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ET-201(A)

B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering)

00036

Term-End Examination

June, 2010

ET-201(A) : MECHANICS OF FLUIDS

Time : 3 hours *Maximum Marks : 70*

Note : Attempt any seven questions. Use of calculator is permitted.

1. (a) One litre of crude oil weighs 9.6 N. Calculate its specific weight, density and specific gravity. **2x5=10**

   (b) Assuming that the bulk modulus of elasticity of water is 2.07×10^6 kN/m^2 at standard atmospheric conditions, determine the increase of pressure necessary to produce 1% reduction in volume at the same temperature.

2. (a) Determine the gauge pressure and absolute pressure at a point 4m below the free surface of a liquid of specific gravity 1.53, if atmospheric pressure is equivalent to 750 mm of mercury. **2x5=10**

(b) A wooden block of width 2m, depth 1.5m, and length 4m floats horizontally in water. Find the volume of water displaced and position of centre of buoyancy. The specific gravity of wooden block is 0.7.

3. (a) The velocity potential function ϕ, is given by : **2x5=10**

$$\phi = x^2 - y^2.$$

Find the velocity components in x and y direction. Also show that ϕ represents a possible case of fluid flow.

(b) The velocity components in a two - dimensional flow are :

$$u = 8x^2 y - \frac{8}{3} y^3, \text{ and}$$

$$v = -8xy^3 + \frac{8}{3} x^3.$$

Show that these velocity components represent a possible case of an irrotational flow.

4. (a) Pipe A, 450 mm in diameter branches into two pipes B and of diameters 300 mm and 200 mm respectively as shown in figure 1. **2x5=10**

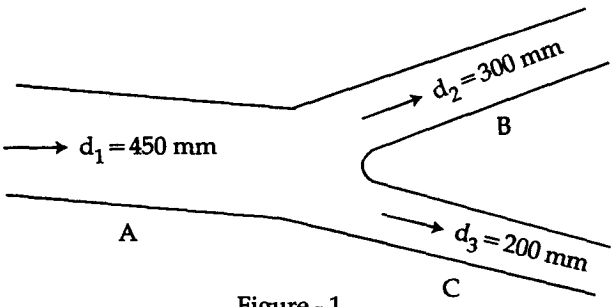

Figure - 1

If the average velocity in 450 mm diameter pipe is 3 m/sec, find :

(i) discharge through 450 mm diameter pipe, and

(ii) Velocity in 200 mm diameter pipe, if the average velocity in 300 mm diameter pipe is 2.5 m/sec.

(b) The water is flowing through a pipe having diameters 20 cm and 15 cm at sections 1 and 2 respectively. The rate of flow through pipe is 40 litres/sec. The section 1 is 6 m above datum line and section 2 is 3 m above the datum. If the pressure at section 1 is 29.43 N/cm^2, find the intensity of pressure at section 2.

5. (a) What is a venturimeter ? Derive an expression for the discharge through a venturimeter. **2x5=10**

(b) For the laminar flow through a circular pipe, prove that :

(i) The shear stress variation across the section of the pipe is linear, and

(ii) The velocity variation is parabolic.

6. (a) What are the different methods of determining the co-efficient of viscosity of a liquid ? Describe any one method in detail. **2x5=10**

(b) An oil of specific gravity 0.9 and viscosity 10 poise is flowing through a pipe of diameter 110 mm. The velocity of the fluid at the centre is 2 m/s, find

(i) pressure gradient in the direction of flow,

(ii) shear stress at the pipe wall, and

(iii) velocity at a distance of 30 mm from the wall.

7. (a) What do you understand by turbulent flow ? What factor describes the type of flow in pipes ? **2x5=10**

(b) An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/sec. Find the head loss due to friction and power required to maintain the flow for a length of 1000 m. Take $\vartheta = 0.29$ stokes.

8. (a) A partially submerged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ of water, length l of the body, velocity V of the body, and the acceleration due to gravity g. Show that the resistance to the motion can be expressed in the form **2x5=10**

$$R = \rho L^2 V^2 \phi \left[\left(\frac{\mu}{\rho VL} \right), \left(\frac{lg}{V^2} \right) \right].$$

(b) What is meant by boundary layer ? Why does it increase with distance from the upstream edge ?

9. (a) Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by : **2x5=10**

$$\frac{u}{v} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

where δ = boundary layer thickness.

(b) Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2 m long and 1m wide. The density of air is 1.15 kg/m^3. The coefficient of lift and drag are 0.75 and 0.15 respectively.

Determine :

(i) the lift force

(ii) the drag force,

(iii) the resultant force, and

(iv) the direction of resultant force

10. Write short notes on ***any four*** of the following : **4x2½=10**

(a) Nozzle

(b) Continuity equation

(c) Water hammer

(d) Viscosity

(e) Reynold's number

(f) Head loss