



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: July 2017

Module Number: ME 5215

Module Name: Naval Architecture and Basics of Hull
Engineering

[Three Hour]

[Answer all questions, fifty marks for all questions]

All assumptions must be stated clearly. Sketches and diagrams are to be provided where required. Symbols stated within the paper denote the standard parameters.

- Q1. a) Define the terms Naval Architecture and Naval Architect. [1.0 Mark]
- b) According to your knowledge, describe the “Importance of Hull Structure Design” [2.0 Marks]
- c) With the suitable sketches indicate “Six Motion of a ship”. [2.0 Marks]
- d) Explain the terms “Deadweight, Light displacement and Load displacement”. [2.0 Marks]
- e) With the suitable sketches (Longitudinal and Lateral cross sections) indicate the “Basic Ship Terminologies” and explain the terms Freeboard, Sheer and Rudder. [3.0 Marks]
- Q2. a) Describe the types of performances of a Vessel which is required and considered by the Owner and the Naval Architect? [1.0 Mark]
- b) What are the forces that should be considered in hull designing and explain them with suitable sketches. [2.0 Marks]
- c) Describe “Specialization of Ships” and give suitable two examples with sketches. [2.0 Marks]
- d) Explain the “Environmental Impact of shipping”. [2.0 Marks]

- e) Derive the following equation which is related to the **Moment to Change the Trim**.

$$\frac{W \times GM_L}{L} = \frac{w \times d}{t}$$

Where W is weight of vessel, GM_L is metacentric height, L is length of the vessel, w is weight of longitudinally moving mass, d is moved length and t is trim.

[3.0 Marks]

- Q3) a) “**Bonjean Curves**” are utilized to calculate the underwater volume. Briefly explain this method. [2.0 Marks]
- b) Explain “**Heeling**” and “**Trimming**” of a vessel. [2.0 Mark]
- c) List out **types** of marine vessels. [1.0 Marks]
- d) What are the **four types** of **Ship Launching** methods? [2.0 Marks]
- e) Explain the term “**Dry Docking**” of ships [1.0 Mark]
- f) Give **four** maintenance activities covered during dry docking of ships [2.0 Marks]
- Q4) a) Explain the term “**methodical series**” in ship designing [1.0 Mark]
- b) What are the **types of resistance** acting on a moving ship? [2.0 Marks]
- c) With the usual notations, use **Dimensional Analysis** to show that the resistance on a ship can be written as;
- $$R = \rho v^2 L^2 \left[f_1 \left(\frac{v}{\sqrt{L}} \right) + f_2 \left(\frac{gL}{v^2} \right) \right]$$
- [2.0 Marks]
- f_1 and f_2 are functions of Reynolds’ number, and Froude number, respectively.

- d) A ship having a length of 200 m, beam of 24 m, and 10 m draught is running at speed of 18 knots. It has

Block coefficient : 0.65

Midship area coefficient : 0.98

Wetted surface area : 3700m²

Density of sea water : 1025 kg/m³

A geometrically similar model of 7 m long running at corresponding speed, gave a total resistance of 21 N in fresh Water whose density was 1000 kg/m³. Calculate the total resistance on the ship using ITTC method.

Hint: $C_f = \frac{0.075}{(\lg R_n - 2)^2}$, C_f is friction coefficient and R_n is the appropriate Reynolds' Number.

[5.0 Marks]

- Q5) a) Define the term "Quasi-Propulsive Coefficient(QPC)"

[1.0 Mark]

- b) Write **short notes** on following **Propulsor Types**

- i. Controllable pitch propeller
- ii. Pump jets
- iii. Vertical axis propeller
- iv. Water jet propulsion

[2.0 Marks]

- c) Indicate following **propeller features** on a **diagram** and define them

- i. Propeller Diameter and Boss
- ii. Skew and Rake
- iii. Leading edge and Tailing Edge
- iv. Blade outline and Developed outline

[2.0 Marks]

- d) Considering the general case of a simple actuator disc imparting momentum to water. Show that the efficiency of the disc as a propulsor is;

$$\text{Efficiency} = \frac{\rho AV_a^3(1+a)b}{\rho AV_a^3[(1+a)ab+(1+a)b]} = \frac{1}{1+a}$$

Where **a** is axial inflow factor and **b** is velocity factor at infinity behind the disk, V_a is speed of advanced screw, **A** is disc Area, ρ is fluid density and take **b= 2a**.

[5.0 Marks]