INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

END SEMESTER EXAMINATION DECEMBER 2017

Programme : B. Tech. (Marine Engineering) **Semester:** IV
Subject Name: Fluid Mechanics-I **Subject Code:** UG11T2405/ UG11T1405
Date: 04.01.2018 **Maximum Marks:** 100
Time: 3 Hours **Pass Marks :** 50

PART-A **(Marks: 3x10=30)**

(All questions are compulsory)

Q1(a) Explain Newtonian and non-Newtonian fluids with example.

(b) Differentiate between dynamic and kinematic viscosity.

(c) Define the terms in respect of floating body: stable, unstable and neutral equilibrium.

(d) How do you find the pressure intensity inside a soap bubble and a droplet?

(e) Define the terms: i) Co-efficient of velocity, ii) Co-efficient of contraction and iii) Co-efficient of discharge.

(f) What is hydraulic radius? Why it is used in Chezy's formula.

(g) What is a Pitot static tube?

(h) What is the basis on which the choice of repeating variables is made in case of Buckingham's π-theorem.

(i) Draw the sketch of i) velocity distribution and ii) shear stress distribution across a section of a pipe when the flow is viscous.

(j) Define the terms with examples (i) Free vortex flow (ii) Forced vortex flow.

PART-B **(Marks :14 x 5=70)**

(Answer any five of the following)

2.a) Describe Buckingham's π-theorem ? Why this theorem is considered superior to Rayleigh's method for dimensional analysis.

2.b) Prove by the method of dimensional analysis that F, the resistance to the motion of a sphere of diameter D falling with a velocity V through a fluid of viscosity μ, density ρ is given by $F=K\rho D^2V^2\Phi(\mu/\rho VD)$ where K is a dimensional constant.

(Marks 7+7)

3.a) Find the force on plate and work done for the following condition: A nozzle of 45 mm diameter delivers a stream of water at 25 m/s perpendicular to a plate that moves away from the jet at 8 m/s. Also compute the efficiency of jet.

3.b) Show that a uniform circular cylinder of sp.gr. 1/3 cannot be in stable equilibrium when floating upright in water when its length exceeds 3/4 of its diameter.

(Marks 7+7)

4. Each gate of lock is 6 m high and 5 m wide is supported on one side by two hinges, each 0.5 m from the top and from the bottom. The angle between the gates in closed position is 120 degree. If the depths of water on the two sides are 5 and 1.25 m respectively, find the magnitude and position of the resultant water pressure on each gate, the magnitude of reaction between the gates and the magnitude and directions of the reactions at hinges. Assume the reaction between the gates to be in the same horizontal plane as that of the resultant water pressure, sketches of the top view and of the end view of the lock must be shown.

(Marks- 14)

5) A fluid of relative density 0.86 flows through a pipe of diameter 120 mm. The flow rate is measured using a 6 cm diameter orifice plate with corner tappings, which are connected to the two limbs of a differential U- tube manometer using mercury as the mano-metric fluid. The discharge coefficient is 0.62. Calculate the mass flow rate when the difference in the mercury levels in the U-tube is 100 mm.

(Marks 14)

6) Two vertical cylindrical water tanks, each open to atmosphere and of diameters 3m and 2m respectively, are connected by two pipes in parallel, each 50 mm diameter and 75 m long. Initially the water level in the larger tank is 1.8 m above that in the smaller. Assuming that entry and exit losses for each pipe total 1.5 times the velocity head, that the pipes are always full of water, and that coefficient of friction (f) for each pipe has the constant value 0.007, determine the change in level in the larger tank in 15 minutes.

(Marks 14)

7.a) Deduce an expression for the power absorbed in overcoming viscous resistance of a Collar Bearing.

7.b) A collar bearing having internal and external diameter of 200mm and 400 mm, oil film thickness 0.2 mm and μ=0.8 poise, is taking the thrust of the shaft and overcoming viscous resistance when shaft rotates with 300 rpm. Find power consumed by the collar bearing.

(Marks 7+7)

8.a) A cylinder containing water is subjected to constant angular rotation. Prove that the rise of liquid level at the ends is equal to fall of liquid level at the axis of rotation.

8.b) Find out the total pressure forces on top and base of a closed cylinder which is fully filled with liquid when it is subjected to radial acceleration. **(Marks7+7)**