Printed Pages : 4 ECE301

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

PAPER ID : 0021 Roll No.

B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10

FLUID MECHANICS **

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

Note : *Attempt **all** the questions. All questions carry **equal** marks.*

1 Attempt any **four** of the following : **4×5=20**

(a) A square plate 50 cm × 50 cm weighing 200 N slides down an inclined plane of slope 1 vertical : 2.5 horizontal with a uniform velocity of 0.40 m/s. If a thin layer of oil of thickness 0.5 cm fills the space between the plate and the inclined plane, determine the coefficient of viscosity of the oil.

(b) Obtain an expression for the height of capillary rise for a fluid of surface tension σ and contact angle θ between two parallel vertical plates at a distance B apart.

(c) Define the term center of pressure of the plane area immersed in a fluid. What relation has it got with the centre of gravity of the area ? Do the centre of pressure and center of gravity ever coincide and if so under what conditions ?

(d) Derive an expression for the absolute pressure to be measured in pipe carrying highly pressurized water with the help of a Double U-tube Manometer having Mercury in each tube with different levels in the four limbs.

(e) What is Metacentric height ? And what are the three states of equilibrium for floating bodies ?

(f) Derive an expression for the slope of the inclined surface of water in a container moving with a constant acceleration.

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

(a) Explain and distinguish between (i) steady and unsteady flow (ii) uniform and non-uniform flow (iii) rotational and ir-rotational flow (iv) Subcritical and super critical flows and (v) Laminar and Turbulent flows.

(b) Derive the expression for the continuity equation for the steady state 3-D flow of a compressible fluid.

(c) Derive the equation of a stream line for 2-D flow. Prove that the discharge between two stream lines is the difference in their stream function values.

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

(a) What are local and convective components of total acceleration ? Explain these with the help of a suitable example. Derive an expression for the equation of motion along a stream line for non-viscous and incompressible fluids.

(b) A venturimeter is fitted horizontally in a 15 cm dia. pipe and the pressure in the pipe corresponds to a water head of 10 m. If the maximum flow through the meter is 0.15 m^3/sec., find the smallest throat diameter so that the pressure does not fall below 2.45 m of water (absolute).

(c) If both the Reynolds number and the Froude number are significant, determine the scale for kinematic viscosity in terms of the length scale if the gravitational field remains the same both for the model and the prototype.

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

(a) Derive the equation of motion for laminar flow through pipes. Also derive the expression for velocity and shear stress distribution across the pipe.

(b) A 10 cm dia. shaft runs at 900 rpm in a sleeve with a radial clearance of 1 mm. If the sleeve length is 15 cm long and the space is filled with an oil of dynamic viscosity, $\mu = 0.10$ kg/m-s, determine the torque resistance.

(c) The total flow in three parallel pipe system is 4 m^3/sec. The pipe diameters and lengths of the three pipes are : $d_1 = 1.0$ m, $L_1 = 1000$ m; $d_2 = 0.5$ m, $L_2 = 800$ m; $d_3 = 0.75$ m, $L_3 = 750$ m. Find the discharge in the three pipes.

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

(a) Define physically and mathematically the concept of Displacement Thickness, Momentum Thickness and Energy Thickness of a boundary layer and state their relative order these thicknesses.

(b) Explain the essential features of Blasius method of solving laminar boundary layer equations for a flat plate. Derive the expression for boundary layer thickness and local skin friction coefficient from this solution.

(c) State the Stokes' law for finding drag force of a sphere moving in an infinite medium. How this law can be applied to determine the viscosity of fluid ?