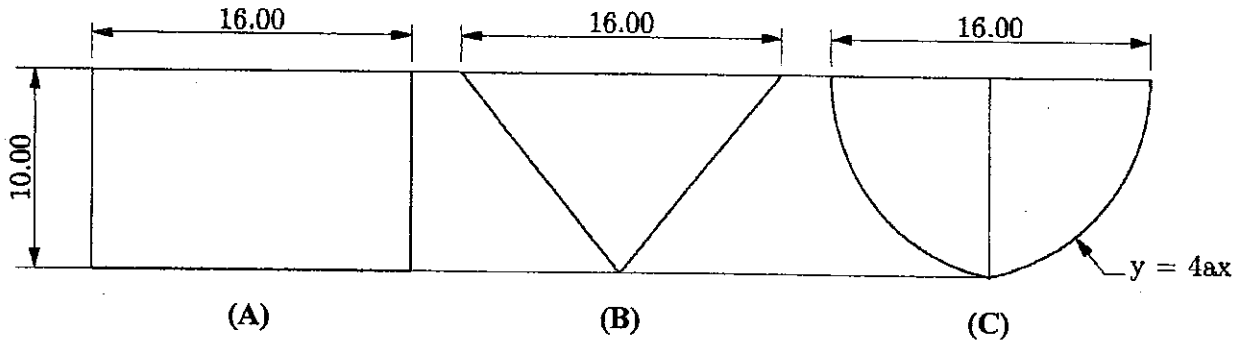

Figure Q3-1: Midship sections

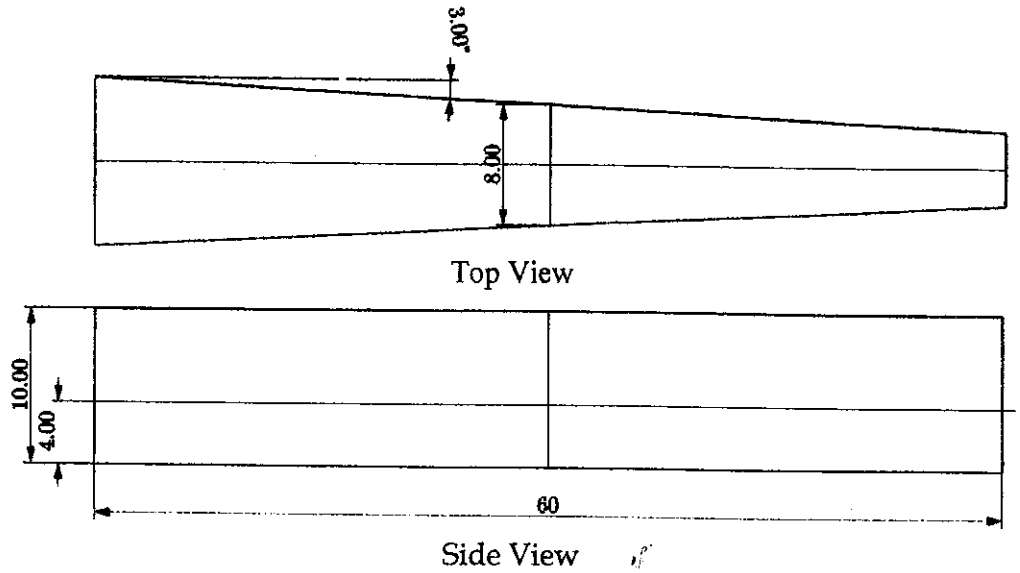

Figure Q3-2: Top and side views of the vessel

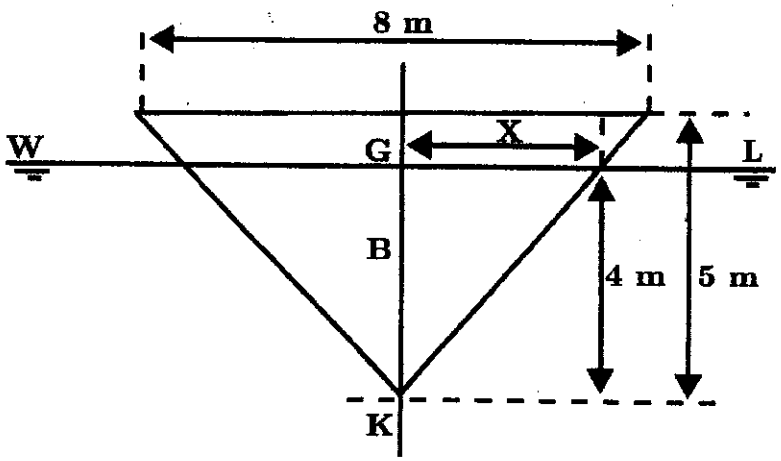

Figure Q5-2: Loss coefficients