00407

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

Term-End Examination

June, 2011

ET-201(A) : MECHANICS OF FLUIDS

Time : 3 hours *Maximum Marks : 70*

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

1. (a) The velocity distribution, for small values of y, in laminar boundary layer on a flat plate is given by the equation. **5+5**

$$u = 5y - 2y^3$$

in which u is the velocity in m/s at a distance y metre above the plate. Determine, shear stress at $y=0$ and $y=0.25$ m if $\mu = 1.85 \times 10^{-5}$ Pas

(b) Find the increase in the pressure required to reduce the volume of water by 0.8 percent if its bulk modulus of elasticity is 2.075×10^9 N/m^2.

2. (a) A wooden block of width 2 m, depth 1.5 m, and length 4 m 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. **5+5**

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

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

$$v = -8xy^2 + \frac{8}{3}x^3,$$

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

3. (a) The water is flowing through a pipe having diameter 20 cm and 15 cm at section 1 and 2 respectively. The rate of flow through pipe is 40 litres/sec. The section 1 is 6 m above the 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+5**

(b) If a 300 mm diameter pipe carrying 0.212 m^3 discharge of oil of relative density 0.8 has 200 kN/m^2, pressure at a section 10 m above the datum, determine total energy per unit mass of fluid.

4. (a) Determine whether the specified flows are rotational or irrotational. **5+5**

(i) $u = y, \ v = -\frac{3}{2}x$, and

(ii) $u = xy^2, \ v = x^2y$

(b) A 50 mm diameter tube gradually expands to 100 mm diameter tube in a length of 10 m. If the tube makes an angle of 20° in

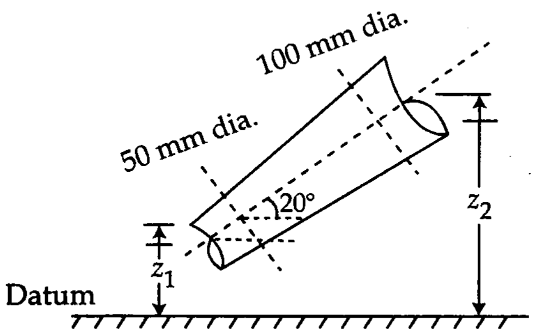

Figure - 1

upward direction with the horizontal as shown in figure - 1, determine the pressure p_2 at the exit if the tube carries a discharge of 3.925 litres/sec and the inlet pressure p_1 is 60 kN/m^2, assuming

(i) no energy loss and

(ii) a loss of 0.20 m

5. (a) Oil of relative density 0.80 flows through a pipe line which changes in its size from 150 mm diameter at section A to 300 mm diameter at section B, section B being 4.5 m higher than section A. If the gauge pressure at A and B are 200 kN/m^2 and 140 kN/m^2 respectively, determine the direction of flow and energy loss when the pipe carries discharge of 0.110 m^3/sec. 5+5

(b) Find the gauge pressure and absolute pressure in N/m^2 at a point 4 m below the free surface of a liquid of sp. gr. 1.2, if the atmospheric pressure is equivalent to 750 mm of mercury.

6. (a) An agitator of diameter D rotates at a speed N in a liquid of density ρ and viscosity μ. Show that the power ρ required to mix the liquid is expressed by a functional form. 5+5

$$\frac{P}{\rho N^3 D^5} = f\left(\frac{\rho N D^2}{\mu}, \frac{N^2 D}{g}\right).$$

(b) Differentiate between Laminar flow and turbulent flow.

7. (a) Is turbulence always undesirable ? If your answer is yes, give reasons. If your answer is negative give examples where turbulence is advantageous. 5+5

(b) An oil having a viscosity of 0.096 Pas and a specific gravity of 1.59 flows through a horizontal pipe of 5 cm diameter with a pressure drop of 5.886 kN/m^2 per metre length of the pipe.

Determine

(i) the rate of flow in kg/min, and

(ii) the shear stress at the pipe wall.

8. (a) The chimney of a boiler house is 50 m tall and has an outside diameter of 3 m. Compute the overturning moment about the base if a 30 m/s wind blows past it at the standard atmospheric conditions. **5+5**

(b) Give four examples in every day life where formation of boundary layer is important.

9. (a) With neat sketches explain the development of a boundary layer along a thin flat smooth plate held parallel to a uniform flow and explain its salient features. **5+5**

(b) Determine the terminal velocity of a spherical steel ball of diameter 50 mm when dropped in a large mass of water. Assume that the specific gravity of steel is 8.0 and that the C_D is 0.4.

10. Write short notes *any five* of the following : **5x2=10**

(a) Aero foil

(b) Nozzle

(c) Bulk Modulus

(d) Drag

(e) Continuity Equation

(f) Irrotational flow

(g) Reynold's Number

(h) Viscosity
