Printed Pages : 4 TCE-301

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4070 Roll No.

B. Tech.

(SEM. III) EXAMINATION. 2008-09

FLUID MECHANICS

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all five** questions.*

*(2) The figure in the **right** hand margin indicate marks.*

(3) Missing data, if any, may suitably be assumed.

1 Attempt any **two** of the following : **2×10=20**

(a) (i) What do you mean by **4**

(1) Ideal and Real fluids

(2) Newtonian and non-Newtonian fluids ?

Give examples of each.

(ii) Establish a relationship between surface tension and pressure intensity for a liquid droplet. How does the relationship differ from that of a sollow soap bubble ? **6**

(b) A solid cylinder of 2 m diameter and 2 m height is floating in water with its axis vertical. If the specific gravity of the cylinder is 0.65, find its metacentric height and state whether the equilibrium is stable or unstable.

(c) Using Buckingham's π – theorem of dimensional analysis, show that the boundary shear stress τ_0 in turbulent flow through a rough pipe is given by $\tau_0 = \rho v^2 \phi\left(\frac{\rho VD}{\mu}, \frac{K}{D}\right)$, where ρ, V, D, μ and K are fluid density, average velocity of flow, pipe diameter, fluid viscosity and height of roughness respectively. ϕ is a functional notation.

2 Attempt any **two** of the following : **2×10=20**

(a) (i) Distinguish between **4**

(1) Steady and unsteady flows

(2) Uniform and non-uniform flows

(ii) Define stream function ψ and velocity potential function ϕ. Express the conditions for continuity of flow and irrotational flow in terms of ψ and ϕ for 2-D flow. **6**

(b) A pipe having 20 cm diameter at section-1 and 50 cm diameter at section-2 carries oil of specific gravity 0.85 at the rate of 240 litres/s. Section-2 is at elevation of 4 m above section-1. If pressure of the oil at section-1 and section-2 are 100 KPa and 60 KPa respectively, determine the direction of flow and loss of head between the two sections.

(c) (i) Discuss the importance of model study in fluid flow probelms. **5**

(ii) Find an expression for the discharge over a rectangular weir. **5**

3 Attempt any **two** of the following : **10×2=20**

(a) A 2.5 cm diameter nozzle is fitted to a horizontal pipe of 5 cm diameter to discharge water. The velocity of flow in the pipe is 16 m/s. Calculate the force exerted by water on the nozzle. Neglect losses.

(b) For Laminar flow between two parallel fixed plates, derive expressions for velocity and shear stress distributions.

(c) Discuss the significance of Reynolds' stress and 'mixing length' in the turbulent flow.

4 Attempt any **two** of the following : **2×10=20**

(a) What is a Boundary Layer ? Explain with a sketch the development of boundary layer over a smooth flat plate.

(b) A pipe of 10 cm diameter carries water. The velocities at the pipe centre and 3 cm from the pipe centre are 2 m/s and 1.5 m/s respectively. If the flow in the pipe is turbulent, determine the shear stress at the pipe wall and at 3 cm from the pipe wall.

(c) Find the loss of head due to friction and power required to pump an oil of specific gravity 0.85 and absolute viscosity 1.5 poise through a 25 cm diameter and 10 km long pipe laid at a slope of 1 in 200. The rate of flow of the oil is 0.022 m^3/s.

5. Attempt any **two** of the following : **2×10=20**

(a) Define compressible flow. Show that the velocity of propagation C of the pressure wave in a compressible fluid flow is given by $C = \sqrt{E/\rho}$, where E and ρ are the volume modulus of elasticity and mass density of fluid respectively.

(b) Analyse the flow past a source-sink pair in a uniform flow. Extend the analysis to study the limiting case of a doublet in uniform flow.

(c) A kite 0.8 m × 0.8 m and weighing 4 N is maintained in air at an angle of 10° to the horizontal. The string attached to the kite makes an angle of 45° to the horizontal and at this position the values of coeff. of drag and lift are 0.6 and 0.8 respectively. Find the speed of the wind tension in the string. Take density of air = 1.25 kg/m^3.