Code : 011307

B.Tech 3rd Semester Examination, 2016

Fluid Mechanics

Time : 3 hours *Full Marks : 70*

Instructions :

*(i) There are **Nine** Questions in this Paper*

*(ii) Attempt **Five** questions in all.*

*(iii) **Question No. 1 is Compulsory.***

(iv) The marks are indicated in the right hand margin.

(v) Assume data if necessary with proper justification.

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1. Choose the correct answer (any seven) : 2×7=14

(a) Discharge coefficient of a 'Venturimeter' is:

(A) less than Orifice meter

(B) approximately equal to 0.65

(C) greater than Orifice meter

(D) greater than 1.2

(b) Correct unit for Kinematic Viscosity is:

(A) Ns/m^2 (B) m^2/s

(C) m/kg.s (D) kg/m^2s

(c) For 2-D flow field, the equation of streamline is given as:

(A) u/dx=dy/v (B) dx/u=dy/v

(C) du/dx+dv/dy=0 (D) dy/u=dx/v

(d) The stream function for a 2-D flow is given by ψ =2xy+ constant The flow between the streamlines (1,1) and (2,2) would be:

(A) 4 units (B) 6 units

(C) 8 units (D) 10 units

(e) Consider the Chezy's equation for the flow velocity through a channel: $V = C\sqrt{(mi)}$ where V is flow velocity in m/s,m is the hydraulic mean depth in meter and i is longitudinal slope of the channel. The dimensions of the Chezy constant C are:

(A) $ML^{-1}T$ (B) $L^{1/2}T^{-1}$

(C) $M^0L^0T^0$ (D) L^2T^{-1}

(f) Each term of Bernoulli' equation has the unit of:

(A) Newton (B) Meter

(C) Pascal (D) N/m^2

(g) The equation of motion for a viscous fluid are known as :

(A) Euler's equation

(B) Reynolds equation

(C) Navier-Stokes equation

(D) Hagen-Poiseuille equation

(h) Momentum integral equation for zero pressure gradient is given by:

(A) $\tau_0 / \rho = U_\infty d\theta / dx$

(B) $\tau_0 / \rho = (U_\infty d\theta / dx)^2$

(C) $\tau_0 / \rho = U_0^2 d\theta / dx$

(D) $\tau_0 / \rho = U_\infty (d\theta / dx)^2$

(i) The pressure at the bottom of a water Lake is 1.5 times to that at half the depth. If the water barometer reads 10 m. the depth of lake is:

(A) 10 m (B) 15 m

(C) 20 m (D) 25 m

(j) The barnoulli equation refers to the conservation of:

(A) mass (B) momentum

(C) force (D) energy

2. (a) State the Newton's law of viscosity and give examples of its application. 6

(b) The velocity distribution for flow over a flat plate is given by $u = \frac{3}{4}y - y^2$ in which u is the velocity in meter per second at a distance y metre above the plate. Determine the shear stress at y= 0.15 m. Take dynamic viscosity of fluid as 8.6 poise. 8

3. (a) An inclined-tube reservoir manometer is constructed as shown in Fig. 1. Derive a general expression for the liquid deflection, L, in the inclined tube, due to the applied pressure difference, Δp. Also obtain an expression for the manometer sensitivity, and discuss the effect on sensitivity of D, d, θ and SG. 9

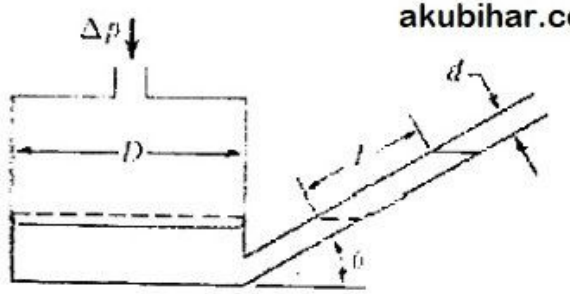

Fig. 1

3. (b) What is manometer ? How are they classified? 5

4. (a) Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plate surface submerged in the liquid. 7

(b) Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the centre of the plate is 3 m below the free surface of water. Find the position of centre o pressure. 7

5. (a) Consider a flow with velocity components $u=0$, $v = -y^3 - 4z$, and $w = 3y^2 z$.

i. Is this a one-, two-, or three-dimensional flow?

ii. Demonstrate whether this is an incompressible or compressible flow.

iii. Derive a stream function for this flow. 8

(b) What do you understand by 'local acceleration' and 'convective acceleration'? 6

6. (a) A 300 mm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. If the axis of the pipe turns through 45°, find the magnitude and direction of the resultant force at the bend. 8

(b) What is venturimeter ? Derive an expression for the discharge through a venturimeter. 6

7. (a) When tested in water ($\rho = 998 kg/m^3$ and $\mu = 0.001$ kg/m.s) flowing at 2 m/s, an 8 cm diameter sphere has a measured drag of 5 N. What will be the velocity and drag force on a 1.5 m diameter weather balloon moored in sea-level standard air (p=1.2255 kg/m^3 and $\mu = 1.78 \times 10^{-5} kg/m.s$)? 7

(b) The drag force, F, on a smooth sphere depends on the relative velocity, V, the sphere diameter, D, the fluid density, p, and the fluid viscosity, μ. Obtain a set of dimensionless groups that can be used to correlate experimental data. 7

8. (a) In Fig.2 the flowing fluid is CO_2 at 20°C. Neglect losses. If P$_1$=170 kPa and the manometer fluid is Meriam red oil (SG=0.827), estimate (a) p^2 and (b) the gas flow rate in m^3/h. 8

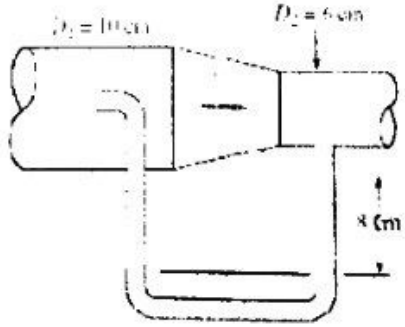

Fig. 2

(b) What do you mean by boundary layer separation ? Discuss the methods of preventing the separation of boundary layer. 6

9. Write short notes on following: 5+5+4

(i) Navier-Stokes Equation

(ii) Flow Net

(iii) Friction Drag and Pressure drag

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