No. of Printed Pages : 7

BME-028

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

01143

Term-End Examination

December, 2016

BME-028 : FLUID MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume missing data, if any.*

1. (a) One litre of crude oil weighs 9·6 N. Calculate its specific weight, density and specific gravity.

(b) The velocity distribution for flow over a flat plate is given by

$$u = \frac{3}{2}y - y^{3/2},$$

where u is the point velocity in m/sec at a distance y metres above the plate. Determine the shear stress at y = 9 cm. Assume dynamic viscosity as 8 poise. *5+5*

2. (a) Water flows through a pipe AB of 1·2 m diameter at 3 m/s and then passes through a pipe BC of 1·5 m diameter as shown in Figure 1. At C, the pipe branches. Branch CD is 0·8 m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2·5 m/sec. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE.

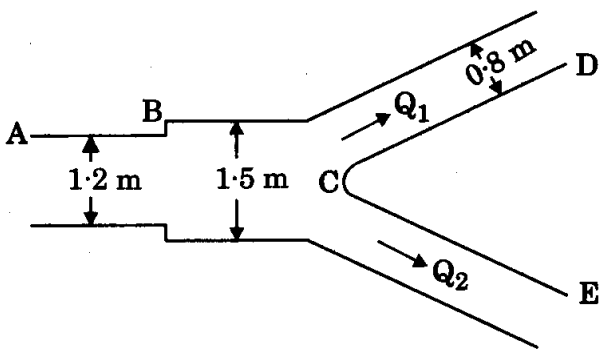

Figure 1

(b) What are the gauge pressure and absolute pressure at a point 3 m below the free surface of a liquid having a density of $1{\cdot}53 \times 10^3$ kg/m^3, if the atmospheric pressure is equivalent to 750 mm of mercury ? The specific gravity of mercury is 13·6 and the density of water = 1000 kg/m^3. *5+5*

3. (a) Show that the following stream function

$$\psi = 6x - 4y + 7xy + 9$$

represents an irrotational flow. Find its velocity potential.

(b) Differentiate between any ***two*** of the following :

(i) Stream function and Velocity potential function

(ii) Stream line and Streak line

(iii) Rotational and Irrotational flows *5+5*

4. (a) Give four examples in everyday life where formation of boundary layer is important. What boundary conditions must be satisfied by the velocity distribution in laminar boundary layer over a flat plate ?

(b) The velocity vector in a fluid flow is given by.

$$V = 2x^3 \hat{i} - 5x^2 y \hat{j} + 4.$$

Find the velocity and acceleration of a fluid particle at (1, 2, 3) at time, t = 1. *5+5*

5. (a) A venturimeter with a throat diameter of 7·5 cm is installed in a 15 cm diameter pipe. The pressure at the entrance to the meter is 70 kPa (gauge) and it is desired that the pressure at any point should not fall below 2·5 m of water absolute. Determine the maximum flow rate of water through the meter. Take C_d = 0·97 and atmospheric pressure as 100 kPa.

(b) For the flows represented by the following stream functions, determine the velocity components u and v :

(i) $\psi = xy$

(ii) $\psi = 9r^2 \sin^2 \theta$ *5+5*

6. (a) Find the displacement thickness and the momentum thickness for the velocity distribution in the boundary layer given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2.$$

(b) Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2 m long and 1 m wide. The density of air is 1·15 kg/m^3. The coefficients of lift and drag are 0·75 and 0·15 respectively.

Determine

(i) the lift force,

(ii) the drag force, and

(iii) the resultant force. *5+5*

7. (a) A pump discharges 2 m^3/sec of water through a pipeline. If the pressure difference between the inlet and the outlet of the pump is equivalent to 10 m of water, what power is being transmitted to the water from the pump ?

(b) A paratrooper and a parachute together weigh 1 kN. Estimate its rate of descent, if the parachute diameter is 7 m and the drag coefficient is assumed to be 1·2. Given that the density of air is 1·22 kg/m^3. *5+5*

8. (a) Glycerine of density 1250 kg/m^3 and viscosity 0·72 kg/ms flows through a pipe of 80 mm diameter. If the shear stress at the wall is 300 N/m^2, calculate the

(i) pressure gradient along the flow,

(ii) average velocity in the pipe,

(iii) rate of discharge, and

(iv) Reynolds number of the flow.

(b) A lead sphere of 1·00 mm diameter acquired a terminal velocity of 7 mm/sec, in an oil while falling down. Assuming that the density of lead is 11000 kg/m^3, and that of the oil is 1200 kg/m^3,

compute

(i) the Reynolds number, and

(ii) the kinematic viscosity of the oil. *5+5*

9. (a) With neat sketches, explain the development of a boundary layer along a thin flat smooth plate held parallel to a uniform flow and explain the salient features.

(b) What are the causes of separation of boundary layer and how can the separation be controlled ? *5+5*

10. Write short notes on any ***five*** of the following : *5×2=10*

(a) Turbulent Flow

(b) Syphon

(c) Cavitation

(d) Water Hammer

(e) Head Loss

(f) Bernoulli's Equation

(g) Eddy Viscosity

(h) Newtonian Fluids