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12MTP13/13MTH13

First Semester M.Tech. Degree Examination, Dec. 2013 / Jan 2014.
Advanced Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Explain the concept of continuum. **(05 Marks)**

b. Explain the following with an example :
i) Steady and uniform flow ii) Unsteady and non – uniform flow. **(05 Marks)**

c. A fluid is flowing at a constant volume flow rate of Q through a divergent pipe having inlet and outlet diameters of D_1 and D_2 respectively and a length of L. Assuming the velocity to be axial and uniform at any section, show that the accelerations at the inlet and outlet of the pipe are given by

$$-\frac{32Q^2(D_2-D_1)}{\pi^2 LD_1^5} \quad \text{and} \quad -\frac{32Q^2(D_2-D_1)}{\pi^2 LD_2^5} \quad \text{respectively.} \qquad \textbf{(10 Marks)}$$

2 a. Derive three dimensional continuity equation in spherical coordinates. **(10 Marks)**

b. Write down Euler's equation for unsteady two dimensional motions in Cartesian co-ordinates. Integrate thin equation for irrotational flow and reduce it to following form :

$$\frac{\partial Q}{\partial t}+\frac{1}{2}(u^2+v^2)+\frac{p}{\rho}+gy=F_2(t)\text{, where } \phi \text{ - velocity potential function.} \qquad \textbf{(10 Marks)}$$

3 a. Distinguish between Laminar and Turbulent flows. **(05 Marks)**

b. Derive an expression for discharge of steady laminar flow through an annular space between two concentric coaxial tubes with inner radii R_1 and outer radii R_2. Further prove that $\tau_w=\left(-\frac{\partial p}{\partial x}\right).\frac{D_h}{4}$, where D_h = Hydraulic diameter , τ_w = Average shear stress at wall. **(15 Marks)**

4 a. Explain any two types of turbulence models. **(10 Marks)**

b. A pipe line of 0.6m in diameter is 1.5km long. In order to argument the discharge, another parallel line of the same diameter is introduced in the second half of the length. Neglecting minor losses, find the increase in the discharge if f = 0.04. Head at inlet is 30m over that at the outlet. f – Friction factor. **(10 Marks)**

5 a. Discuss steady parallel flow past a sphere and obtain an expression for the drag force. **(10 Marks)**

b. Write notes on :
i) Hydrodynamic theory of lubrication ii) Hele – Shaw flow. **(10 Marks)**

6 a. Assuming linear velocity profile in the boundary layer and using integral momentum equation, determine thickness of the boundary layer. Also determine the friction co-efficient, displacement and momentum thickness. **(15 Marks)**

b. Write a note on boundary layer separation. **(05 Marks)**

7 a. Explain with neat sketches, the flow past a circular cylinder for various Reynolds number. **(10 Marks)**

b. Explain the phenomenon of lift and drag on airfoil. **(05 Marks)**

c. Discuss influence of lift and drag of moving vehicles on power consumption and vehicle stability. **(05 Marks)**

8 Write short notes on :

a. Sources of errors during measurements. **(05 Marks)**

b. Hot wire anemometer. **(05 Marks)**

c. Flow visualization techniques. **(05 Marks)**

d. Laser Doppler Velocimetry. **(05 Marks)**

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