

Indian Maritime University
(A Central University, Govt of India)

Sep/Oct'25 SE

Programme Name: B Tech (ME)

Semester: VI

Subject Code: UG11T4605

Subject Name: NAVAL ARCHITECTURE II

Date: 23.10.2025

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

Section A

(All Questions are compulsory)

Ten MCQs/Fill in the Blanks of 1 Mark each-Choose the correct answer.

1. Choose the correct statement
 - a. Frictional resistance is same for all type of ships
 - b. Wave making resistance is same for all type of ships
 - c. Wave making coefficient is same for all type of ships
 - d. Correct answer (a) and (c) both

2. Angle of heel occurred in port side due centrifugal force while turning, when the position of rudder angle is at
 - a. port side, b. starboard side,
 - c. Neutral position, d. None of the above

3. Which of the following takes the weight of the rudder?
 - a. The rudder stock, b. The locking pintle,
 - c. The steering gear, d. The rudder carrier bearing.

4. 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

5. Frictional resistance depends on _____
 - a. wetted surface area
 - b. projected area
 - c. velocity of the fluid moving over the draft
 - d. both (a) & (c)

6. When CPP propellers are fitted on to tail shaft of a ship, it has the advantage that main engine can be of a type -----?
 - a. unidirectional/non-reversible b. single cylinder
 - c. engine with no cylinder, d. reversible

7. Action of ship propeller produces-----
 - a. more resistance forces on hull

- b. velocity of water gradually increases towards propeller
 - c. water pressure falls gradually from bow end
 - d. all the above
8. 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
9. Distance between two successive crests is known as
- a. wave height, b. wave length,
 - c. trough, d. None of the above
10. 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

Section B

(All Questions are compulsory)

Five Short Questions of 02 Marks each:

- 11. State reasons for the rudder of a ship fitted at the aft end.
- 12. Explain Thrust Deduction and Augment of Resistance.
- 13. Explain causes and prevention of propeller cavitation
- 14. Define real and apparent slips.
- 15. What are the roles of surface tension and gravity in ocean waves?

Section C

Attempt any 5 Questions out of 7 and Each Question carries 10 Marks.

16. a) Explain the role of a rudder in steering a ship. Considering that the size of a rudder is very small in comparison to the size of a ship, explain how such a small component can effectively help in turning a massive vessel.

b) Describe the Modified Zigzag manoeuvre used for less stable ships. Why is it preferred over the standard Zigzag test in such cases? Illustrate your answer with a diagram showing a 10° rudder angle and 1° heading angle.

(Marks 5+5)

17. A fully unbalanced rudder placed in a twin-screw ship is rectangular in shape, 4m wide and 3 m deep. It is pivoted at its leading edge with the help of a stern frame ahead of it for full depth. Assume the rudder force normal to the mean chord line is given by $F_n = 577AV_r^2 \sin \alpha$ Newton. Where A is the projected area of the rudder in m^2 , V_r in m/s is the relative velocity of water past the rudder, usually 20 % more than the ship's speed and α is the rudder angle in degrees. The ship speed is 18 knots and rudder is placed at 35° . Calculate the proper diameter of the

rudder stock by using (a) Maximum normal Stress theory and (b) Maximum shear stress theory. Assume the maximum allowable stress for both cases is $77.22 \times 10^6 \text{ N/m}^2$. The centre of pressure of the rudder is 2 m below the bearing and 35% of the chord length from the leading edge. (Marks=10)

18. A 5.2 m long ship Model experiences a total resistance of 67 N when towed at 3.5 knots. Its wetted surface area is 4.25 m^2 . To determine the effective power of a similar ship of length 131 m at the corresponding speed, you use the ITTC 1957 Method. Given Data:

$$\text{Coefficient of frictional resistance } C_f = \frac{0.075}{\{\log_{10}(R_n) - 2\}^2}$$

Assume Kinematic viscosity of fresh water $\gamma_M = 1.14 \times 10^{-6} \frac{\text{m}^2}{\text{s}}$ and the same for seawater $\gamma_S = 1.19 \times 10^{-6} \frac{\text{m}^2}{\text{s}}$

The coefficient for roughness allowances $C_A = 0.0004$

(Marks=10)

19.a) A ship travels 2000 nautical miles at 16 knots and returns the same distance with same displacement at 14 knots. Find the savings in fuel consumption on the return voyage if the consumption per day at 16 knots is 28 tonnes.

b) What would have been the savings in the return voyage in the above problem, if the ship would return with 35.36% less displacement than its original?

(Marks 5+5)

20. (a) Explain the key approach of the Propeller Blade Element Theory. Also, state its major advantages and limitations.

(b) Using Blade Element Theory with consideration of induced velocity, derive an expression for the propeller efficiency. Provide all necessary assumptions and steps clearly. (Marks 3+7)

21. 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 percent. 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 thrust power, the effective power and propeller torque.

(Marks 3+3+4)

22. Write short note on following

- (a) Trochoidal Waves
- (b) Passive Anti-Roll Tank System
- (c) Active Fin Stabilizer System

(Marks 4+3+3=10)

