2006 Scheme

USN | | | | | | | | | | |

06CV/TR/EV35

Third Semester B.E. Degree Examination, June 2012
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. When do you consider the fluid in continuum? What is the limit for considering the fluid in continuum? **(04 Marks)**

b. Show that pressure inside a water droplet of diameter 'd' in excess of outside pressure is $\left(\frac{4\sigma}{d}\right)$. **(04 Marks)**

c. A 400 mm diameter shaft is rotating at 200 rpm in a bearing of length 120 mm. The thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 NS/m^2. Determine:
i) Torque required to overcome friction in bearing.
ii) Power utilized. **(08 Marks)**

d. The capillary rise in the glass tube is not to exceed 0.2 mm of water. Determine its minimum size, given surface tension of water in contact with air as 0.0725 N/m. **(04 Marks)**

2 a. State and prove the Pascal's law. **(06 Marks)**

b. A closed tank contains 0.5 m of mercury, 2 m of water, 3 m of oil of specific gravity 0.6 and there is air space above the oil. If the gauge pressure at the bottom of the tank is 196.2 kPa, what is the pressure of air at the top of the tank? **(06 Marks)**

c. Fig.Q2(c) shows a differential manometer connected to two points A and B. At A air pressure is 100 kN/m^2(abs). Find the absolute pressure at B. **(08 Marks)**

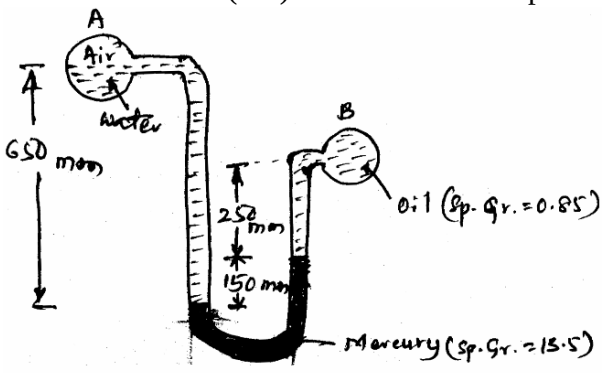

Fig.Q2(c)

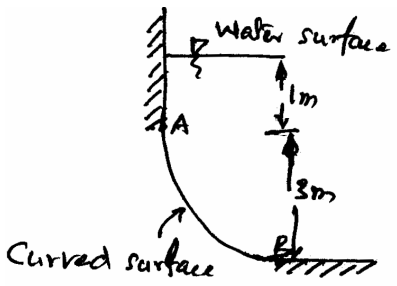

Fig.Q3(b)

3 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(10 Marks)**

b. Fig. Q3 (b) shows a curved surface AB, which is in the form of a quadrant of a circle of radius 3m, immersed in the water. If the width of the gate is unity, calculate the horizontal component of the total force acting on the curved surface. **(10 Marks)**

4 a. Differentiate between the Eulerian and Lagrangian method, of representing fluid flow. **(04 Marks)**

b. Show that streamlines and equipotenital lines form a set of perpendicular lines. **(06 Marks)**

c. In a 2 dimensional incompressible flow, the fluid velocity components are given by u = x-4y and v = -y-4x. Show that velocity potential exists and determine its form as well as stream function. **(10 Marks)**

PART – B

5 a. What is a pitot tube? How is it used to measure velocity of flow at any point in a pipe? **(05 Marks)**

b. A 200 mm × 100 mm venturimeter is provided in a vertical pipe carrying water, flowing in the upward direction. A differential mercury manometer connected to the inlet and throat gives a reading of 220 mm. Find the rate of flow. Assume $C_d = 0.98$. **(05 Marks)**

c. In a 45° bend rectangular air duct of 1 m^2 cross sectional area is gradually reduced to 0.5 m^2 area. Find the magnitude and direction of the force required to hold the duct in position if the velocity of flow at 1 m^2 section is 10 m/s, and pressure is 30 kN/m^2. Take specific weight of air as 0.0116 kN/m^3. **(10 Marks)**

6 a. Derive an expression for the loss of head due to sudden enlargement of a pipe. **(08 Marks)**

b. A 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 of its length from the tank, the pipe is 15 cm diameter and then its diameter is suddenly enlarged to 30 cm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses, determine the rate of flow. Assume pipe friction factor 4f = 0.04 in Darcy-Weisbach formula for both the sections of the pipe. **(08 Marks)**

c. Three pipes of lengths 800 m, 500 m and 400 m and of diameters 50 cm, 40 cm and 30 cm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700 m. Find the diameter of the single pipe. **(04 Marks)**

7 a. Obtain an expression for absolute pressure head at vena contracta for an external cylindrical mouth piece. **(06 Marks)**

b. A tank has two identical orifices in one of its vertical sides. The upper orifice is 1.5 m below the water surface and the lower one is 3 m below the water surface. Find the point at which two jets will intersect, if the coefficient of velocity is 0.92 for both the orifices. **(06 Marks)**

c. Water under a constant head of 4.5 m discharges through an external cylindrical mouthpiece of 50 mm diameter and 150 mm long. If Cc for the orifice is 0.60, find i) the discharge in litres per second and ii) the absolute pressure at vena-contracta. Assume atmospheric pressure to be 10.3 m of water. **(08 Marks)**

8 a. What are the advantages of triangular notch over a rectangular notch? **(06 Marks)**

b. Water flows over a rectangular sharp crested weir 1 m long, the head over the sill of the weir being 0.6 m. The approach channel is 1.4 m wide and the depth of flow in the channel is 1.2 m. Starting from the first principle, determine the rate of flow over the weir, considering velocity of approach and the effect of end contractions. Take the coefficient of discharge of the weir as 0.6. **(08 Marks)**

c. A discharge of 0.06 m^3/s was measured over a right angled notch. While measuring the head over the notch, an error of 1.5 mm was made. Determine the percentage error in discharge, if the coefficient of discharge for the notch is 0.6. **(06 Marks)**

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