Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 level 1st Semester Examination – June /July 2017
MRT 374-2 Fluid Mechanics

Uva Wellassa University

Instructions to candidates
Duration: Two (02) hours
Number of questions: Four (04) Essay
Mark allocation: 40 marks
Answer all questions

1.

a. What is a "Fluid".? (01 Mark)

b. Briefly explain the term "Cavitation". (02 Marks)

c. If the equation of a velocity profile over a plate is $u = 3y^2$ in which u is the velocity in m/s at a distance of y meters above the plate, determine the shear stress at y = 0 and y = 0.05m. it's given that dynamic viscosity $\mu = 0.85 Ns/m^2$

(03 Marks)

d. A thin 20cm x 20cm flat plate is pulled at 1m/s horizontally through a 3.6mm thick oil layer sandwitched between two plates, one stationary and other moving at a constant velocity of 0.3m/s as shown in Figure 01 in the third page. The dynamic viscosity of the oil is $0.027 Ns/m^2$. Assuming the velocity in each oil layer to vary linearly,

i. Plot the velocity profile. (01 Mark)
ii. Find the location where the oil velocity is zero. (01 Mark)
iii. Determine the force that needs to be applied on the plate to maintain this motion. (02 Marks)

2.

a. Briefly describe the difference between absolute pressure and gauge pressure.

(02 Marks)

b. Why "Meta centric height" is important in ship-building industry.? (02 Marks)

c. A solid cylinder of a diameter 4.0m has a height of 3.0m . Find the meta centric height of the cylinder if the specific gravity of the material of the cylinder = 0.7 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable.

(04 Marks)

d. The head of water over an orifice of diameter 20mm is 15m. Find the actual discharge and actual velocity of the jet at vena – contracta. Take $C_d = 0.6$ and $C_v = 0.98$

(02 Marks)

3.

a. Write short notes on following topics.

i. Steady flow (01 Mark)

ii. One dimensional flow (01 Mark)

b. A fluid flow is given by,

$$V = xy^2 i - 2yz^2 j - \left(zy^2 - 2\frac{z^3}{3}\right)k$$

i. Prove that iy is a case of possible steady incompressible fluid flow.

(02 Marks)

ii. Calculate the velocity at point P(1,2,3).

(01 Mark)

c. For two dimensional potential flow, the velocity potential is given by,

$$\phi = 4x(3y - 4)$$

i. Determine the velocity at point P(2,3).

(02 Marks)

ii. Determine the value of stream function ψ at the point P(2,3).

(03 Marks)

4.

a. Write down the assumptions that are made in derivation of bernoulie's equation.

(02 Marks)

b. A conical tube of length 3.0m is fixed vertically with its smaller end upwards. The velocity of the flow at the smaller end is 4m/s while at the lower end is 2m/s. The pressure head at the smaller end is 2.0m of liquid. The loss of head in the tube is, $\mathbf{0.95*(V_1 - V_2)^2/2g}$ where V_1 is the velocity at smaller end and V_2 at the lower end respectively. Determine the pressure head at the lower end. Flow take place in downward direction.

(03 Marks)

c. A crude oil of viscosity 0.09Ns/m^2 and specific gravity 0.8 is flowing through a horizontal circular pipe of diameter 80mm and of length 15m. Calculate the differnace of pressure at two ends of pipe if 50kg of oil is collected in a tank in 15 seconds.

(05 Marks)

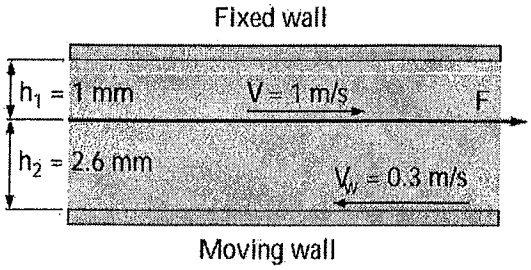

Figure 01

Important Equations

1. $I = \frac{\pi D^4}{64}$
2. $R_e = \frac{\rho V D}{\mu}$
3. $P_1 - P_2 = \frac{32\mu\bar{v}L}{D^2}$
4. $GM = \frac{I}{V} - BG$
5. $\tau = \mu\frac{du}{dy}$