# INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

**End Semester Examination December 2017**

**Programme:** B.Tech (Marine Engineering) **Semester:** VI

**Subject Name:** Naval Architecture - II **Subject Code:** UG11T2605/1605

**Date:** 20/12/2017 **Maximum Marks:**100

**Time:** 3 Hours **Pass Marks:**50

## PART – A

**All questions are compulsory (10X3=30 Marks)**

1. Answer the following questions:
   (a) For a fixed pitch propeller, explain how the pitch angle varies from the root to the tip of the blade.

   (b) Explain the following terms:

   (i) Right handed propeller

   (ii) Outward turning propeller

   (iii) Developed blade area of propeller

   (c) In case of a trochoidal wave, explain the relationship between the line of orbital centres and the undisturbed sea surface.

   (d) With respect to the ship executing a steady turn under the action of a rudder, explain the drift angle.

   (e) Using the definitions of Thrust Coefficient ($K_T$), Torque Coefficient ($K_Q$), Advance Coefficient (J) and the efficiency of propeller ($\eta_o$) in open water, show that they are related by following equation:

$$\eta_O = \frac{K_T}{K_Q}\frac{J}{2\pi}$$

   (f) How does loading / unloading or shift of cargo affect ship's rolling period?

   (g) State reasons for positioning the propeller at the stern of the ship.

   (h) State the properties and relationships of weight curve, buoyancy curve, load curve, shear force curve and bending moment curve.

   (i) A vessel departed from port A, at 1206 Hrs with the 'number of revolutions' counter reading 616729 and arrived the following day at port B at 1148 Hrs, when the counter read 731929. The vessel has a 630 cm diameter propeller with a pitch of 610 cm. If the distance covered was 404.16 NM, determine the apparent slip.

(j) Determine the centre of pressure of a circular lamina of diameter 'D', floating vertically in water with its centre D/2 below the waterline.

## PART – B

**Answer any 5 of the following seven questions**

**(5X14=70 Marks)**

2. 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 Taylor 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.

3. Calculate the force on the spade rudder shown below in Fig 1 and torque on its stock, which is one oftwo working behind twin propellers. It is given that the rudder angle is 35 degrees and ship speed is 18 knots ahead. Assume that the force on rudder is given by 21.1 $A_P$ $V^2\delta_R$Newtons (Where $A_R$ is the area of rudder in $m^2$, V is the ship speed in m/s and $\delta_R$ is the rudder angle in degrees) and the centre of pressure is 0.31 times the chord length aft of leading edge.

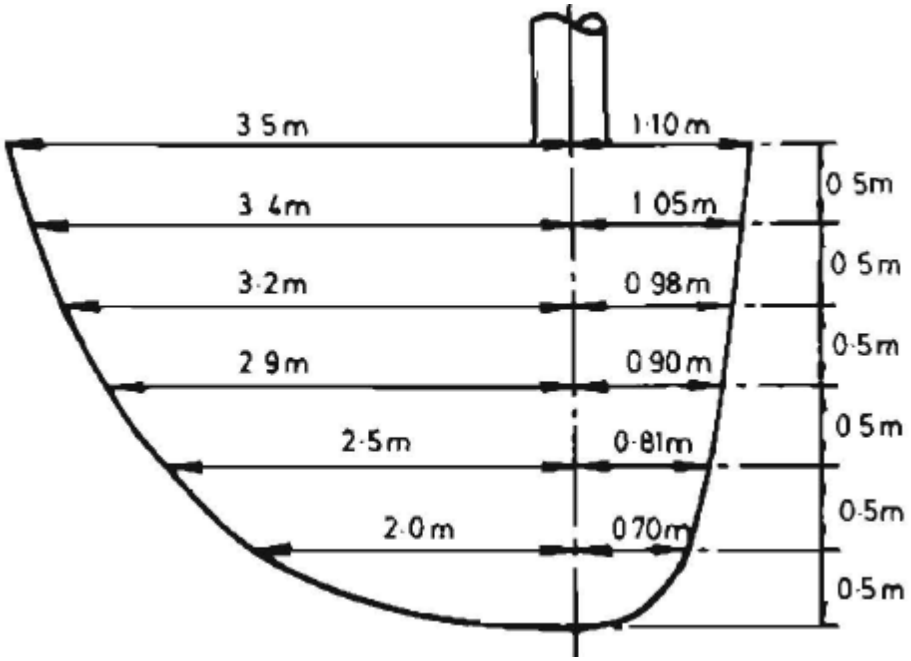


Figure 1: For Question No 3



4. 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 holds. Cargo is loaded into each of these and level stowed as follows:
   No 1 hold: 192 tonnes, No 2 hold: 224 tonnes,
   No 3 hold: 272 tonnes, No 4 hold: 176 tonnes

Draw the load, shear force and bending moment curves and determine the magnitude and location of maximum bending moment.

5. (a) Derive an expression for the natural period of unresisted rolling of a ship in still water if the transverse radius of gyration is '$k_T$' and the transverse metacentric height is '$GM_T$'. (Marks: 6)

(b) A ship of 13,700 tonnes displacement has a transverse metacentric height 2.0 m and a transverse radius of gyration 7.76 m. A mass of 300 tonnes is then shifted 3.7 m vertically upwards within the ship.The mass moment of inertia of the ship after the shift was calculated as 865500 tonne.$m^2$. Estimate the natural period of roll after the shift of weight. (Marks: 8)

6. (a) Explain the wave energy spectrum and state its significance. (Marks: 6)

(b) Explain the actions that can be taken during operation of a ship to reduce the likelihood of occurrence of cavitation. (Marks: 8)

7. (a) Write a short note on ship's speed trials. (Marks: 5)

(b) A propeller has a pitch of 5.5 m. When turning at 93 rpm the apparent slip is found to be - S%and the real slip + S%,thewakespeed being 10% of the ship's speed. Calculate the speed of the ship, the apparent slip and the real slip. (Marks: 9)

8. A ship's propeller of 5.76m diameter, 0.8 pitch ratio, 0.55 blade area ratio and 0.18 boss diameter ratio produces a thrust of 1200 kN with a delivered power of 15000 kW at 150 rpm and 7.5 m per sec speed of advance in sea water. A 0.16 m diameter geometrically similar model of this propeller is to be tested in fresh water. Determine for the model propeller (a) pitch, (b) blade area, (c) boss diameter, (d) speed of advance, (e) revolution rate, (f) thrust, (g) delivered power, if the Froude number and advance coefficient of the model and the ship propellers are to be made equal.

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