INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)
End Semester Examinations- June-July 2019
Semester – IV
B.Tech (Marine Engineering)
Fluid Mechanics- I (UG11T1405 / UG11T2405)

Date: 03-07-2019 Maximum Marks: 100
Time: 3 Hrs Pass Marks: 50

Part A (3 x 10 = 30 Marks)
Compulsory Questions

1. a) Define capillarity and derive an expression for capillary rise.
   b) What are dynamic and kinematic viscosities?
   c) What is dimensional homogeneity?
   d) What are the assumptions in Bernoulli's equation of motion.
   e) Explain 'total pressure' and 'centre of pressure' .
   f) Define the term (i) Hydraulic gradient line and (ii) Total energy line.
   g) What is forced vortex?.
   h) What are the different types of minor losses in pipes?
   i) How can you experimentally determine the orifice co-efficient?
   j) Write the expression for the loss of head of viscous fluid flowing through a circular pipe.

Part B (5x14=70 Marks)
Answer any **five** of the followings.

2. a) Deduce the expression for Reynolds number with the help of dimensional analysis. (6)
   b) The pressure difference Δp in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham''s Π theorem, obtain an expression for Δp . (8)

3. a) Explain Newton's law of viscosity . What are the CGS and S.I. units of Kinematic and Dynamic viscosities? (7)
   b) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 metre per sec requires a force of 10 kgf to maintain the speed. Determine : i) the dynamic

viscosity of the oil in poise, and ii) the kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0'95. (7)

4. a) Derive Bernoulli's equation of motion from Euler's equation of the motion. (7)
   b) The water is flowing through a taper pipe of length 100 m having diameters 60 cm at the upper end and 30 cm at the lower end, at the rate of 50 litres/sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 2.0 kgf/cm^2. (7)

5. a) Deduce the expression for the force on the inclined plane moving in the direction of the jet and also work done per second by the jet on the plate. (8)

   b) A jet of water of diameter 10 cm strikes a flat plate normally with a velocity of 15 m/sec. The plate is moving with a velocity of 6m/sec in the direction of the jet and away from the jet. Find the force exerted by the jet on the plate and work done by the jet on the plate. (6)

6. a) Establish an expression for the head loss due to sudden enlargement in a pipeline. (7)
   b) At a sudden enlargement of a water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Estimate the rate of flow. (7)

7. a) Derive the expression for the horse power absorbed to overcome the viscous resistance in foot step bearing. (8)
   b) Find the power required to rotate a circular disc of diameter 20 cm at 1000 r.p.m. The circular disc has a clearance of 0.04 cm from flat plate and the clearance contains oil of viscosity 1.05 poise. (6)

8. a) Show that the free surface of the liquid subjected to forced vortex is a paraboloid. (8)
   b) Prove that in case of forced vortex the rise of liquid level at the ends is equal to the fall of liquid level at the axis of rotation. (6)

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