Indian Maritime University
(A Central University, Govt of India)
Supplementary Examinations – September/October 2024
Programme Name: B Tech (ME)
Semester: VI
Subject Code: UG11T3605
Subject Name: Naval Architecture – II

Date: 24.09.2024 Max Marks: 70
Duration: 03 Hrs Pass Marks: 35

General Instructions
(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

Section A

Answer all questions. Each MCQ carries 1 marks. [10 x 1 = 10 marks]
Choose the most appropriate answer from the given choices.

1. Which one of the following is the function of bilge keel

(a) Roll stabilisation (b) Resist docking loads
(c) Resist longitudinal bending (d) part of bilge and ballast system

2. The ratio of efficiency of propeller in behind ship condition to the efficiency of propeller in open water condition is called _____.

(a) Quasi-Propulsive Coefficient (b) Propulsive efficiency
(c) Relative Rotative Efficiency (d) Propeller efficiency

3. Which one of the following can have a negative value?

(a) Real Slip (b) Thrust Deduction Fraction
(c) Relative Rotative Efficiency (d) Apparent Slip

4. If the shaft power of a ship of displacement Δ is P_S at a speed is V then, the Admiralty Coefficient will be given by

(a) $\frac{\Delta^2 V^{2/3}}{P_S}$ (b) $\frac{P_S}{\Delta^{2/3} V^3}$
(c) $\frac{\Delta^{2/3} V^3}{P_S}$ (d) $\frac{\Delta^2 V^3}{P_S}$

5. Which one of the following is NOT a part of residuary resistance of the ship?

(a) Air Resistance (b) Appendage resistance
(c) Eddy Resistance (d) Wave-making Resistance

6. Which of the special types of propeller arrangements given below does not require a rudder to be fitted for steering the ship

(a) Voith-Schneider Propeller (b) Kort Nozzle
(c) Controllable Pitch Propeller (d) Paddle wheel

7. Which of the following statements correctly describes the relation between time period of rolling (T_R) and transverse metacentric height of ship (GM_T)

(a) T_R increases with increasing GM_T (b) T_R reduces with increasing GM_T
(c) T_R reduces with decreasing GM_T (d) T_R does not depend on GM_T

8. Which of the following theories of propeller action assumes that the propeller is an actuator disc imparting a uniform acceleration to all fluid passing through it.

(a) Blade element theory (b) Circulation theory
(c) Lifting line theory (d) Axial Momentum theory

9. As per the Froude's law of comparison, the corresponding speeds of two geometrically similar ships are in the ratio of _____

(a) their Lengths (b) their displacements
(c) square roots of their lengths (d) square roots of their displacements

10. In a turning circle test, the distance travelled by the centre of gravity of the ship in a direction parallel to the original course after the instant the rudder is put over is called as _____.

(a) Transfer (b) Advance
(c) Tactical diameter (d) Turning circle diameter

Section B

Answer all questions. Each question carries 2 marks. [5 x 2 = 10 marks]

11. In a twin screw ship, the two propellers rotate in opposite directions. State the significance of the same.

12. State reasons for fitting the rudder of a ship at the aft end.

13. With the help of a neat sketch show the six degrees of freedom of a ship. Which of these are oscillatory?

14. Define centre of pressure for a rudder. What is its significance?

15. State two important distinguishing features of a trochoidal wave when compared with a sinusoidal wave.

Section C

Answer any 05 questions. Each question carries 10 marks.

16. (a) What are the effects of cavitation on propeller performance? Suggest some checks and operational practices you would take on board a merchant ship with screw propeller to minimize cavitation. (6 Marks)

(b) Define quasi-propulsive coefficient (QPC). What are its components? (4 Marks)

17. A ship is 140 m long has a speed of 15 knots. Wetted surface area of the ship is 3300 m^2, Density of sea water = 1025 kg/m^3. Tests on a geometrically similar model 4.9 m long, run at corresponding speed, gave a total resistance of 19 N in fresh water whose density was 1000 kg/m^3. Estimate total resistance of the ship using ITTC 1957 model ship correlation line. Given: $C_f = \frac{0.075}{(\log_{10} R_n - 2)^2}$ R_n *for model* = 6.195×10^6 *and* R_n *for ship* = 9.0941×10^8. Use Roughness allowance, $C_A = 0.0004$ (10 Marks)

18. (a) A vessel uses 125 tonnes of fuel on a voyage when travelling at 16 knots. Calculate the mass of fuel saved, if on the return voyage, the speed is reduced to 15 knots, the displacement of the ship remaining constant. (3 Marks)

(b) A ship moving at a speed of 18.0 knots is propelled by a gas turbine of shaft power 10000 kW at 5400 rpm. The turbine is connected to the propeller through 45: 1 reduction gearing. The losses in the gearing and shafting are 5%. The propeller has a thrust of 900 kN, and the wake fraction and thrust deduction fraction are 0.250 and 0.200 respectively. Determine the delivered power, the thrust power and the effective power, as well as the propeller torque. (7 Marks)

19. (a) Compare the balanced rudder with unbalanced rudder. (4 marks)

(b) Deduce the angle of heel due to centrifugal force on rudder. (6 marks)

20. (a) State the important assumptions of Axial Momentum Theory. (5 Marks)

(b) Define Thrust Coefficient (K_T), Torque Coefficient (K_Q), Advance Coefficient (J) and the efficiency of propeller (η_o) in open water. Show that they are related by following equation: $\eta_O = \frac{K_T}{K_Q} \frac{J}{2\pi}$ (5 Marks)

21. (a) Describe a turning circle test with the use of neat diagram showing Advance, Transfer, Tactical Diameter and Steady-turning Diameter. (5 Marks)

(b) A vessel turns in a radius of 300 m at a speed of 20 Knots under the action of a rudder force of 1.5 MN. If the draught of the ship is 5m, Distance of CG above keel is 6 m and metacentric height is 2 m, find the angle of heel during the steady turn. (5 Marks)

22. (a) A ship of displacement 2,540 tonnes and transverse metacentric height of 0.765 m has a period of roll of 8.5 seconds. Estimate the probable period for a similar ship of 3,050 tonnes displacement and metacentric height of 0.825 m. Assume that linear dimensions $\propto \Delta^{1/3}$. (5 Marks)

(b) Describe activated fin system used as a roll stabilization device. How does it control rolling? Why is it more effective on fast moving ships? (5 Marks)

******* End of Paper *******