Total No. of printed pages = 5

CT-403/FM/4th Sem/2015/M

FLUID MECHANICS

Full Marks – 70

Pass Marks – 28

Time – Three hours

The questions are of equal value.

Answer any *five* questions.

1. (a) What do you mean by mass density and relative density ? Write down the standard value of water for both along with MLT system.

   (b) What do you mean by total pressure and centre of pressure ? How to determine total pressure on a vertical plane surface ?

   (c) Find the depth of a point below water surface in a sea where pressure intensity is 1.006 MN/m^2. Specific gravity of sea water is 1.025.

   (d) A rectangular plane surface 2m wide and 3m deep lies in water in such a way that its plane makes an angle of 300 with the free surface of water. Determine the total pressure and position of centre of pressure when the upper edge is 1.5m below the free water surface.

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2. (a) Write the definition of stream line and stream tube.

(b) What do you mean by steady flow and non-uniform flow ? Write down the continuity equation for three dimensional steady incompressible flows.

(c) Derive the equation for three dimensional total acceleration in x, y and z direction when velocity of flow is given by V = v (x, y, z, t).

3. (a) What do you mean by hydraulic grade line and energy grade line of flow ?

(b) Derive the Bernoulli's equation along the stream line. Also write down Bernoulli's equation in the form of mechanical energy.

(c) The water is flowing through a pipe having diameters 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through pipe is 35 litres per second. The section 1 is 6m above datum and section 2 is 4m above datum. If the pressure at the section 1 is 39.24 N/cm^2, then find the intensity of pressure at section 2.

4. (a) What do you mean by laminar flow and turbulent flow ? Write down the Reynold's number for the same.

(b) How to determine the shear stress in laminar pipe flow ? Also show the shear stress distribution in laminar pipe flow.

(c) An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres per second. Find the head loss due to friction for a 500m length of pipe. Find the power required to maintain this flow.

5. (a) What are the energy losses generally is observed due to flow in pipe ?

(b) Derive a mathematical expression for loss of head due to sudden enlargement of pipe.

(c) A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Find the loss of head due to contraction if coefficient of contraction is 0.62. Also determine rate of flow of water.

6. (a) Write the definition of coefficient of velocity, coefficient of discharge and coefficient of contraction.

(b) A 25 mm diameter nozzle discharges $0.76m^3$ of water per minute when the head is 60m. The diameter of jet is 22.5 mm. Determine (i) values of coefficient of velocity, coefficient of discharge and coefficient of contraction and (ii) the loss of head due to fluid resistance.

(c) Determine the height of a rectangular weir of length 6m to be built across a rectangular channel. The maximum depth of water on the upstream side of weir is 1.8m and discharge is 2000 litres per second. Take coefficient of discharge is 0.6 and neglect end contractions.

7. (a) What do you mean by prismatic and non-prismatic channel ?

(b) What do you mean by hydraulically efficient channel ? How to obtain hydraulically efficient rectangular channel ?

(c) A trapezoidal channel is 10m wide and has a side slope of 1.5 horizontal : 1 vertical. The bed slope is 0.0003. The channel is lined with smooth concrete of n is 0.012. Compute the mean velocity and discharge for a depth of flow of 3.0m.

8. (a) Manning's equation is valid for which type of flow ? 1

(b) Draw the velocity distribution for laminar and turbulent pipe flow. 2

(c) What is Pascal law ? 2

(d) Continuity equation is based on which principle ? 1

(e) What are the instruments used for measuring the velocity of flow ? 1

(f) What do you mean by viscosity ? Write its unit along with MLT system. 2

(g) If $5m^3$ of a certain oil weights 40 kN, calculate specific weight, mass density and specific gravity of this oil. 4

(h) What do you mean by Reynold's number ? 1