

**INDIAN MARITIME UNIVERSITY**

(A Central University, Government of India)

May/ June 2017 End Semester Examinations  
B.Tech. (Marine Engineering) Sixth Semester  
**(AY 2009-2014 batches)**

**Naval Architecture II (UG11T1605/ UG11T2605)**

Date : 21.06.2017

Maximum Marks: 100

Time: 3 Hrs

Pass Marks : 50

**PART – A**

**(10 x 3=30 Marks)**

**(All questions are compulsory)**

1. Explain the following questions with suitable free hand sketches wherever applicable:
  - (a) Explain the definitions used in a ship's turning circle experiment using a simple sketch
  - (b) List down the various motions of a ship at sea. Show with simple free hand sketches.
  - (c) Define - Lift and drag on a control surface immersed in a steady flowing liquid
  - (d) Define - Quasi Propulsive Coefficient and Transmission Efficiency
  - (e) Define- Wake. Mention the different wake fractions used in Naval Architecture.
  - (f) Why are rudders fitted at the aft of the vessels mostly ?
  - (g) How are water waves classified ?
  - (h) What is a Podded Propulsor and Azimuth Propulsor ? How are they different from each other ?
  - (i) What is bending moment and shear force ?
  - (j) What is a cavitation number ? Mention its use

**PART – B**

**(5 x 14 = 70 Marks)**

**Answer any FIVE questions**

2. a) List and briefly describe the control surface definitions of a spade rudder with a good free hand sketch. (7 Marks)

- b) What are the effects of propeller cavitation on ship performance? Suggest some checks and operational practices you would take onboard a merchant ship with screw propeller, to minimize these effects. Using free hand sketches describe various types of cavitation on a marine screw propeller. (7 Marks)
3. a) In a propeller of 5.0 m diameter and 4.0 m pitch, radial lines from the leading and trailing edges of the section at 0.6R make angles of  $42.2^\circ$  and  $28.1^\circ$  with the reference plane through the propeller axis. Determine the width of the expanded blade outline at 0.6R. (7 Marks)
- b) For a new design, it was found from towed ship model tests that the naked effective power ( $P_{NE}$ , with out appendages) for the prototype was 3200 kW. Using a basic ship, it was decided to use the following data for this new design: Hull efficiency = 99.2%, propeller efficiency = 70.85%, shaft losses = 4.75%. Engine efficiency = 86.13%, weather and appendage allowances = +10%. Steam Turbine machinery installed with thrust block fitted Aft of Engine Room. Calculate all the powers from the propeller tips to the Engine Room. (7 Marks)
4. a) Describe Open Water Testing of marine screw propellers. What are  $K_T$ ,  $K_Q$  and Thrust Coefficients ? (7 Marks)
- b) The cylindrical polar coordinates ( $r, \theta, z$ ) of a propeller,  $r$  being measured in "mm" from the propeller axis,  $\theta$  in degrees from a reference plane through the axis and  $z$  in mm from a plane normal to the axis, are found to be (1500, 10, 120) at the leading edge and (1500, -15, -180) at the trailing edge at the blade section at 0.6R. The blade section at this radius has a flat face. Determine the width of the expanded outline at this radius and the position of the reference line,  $\theta = 0$ , with respect to the leading edge. What is the pitch ratio of the propeller at 0.6R ? The propeller has no rake. (7 Marks)
5. A box-shaped barge of uniform construction is 32 m long and displaces 352 tonnes when empty, is divided by transverse bulkheads into four equal compartments. Cargo is loaded into each compartment and level stowed as follows: (14 Marks)
- (a) No. 1 hold 192 tonnes  
 (b) No. 2 hold 224 tonnes  
 (c) No. 3 hold 272 tonnes  
 (d) No. 4 hold 176 tonnes

Construct load, shearing force and bending moment diagrams.

6. Describe the behaviour of a ship when its rudder is put hard over to starboard during its stable course ahead, at full speed ahead and in deep waters. Describe the various angles of heel generated as a result till it achieves about  $540^\circ$  turning. Assuming standard nomenclature used in naval architecture, derive relations to measure maximum angles of heel generated. (14 Marks)
7. With respect to water waves using free hand sketches,
- (a) Describe regular waves and wave characteristics (3 Marks)
  - (b) Describe trochoidal waves with sketches to aid description of the movement of water particles (5 Marks)
  - (c) What are Irregular waves ? Describe how the waves are studied and documented using statistical distributions and wave spectra. (6 Marks)
8. (a) Explain the Axial Momentum Theory of marine screw propeller. Write the equation for ideal efficiency of the propeller in terms of the ratio of the slip stream velocity to velocity of advance. (8 Marks)
- (b) A propeller has a pitch of 5.5m. When turning at 80 rpm the ship speed is 13.2 knots, speed of advance 11 knots, propeller efficiency 70% and delivered power 3000 kW. Calculate:
- i. Real slip
  - ii. Taylor's wake fraction
  - iii. Propeller thrust (6 Marks)

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