

**Indian Maritime University**  
(A Central University, Govt of India)  
**End Semester Examinations – December 2023**  
**Programme Name: B.Tech (NAOE)**  
**Semester: V**  
**Subject Code: UG12T2502**  
**Subject Name: Resistance & Propulsion**

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Date: 07.12.2023

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

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General Instructions

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

**Section A**

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. Ducted propellers are known as \_\_\_\_\_.
2. State whether the statement is true/false: "ship self-propulsion point on the model is at  $F = 0$ ".
3. Wake measured in the presence of propeller is known as \_\_\_\_\_.
4. Cavitation can be prevented by \_\_\_\_\_.
5. \_\_\_\_\_ propeller theory treats the propeller as an "actuator disc".
6. When advance coefficient ratio is maintained, model propeller revolutions are smaller than a geometrically similar full scale propeller. Is this statement correct or incorrect?
  - a. Correct
  - b. Incorrect
7. The fluid flow characteristics for geometrically similar model and full scale are not the same. Select one:
  - a. Correct. Both flow in the model scale and the full scale will not be similar as both of the Reynolds number are not the same.
  - b. Incorrect. Both flow in the model scale and the full scale will be similar as both of the Reynolds number are the same.

8. Describe a way of minimizing a wave resistance of a ship?
- Adding a bulbous bow to the ship
  - Adding a stabilizer to a ship
  - Adding a bow thruster at the forward end of the ship
  - Adding a skeg at the baseline of the ship
9. Why a residuary resistance curve in some cases do exhibits a series of 'hump' and 'hollows'?
- The wave resistance oscillate about the mean curve as the frictional resistance become lower and higher with increasing of Froude number.
  - The wave resistance would oscillate about a mean curve depending upon whether the interference effect arising from the bow system and the stern system yields a maximum or minimum resistance.
  - As the vessel heave and pitch on the free surface of the water.
10. The dimensional analysis of the resistance of a ship can be expressed in its final form of three dimensionless numbers as shown below. One of the number is called Euler number. Name the other two non-dimensional numbers.
- Reynolds number and Mach number
  - Cauchy and Mach number
  - Froude and Reynolds number
  - Cavitation and Reynolds number

### **Section B**

Five Questions of 02 Marks each

- How Pitch angle of the propeller can be measured at any particular radial section?
- Describe Spot cavitation and where it occurs?
- What is the effect of shallow water on the resistance of a ship?
- A propeller of diameter 3.0 m has a speed of advance of 4.5 m/sec. The velocity of water relative to the propeller in the slip stream far astern is 7.5 m/sec. determine the thrust and the efficiency of the propeller using the axial momentum theory?
- Name the processes involved in the manufacture of a propeller?

### Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. Describe how the Kelvin wave pattern explains the nature of the waves generated by a ship. How do the "humps and hollows" in the wave resistance curve of a ship occur?
17. A propeller of diameter 5.5 m and pitch ratio 1.0 has its axis 4.0 m below the waterline. The propeller has a speed of advance of 7.0 m per sec when running at 120 rpm and produces a thrust of 520 kN. Determine the expanded blade area ratio of the propeller using the Burrill criterion for merchant ship propellers. ( $\tau_c = 0.0321 + 0.3886\sigma_{0.7R} - 0.1984\sigma_{0.7R}^2 + 0.0501\sigma_{0.7R}^3$ ).
18. Determine the Froude numbers at which favorable and unfavorable wave interference (humps and hollows) can occur for the following scenarios:

Scenario	Bow and stern transverse wave interaction	No. of waves within the characteristic length of ship
1	Cancellation	3.0
2	Superposition	2.5
3	Cancellation	2.0
4	Superposition	1.5
5	Cancellation	1.0
6	Superposition	0.5

Characteristic length can be taken as 90% of LBP

19. Define wake and state the three reasons/causes due to which the wake velocity will arise.
20. What are speed trials of a ship? Discuss about the objectives, procedure and observations made in the speed trials.
21. Discuss briefly the main features of supercavitating propellers and surface piercing propellers.
22. A propeller of a single screw ship has a diameter of 6.0 m and a radially varying pitch as follows:

r/R	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
P/D	0.872	0.902	0.928	0.950	0.968	0.982	0.992	0.998	1.0

Calculate the mean pitch ratio of the propeller.