

Indian Maritime University
(A Central University, Govt of India)
End Semester Examinations - December 2022
Programme Name: B Tech (NAOE)
Semester: V
Subject Code: UG12T2502
Subject Name: Resistance and Propulsion

Date: 13.12.2022
Duration: 03 hrs

Maximum Marks: 70
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 the questions. Each question carries one mark.

Choose the correct answer.

(10 x 1 mark = 10 m)

1. 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.
2. Describe a way of minimizing a wave resistance of a ship?
 - a. Adding a bulbous bow to the ship
 - b. Adding a stabilizer to a ship
 - c. Adding a bow thruster at the forward end of the ship
 - d. Adding a skeg at the baseline of the ship
3. Why a residuary resistance curve in some cases do exhibits a series of 'hump' and 'hollows'?
 - a. The wave resistance oscillate about the mean curve as the frictional resistance become lower and higher with increasing of Froude number.

- b. 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.
 - c. As the vessel heave and pitch on the free surface of the water.
4. The resistance of a vessel is greater in shallow water than in deep water conditions. Is this statement correct or incorrect?
- a. Incorrect.
 - b. Correct.
5. 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.
- a. Reynolds number and Mach number
 - b. Cauchy and Mach number
 - c. Froude and Reynolds number
 - d. Cavitation and Reynolds number
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. From a design point of view, what can be done to increase the propeller efficiency?
- a. Decrease the propeller diameter and increasing propeller turning speed
 - b. Decrease the propeller diameter and decreasing propeller turning speed
 - c. Increase propeller diameter and increasing propeller turning speed
 - d. Increase propeller diameter and decreasing propeller turning speed
8. What are assumptions made in the Momentum Theory of a propeller?
- a. Propeller imparts a uniform acceleration to fluid passing through the propeller disk. The thrust generated will be uniformly distributed over the propeller disk.
 - b. The flow is frictionless.
 - c. There is unlimited inflow of water to the propeller.
 - d. All of the above.

9. Identify the parameter(s) which can be estimated by Self-propulsion experiments.
- Delivered power
 - Wake fraction & thrust deduction fraction
 - Relative rotative efficiency
 - All of the above
10. Identify the true statement:
- Accelerating ducts – will decrease inflow velocity to the propeller
 - Decelerating ducts – will increase inflow velocity to the propeller
 - Accelerating ducts - will increase inflow velocity to the propeller
 - None of the above

Section-B

Answer all the questions. Each question carries 02 marks

(5 x 2 marks= 10 m)

- Name the main methods for estimating effective power in early design stages.
- How Pitch angle of the propeller can be measured at any particular radial section.
- Describe Spot cavitation and where it occurs
- Name the two approaches for designing propellers.
- Mutual interaction between the 'Overlapping propellers' may result in?

Section-C

*Answer any **Five** out of **Seven** questions.*

Each question carries 10 marks.

(5 x 10 marks= 50 m)

- 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

17. A cargo vessel has $L = 135$ m, $B = 22$ m and $T = 9.5$ m. Determine the speed loss in a river with a breadth of 200 m and depth of water, $h = 14$ m, when travelling at the same power as in deep water at 8 knots.
- Assume, $\frac{V_h}{V_\infty} = 1 - 0.09 \left[\frac{\sqrt{A_M}}{R_H} \right]^{1.5}$ where, V_∞ is the speed in deep water, V_h is the speed in shallow water of depth h , A_M is the maximum cross-sectional area of the hull, R_H is the hydraulic radius given, $R_H = \frac{(bh - A_M)}{(b + 2h + p)}$, where p is wetted girth of the hull & b is the breadth of the channel.
18. Define wake and state the three reasons/causes due to which the wake velocity will arise.
19. A ship has a speed of 18 knots when its engine has a brake power of 10000 kW at 150 rpm. The engine is directly connected to the propeller which has a diameter of 6.0 m. The effective power of the ship is 6700 kW and the propeller produces a thrust of 900 kN. The open water characteristics of the propeller are given by: $K_T = 0.319 - 0.527J + 0.169J^2$ & $10K_Q = 0.354 - 0.578J + 0.203J^2$. Determine the propulsive efficiency and its components based on thrust identity. The shafting efficiency may be taken as 0.970.
20. 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. ($\tau_c = 0.0321 + 0.3886\sigma_{0.7R} - 0.1984\sigma_{0.7R}^2 + 0.0501\sigma_{0.7R}^3$).
21. Write a note on the propeller materials which may be used for propeller manufacture.
22. Illustrate the sea trials that are carried out on a newly built ship.