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BME-028

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

01343

Term-End Examination

June, 2016

BME-028 : FLUID MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***seven*** *questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) A hydraulic press has a ram of 200 mm diameter and a plunger of 30 mm diameter. It is used for lifting a weight of 30 kN. Find the force required at the plunger.

(b) What is the difference between dynamic viscosity and kinematic viscosity ? State their units of measurements. *5+5*

2. (a) Explain briefly the working principle of Bourdon pressure gauge with a neat sketch.

(b) A pipeline which is 4 m in diameter contains a gate valve. The pressure at the centre of the pipe is $19{\cdot}6 \times 10^4$ N/m^2. If the pipe is fitted with oil of specific gravity 0·87, find the force excerted by the oil upon the gate and the position of centre of pressure. *5+5*

3. (a) Derive an expression for the force excerted on a submerged plane surface by the state and locate the position of centre of pressure.

(b) The time period of rolling of a ship of weight 29430 kN in sea water is 10 seconds. Determine the centre of buoyancy of the ship, if the moment of inertia of the ship at the water line about fore and aft axis is 1000 m^4. The specific weight of sea water is 10100 N/m^3. *5+5*

4. (a) Distinguish between (i) rotational flow and irrotational flow, and (ii) steady and unsteady flow.

(b) A closed cylindrical vessel of diameter 20 cm and height 100 cm contains water up to a height of 70 cm. The air above the water surface is at a pressure of 78·48 kN/m^2. The vessel is rotated at a speed of 300 r.p.m. about its vertical axis. Find the pressure head at the bottom of the vessel (i) at the centre, and (ii) at the edge. *5+5*

5. (a) What do you mean by repeating variables ? How are the repeating variables selected in dimensional analysis ?

(b) The resistance R, to the motion of a completely submerged body depends upon the length of the body L, velocity of flow V, mass density of fluid ρ, and kinematic viscosity of fluid ν. By dimensional analysis prove that

$$R = \rho V^2 L^2 \phi \left(\frac{VL}{\nu} \right).$$ *5+5*

6. (a) What is a pitot-tube ? How will you determine the velocity at any point with the help of a pitot-tube ?

(b) An oil of specific gravity 0·8 is flowing through a venturimeter having inlet diameter 200 mm and throat diameter 100 mm. The oil-mercury differential manometer shows a reading of 250 mm. Calculate the discharge of oil through the horizontal venturimeter. Take $e_d = 0·98$. *5+5*

7. (a) Explain the classification of orifices and mouthpieces based on their shape, size and sharpness.

(b) A rough pipe of diameter 300 mm and length 600 m carries water at the rate of 0·04 m^2/s. The wall roughness is 0·015 mm. Determine the coefficient of friction, wall shear stress and centre line velocity. *5+5*

8. (a) What is a compound pipe ? What will be the loss of head when pipes are connected in series ?

(b) The rate of flow of water through a horizontal pipe is 0·3 m^3/s. The diameter of the pipe is suddenly enlarged from 250 mm to 500 mm. The pressure intensity in the smaller pipe is 13·734 N/cm^2. Determine the

(i) loss of head due to sudden enlargement,

(ii) pressure intensity in the large pipe, and

(iii) power loss due to enlargement. *5+5*

9. (a) What is meant by boundary layer ? Why does it increase with distance from the upstream edge ?

(b) A thin plate is moving in still atmospheric air at a velocity of 4 m/s. The length of the plate is 0·5 m and width 0·4 m. Calculate the (i) thickness of the boundary layer at the end of the plate, and (ii) drag force on one side of the plate. Take density of air as 1·25 kg/m^3 and kinematic viscosity as 0·15 stokes. *5+5*

10. (a) Explain the drag and lift forces of a body immersed in a moving fluid.

(b) A jet plane which weighs 19620 N has a wing area of 25 m^2. It is flying at a speed of 200 km per hour. When the engine develops 588·6 kN, 70% of this power is used to overcome the drag resistance of the wing. Calculate the coefficient of lift and coefficient of drag for the wing. Take density of air as 1·25 kg/m^3. *5+5*
