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

PAPER ID : 4070 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION

2010-11

FLUID MECHANICS

Time : 3 Hours *Total Marks : 100*

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

(2) Each question carries equal marks.

(3) Assume any missing data suitably.

1. Attempt any **four** parts of the following: **(5×4=20)**

(a) Explain the concept of fluid-continuum. What is the advantage of assuming fluid-continuum concept ?

(b) Explain Newton's Law of Viscosity. The velocity distribution for flow over a flat plate is given by $u = \frac{3}{4}y - y^2$ in which u is velocity in m/s at a distance y(m) above the plate. Determine the shear stress at y = 0.15 M. Take dynamic viscosity of fluid as 8.6 poise.

(c) Explain the following terms :

(i) Newtonian and non-Newtonian fluids

(ii) Vapour Pressure

(iii) Compressibility of fluid.

(d) What are the gage pressure and absolute pressure at a point 3 m below the free surface of a liquid having a density of 1.53×10^3 kg/m^3, if the atmospheric pressure is equivalent to 750 mm of mercury ?

(e) A U-tube manometer is used to measure the pressure of water in a pipeline, which is in excess of atmospheric pressure. The light limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe-line.

(f) What do you mean by dimensionless numbers ? Define and explain Reynold's number and Froude's number.

2. Attempt any **four** parts of the following : **(5×4=20)**

(a) What do you mean by distorted and undistorted model ? Explain the advantages of distorted models.

(b) Explain the following :

(i) Lagrangian and Eulerian approach

(ii) Steady and unsteady flows

(iii) Laminar and turbulent flows

(iv) Path lines, streak lines and stream lines.

(c) For steady and irrotational flows, derive the continuity equation in Cartesian for incompressible fluids.

(d) The velocity components in a 2-D flow field for an incompressible fluids are as follows :

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

$$v = xy^2 - 2y - \frac{x^3}{3}$$

Obtain expression for stream function y.

(e) Explain the experimental method of determination of c_c, c_v and c_d for the flow through an orifice.

(f) Find the expression for discharge for the flow over a weir out notch of rectangular shape.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) A 300 mm diameter pipe carries water under a head of 20 m at 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.

(b) Show that the maximum velocity for the flow through two stationary parallel plates in laminar regime is 1.5 times the average velocity.

(c) Explain the Prandtl mixing length theory for turbulent shear stresses and find the expression for velocity profile. What is velocity defect ?

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) Explain the concept of Boundary Layer. What do you mean by Laminar, boundary layer, transition boundary layer and turbulent boundary layer ? Explain with the help of neat sketch. What is laminar sub layer ?

(b) An oil of S.G. 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres/sec. Find the loss of head due to friction for 500 m length of pipe.

(c) For a town water supply, a main pipeline of diameter 0.4 m is required. As pipes more than 0.35 m diameter are not readily available, two parallel pipes of the same diameter were used. If the total discharge in the parallel pipes is same as in the single main pipe, find the diameter of the parallel pipes. Assume same coefficient of friction for all pipes.

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

(a) Explain the phenomena of water hammer in pipes. Find the expression for increase in pressure head due to water hammer when the valve is closed gradually.

(b) Write short notes on :

(i) Source

(ii) Sink

(iii) Doublet

and explain with suitable neat sketches.

(c) A flat plate 6.5 m × 1.5 m moves at 50 km/hour in stationary air of density 1.15 kg/m³. If the coefficient of drag and lift are 0.15 and 0.75 respectively, determine :

(i) The lift force

(ii) The drag force

(iii) Resultant force

(iv) Power required to keep the plate in motion.