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BME-028

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

00143

December, 2018

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) Distinguish between ideal fluids and real fluids. Explain the importance of compressibility in fluid flow. *5*

(b) Determine the total pressure on a circular plate of diameter 1·5 m which is placed vertically in water in such a way that the centre of the plate is 2 m below the free surface of water. Also find the position of centre of pressure. *5*

2. (a) What do you understand by the hydrostatic equation ? With the help of equation, derive the expression for the buoyant force acting on a submerged body. *5*

(b) A solid cylinder of diameter 5·0 m has a height of 5·0 m. Find the meta-centre 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*

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

(b) An oil of specific gravity 0·9 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a deflection of 20 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0{\cdot}98$. *5*

4. (a) What is a pitot-tube ? How will you determine the velocity at any point with the help of pitot-tube ? 5

(b) A closed vessel contains water up to a height of 2·0 m and on the over the water surface there is air having pressure 8·829 N/cm^2 above atmospheric pressure. At the bottom of the vessel there is an orifice of diameter 15 cm. Find the rate of flow of water from orifice. Take $C_d = 0·6$. 5

5. (a) Derive an expression (Darcy's) for the loss of head due to friction in pipes. 5

(b) A rough pipe of diameter 300 mm and length 800 m carries water at the rate of 0·4 m^3/s. The wall roughness is 0·015 mm. Determine the coefficient of friction, wall shear stress, centre line velocity and velocity at a distance of 100 mm from the pipe wall. 5

6. (a) What is a compound pipe ? What will be loss of head when pipes are connected in series ? 5

(b) Find the head loss due to friction in a pipe of diameter 250 mm and length 60 m, through which water is flowing at a velocity of 3·0 m/s using (i) Darcy's formula, and (ii) Chezy's formula, for which C = 55. Take V for water = 0·01 stoke. 5

7. (a) What do you understand by repeating variables ? How are the repeating variables selected for dimensional analysis ? 5

(b) 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 propulsive force on the ship, if the prototype is subjected to wave resistance only. 5

8. (a) How will you find the drag on a flat plate due to laminar and turbulent boundary layers ? 5

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

9. (a) What is circulation ? Find an expression for circulation for a free-vortex radius R. 5

(b) A body of length 2·5 m has projected area 1·8 m^2 normal to the direction of its motion. The body is moving through water with a velocity such that the Reynolds number is 6×10^6 and drag coefficient is 0·5. Find the drag on the body. Take Viscosity of water as 0·01 poise. *5*

10. (a) Define Mach number. What is the significance of Mach number in compressible fluid flows ? *5*

(b) Find the velocity of flow and rate of flow of water through a rectangular channel 5 m wide and 2 m deep, when it is running full. The channel is having bed slope 1 in 3000. Take C = 50. *5*