

B.Tech. Civil (Construction Management) /
B.Tech. Civil (Water Resources Engineering)
B.Tech. (Aerospace Engineering)

Term-End Examination
December, 2013

ET-201(A) : MECHANICS OF FLUIDS

Time : 3 hours

Maximum Marks : 70

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

1. (a) If 5.27 m^3 of a certain oil weighs 44 kN, Calculate the specific weight, mass density, and specific gravity of the oil.
- (b) Convert a pressure head of 15m of water to
 - (i) metres of oil of specific gravity 0.750,
 - (ii) metres of mercury of specific gravity 13.6. 5+5=10
2. (a) Two velocity components are given as follows : 5+5=10
 $u = x^3 + y^2 + 2z^2$; $v = -x^2y - yz - xy$,
 find the third component such that they satisfy the continuity equation.
- (b) For a three-dimensional flow field described by $V = (y^2 + z^2) \hat{i} + (x^2 + z^2) \hat{j} + (x^2 + y^2) \hat{k}$
 find at (1,2,3)
 - (i) the components of acceleration,
 - (ii) the components of rotation.

3. (a) If for two-dimensional flow the stream function is given by $\Psi = 2xy$,
Calculate the velocity at a point (3, 6), show that the velocity potential ϕ exists for this case and deduce it.
- (b) Define and distinguish between streamline, path line and streak line. 5+5=10
4. (a) Calculate the velocity components u and v for the following velocity potential function ϕ :
$$\phi = x^2 + y^2.$$
Does this velocity potential function satisfy the continuity equation ?
- (b) If the expression for the stream function is described by $\Psi = x^3 - 3xy^2$, indicate whether the flow is rotational or irrotational. If the flow is irrotational determine the value of the velocity potential (ϕ). 5+5=10
5. (a) A 0.3m pipe carries water at a velocity of 24.4 m/s. At points A and B measurements of pressure and elevation were respectively 361 KN/m² and 288 KN/m² and 30.5 m and 33.5 m. For steady flow, find the loss of head between A and B. 5+5=10
- (b) Water flows at the rate of 0.147 m³/sec through a 150 mm diameter orifice inserted in a 300 mm diameter pipe. If the pressure gauges fitted upstream and downstream of the orifice plate have shown readings of 176.58 KN/m² and 88.29 KN/m² respectively, find the coefficient of discharge C_d of the orifice meter.

6. (a) 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 ? Coefficient of discharge of the orifice is 0.60.
- (b) Oil of specific gravity 0.90 flows in a pipe 300 mm diameter at the rate of 120 litres per second and the pressure at a point A is 24.525 kPa. If the point A is 5.2m above the datum line, calculate the total energy at point A in terms of metres of oil. **5+5=10**
7. (a) What is a siphon ? Where is it used ? Explain its working.
- (b) What do you understand by displacement thickness and momentum thickness ? **5+5=10**
8. (a) Describe an expression for mean velocity for laminar flow through a pipe. **5+5=10**
- (b) Explain the terms :
- (i) force of buoyancy and
- (ii) centre of buoyancy.
9. (a) Show by method of dimensional analysis that the resistance R to the motion of a sphere of diameter D moving with uniform velocity V through a fluid having density ρ and viscosity μ may be expressed as **5+5=10**

$$R = \rho D^2 V^2 \Phi \left(\frac{\mu}{\rho V D} \right).$$

- (b) Explain the terms :
- (i) Metacentre and
- (ii) Metacentric height

10. (a) Calculate the total drag, exerted on 1 m length of an infinite circular cylinder which has a diameter equal to 30 mm, air of density 1.236 kg/m^3 flowing past the cylinder with velocity 3.6 m per minute. Take total drag coefficient equal to 1.4.
- (b) An iceberg weighing 8.976 KN/m^3 floats in the ocean with a volume of 600 m^3 above the surface. Determine the total volume of the iceberg if specific weight of ocean water is 10.055 KN/m^3 .

5+5=10
