INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

May/ June 2017 End Semester Examinations

B.Tech. (Marine Engineering) Second Semester

(AY 2009-2014 batches)

Fluid Mechanics- I (UG11T1405/ UG11T2405)

Date : 20.06.2017 Maximum Marks: 100

Time: 3 Hrs Pass Marks : 50

Part – A (10 x 3=30 marks)

(All questions are compulsory)

1. a) Define mass density, specific gravity and viscosity of a fluid.
   b) State Newton's law of viscosity. What are Newtonion and Ideal Fluids?
   c) Define hydrostatics, total pressure and centre of pressure.
   d) What is stable, unstable and neutral equilibrium?
   e) State continuity equation and derive it for incompressible fluids.
   f) Name three types of heads of flowing liquid, state Bernoulli's equation and write its expression.
   g) Give use of venturimeter, orificemeter and pitot tube.
   h) Define vortex motion, forced vortex flow and free vortex flow.
   i) Define Reynolds number, Froude's number and Euler's number.
   j) What is geometric similarity, kinematic similarity and dynamic similarity in model analysis?

PART – B (5 x 14 = 70 marks)

(Answer any 5 of the following)

2. A fluid of viscosity 8 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 100 mm. the maximum shear stress at the pipe wall is 210 N/m^2. Find (i) pressure gradient (ii) centre line velocity (iii) average velocity (iv) Reynolds Number (v) friction coefficient of the pipe. (14 marks)

3. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m length from the tank the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm for the remaining length. The height of

water level in the tank is 8 m above the pipe. Take friction coefficient (f) = 0.01 for both sections of the pipe.

If 'V1' is the velocity in first section (150 mm diameter) and 'V2' is velocity in second section (300 mm diameter), calculate (i) all losses occurring in the flow in terms of kinetic head in section 2 ($V_2^2/2g$) (ii) velocity in section 2 (V_2) (14 marks)

4. Using Buckingham's pi-theorem show that velocity (V) through circular orifice is given by

$$V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$$

Where, H = head causing the flow, D= Diameter of the orifice, μ = Co-efficient of viscosity, ρ = Mass density and g= acceleration due to gravity (14 marks)

5. Derive expression for rate of flow for venturimeter fitted in a horizontal pipe (14 marks)

6. A cylindrical vessel closed at the top and bottom is 0.24 m in diameter, 1.44 m high and contains water up to a height of 0.96 m.

   (i) find the height of the paraboloid formed if it is rotated at 480 rpm about its vertical axis. (7 marks)

   (ii) Find speed of rotation of the vessel when axial depth of water is zero. (7 marks)

7. Each gate of lock is 6 m high and 5 m wide, supported on one side by two hinges, each 0.5 m from top and from bottom. The angle between the gates in closed position is 120 degrees. If the water levels are 5 m and 1.25 m on the upstream and downstream side respectively, find

   (i) magnitude of resultant water pressure (3 marks)

   (ii) position of resultant water pressure from bottom of the gate (4 marks)

   (iii) reaction at top hinge (3 marks)

   (iv) reaction at bottom hinge. Assume reaction between the gates is in same horizontal plane as that of resultant water pressure. (4 marks)

8. a. A nozzle of 60 mm diameter delivers a stream of water at 24 m/s perpendicular to the plate that moves away from the jet at 6 m/s. Find (i) the force on the plate (ii) the work done (iii) efficiency of the jet. (7 marks)

b. A 400 mm diameter shaft is rotating at 200 rpm in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 N-s/m^2, determine torque required to overcome friction in the bearing. (7 marks)

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