00925

BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

June, 2012

BME-028 : FLUID MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **any seven** questions. Use of calculator is **permitted**.*

1. (a) Find the depth of a point below water surface in sea where pressure intensity is 1.006 MN/m^2. Specific gravity of sea water $= 1.025$. **5+5**

(b) An empty ballon and its equipment weighs 441.45 N. When inflated with gas weighing 5.415 N/m^3, the ballon is spherical and 7m in diameter. What is the maximum weight of cargo that the ballon can lift ? Assume the weight tobe 12.066 N/m^3.

2. (a) An incompressible fluid flows steadily through two pipes of diameter 0.15 m and 0.2 m which combine to discharge in a pipe of 0.3 m diameter. If the average velocities in the 0.15 m and 0.2 m diameter pipes are 2 m/s and 3 m/s respectively, then find the average velocity in the 0.3 m diameter pipe. 5+5

(b) Determine which of the following pairs of velocity components u and v satisfy the continuity equation for a two-dimensional flow of an incompressible fluid.

(i) $u = (x+y)$; $v = (x^2 - y)$

(ii) $u = A \sin xy$; $v = -A \sin (xy)$

3. (a) Which of the following stream function ψ are possible irrotational flow fields ? 5+5

(i) $\psi = A \sin xy$

(ii) $\psi = y^2 - x^2$

(b) Calculate the velocity components u and v for the following velocity potential functions ϕ :

(i) $\phi = x^2 - y^2$ (ii) $\phi = \log (x+y)$

which of these velocity potential functions satisfy the continuity equation ?

4. (a) The velocity components in the $x-$ and $y-$ directions are given as : 5+5

$$u = \frac{2xy^3}{3} - x^2 y \text{ and } v = xy^3 - \frac{2yx^3}{3}$$

Indicate whether the given distribution is a possible field of flow or not.

(b) A tank 1.5 m high stands on a trolley and is full of water. It has an orifice of diameter 0.1 m at 0.3 m from the bottom of the tank. If the orifice is suddenly opened, what will be the propelling force on the trolley ? Co-efficient of discharge of the orifice is 0.60.

5. (a) Distinguish between laminar flow and turbulent flow in pipes. **5+5**

(b) Obtain the condition for maximum efficiency in transmission of power through a pipeline ?

6. (a) What is meant by water hammer ? Why are the pipes connected in parallel ? **5+5**

(b) Discuss the concept of the boundary layer with reference to fluid motion over a flat plate.

7. (a) Derive an expression for mean velocity for laminar flow between parallel plates. **5+5**

(b) Explain the terms :

(i) Metacentre and

(ii) Metacentric height

8. The resistance R, to the motion of a supersonic aircraft of length L, moving with a velocity V in air of density ρ, depends on the viscosity μ and bulk modulus of elasticity K of air. Obtain using Buckingham's π-theorem or Rayleigh's method, the following expression for the resistance R. **10**

$$R = (\rho L^2 V^2)\, \phi \left[\left(\frac{\mu}{\rho L V} \right), \left(\frac{K}{\rho V^2} \right) \right]$$

9. (a) A semi-tubular cylinder of 75 mm radius with concave side upstream (drag coefficient $= 2.3$) is submerged in flowing water of velocity 0.6 m/s. If the cylinder is 7.2 m long, calculate the drag. Assume density of water as 1000 kg/m^3. **5+5**

(b) At a certain point in caster oil the shear stress is 0.216 N/m^2 and the velocity gradient 0.216 s^{-1}. If the mass density of caster oil is 959.42 kg/m^3, find kinematic viscosity.

10. (a) If 5m^3 of a certain oil weighs 40 kN, calculate the specific weight, mass density and specific gravity of the oil. **5+5**

(b) For the following type of velocity distribution obtain the values of

$$\left(\frac{\delta^*}{\delta}\right) \text{ and } \left(\frac{\theta}{\delta}\right)$$

$$\frac{u}{v} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$$