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BME-028

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

December, 2015

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) The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft diameter is 0·4 m and rotates at 190 r.p.m. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1·5 mm.

(b) Define surface tension. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $p = \frac{4\sigma}{d}$. 5+5

2. (a) What do you mean by single column manometers ? How are they used for the measurement of pressure ?

(b) A hydraulic press has a ram of 200 mm diameter and a plunger of 40 mm diameter. It is used for lifting a height of 20 kN. Find the force required at the plunger. 5+5

3. (a) What do you understand by 'Total Pressure' and 'Centre of Pressure' ?

(b) A circular opening, 3 m diameter, in a vertical side of a tank is closed by a disc of 3 m diameter which can rotate about a horizontal diameter. Calculate (i) the force on the disc, (ii) the torque required to maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 6 m. 5+5

4. (a) How will you determine the meta-centric height of a floating body experimentally ? Explain with a neat sketch.

(b) A solid cylinder of diameter 5·0 m has a height of 5·0 m. Find the meta-centric height of the cylinder, if the specific gravity of the material of cylinder is 0·7 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. *5+5*

5. (a) Define the equation of continuity. Obtain an expression for the continuity equation for a three-dimensional flow.

(b) A 400 mm diameter pipe, conveying water, branches into two pipes of diameters 300 mm and 200 mm respectively. If the average velocity in the 400 m diameter pipe is 3 m/s, find the discharge in this pipe. Also determine the velocity in the 200 mm pipe, if the average velocity in the 300 mm diameter pipe is 2 m/s. *5+5*

6. (a) Define an orifice meter. Prove that the discharge through an orifice meter is given by the relation

$$\theta = C_d \frac{a_0 a_1}{\sqrt{a_1^2 - a_0^2}} \times \sqrt{2gh},$$

where

a_1 = area of the pipe in which the orifice meter is fitted,

a_0 = area of the orifice.

(b) An oil of specific gravity 0·9 is flowing through a venturimeter having inlet diameter 200 mm and throat diameter 100 mm. The oil-mercury differential manometer shows a reading of 200 mm. Calculate the discharge of the oil through the horizontal venturimeter. Take $C_d = 0{\cdot}98$. *5+5*

7. (a) Explain the following terms :

(i) Coefficient of velocity (C_v)

(ii) Coefficient of contraction (C_c)

(iii) Coefficient of discharge (C_d)

(b) Find the discharge through a fully submerged orifice of width 2 m. If the difference of water levels on both the sides of the orifice be 800 mm, the height of water from top and bottom of the orifice are 25 m and 3 m respectively. Take $C_d = 0{\cdot}6$. *5+5*

8. (a) What do you understand by turbulent flow ? What factors decide the type of flow in pipes ?

(b) Define and explain the terms (i) Energy correction factor, and (ii) Momentum correction factor. *5+5*

9. (a) Show that the loss of head due to sudden expansion in pipeline is a function of velocity head.

(b) A horizontal pipe of diameter 400 mm is suddenly contracted to a diameter of 200 mm. The pressure intensities in the large and smaller pipes is given as $14{\cdot}715$ N/cm^2 and $12{\cdot}753$ N/cm^2 respectively. If $C_c = 0{\cdot}62$, find the loss of head due to contraction. Also determine the rate of flow of water. *5+5*

10. (a) A ship-model of scale $\frac{1}{60}$ is towed through sea-water at a speed of 0·5 m/s. A force of 1·5 N is required to tow the model. Determine the speed of the ship and the propulsive force on the ship, if prototype is subjected to wave resistance only.

(b) What do you mean by separation of boundary layer ? What is the effect of pressure gradient on boundary layer separation ? *5+5*
