No. of Printed Pages : 4

ET-201(A)

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

Term-End Examination

01475

December, 2014

ET-201 (A) : MECHANICS OF FLUIDS

Time : 3 hours *Maximum Marks : 70*

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

1. (a) Derive equation of continuity for incompressible fluid flow.

(b) A cube of relative density 0·8 floats in water. Determine whether it is stable or not against angular tilt. *3+7*

2. (a) A cylindrical container having 50 cm internal diameter has vertical position. It has 1 m height but it is initially filled with water up to 60 cm height. Determine the speed of rotation of the container about its axis when water shall begin to spill over the container. Determine the pressure at the point which is 5 cm above the base and at the radius equal to 20 cm. Derive the formula used.

(b) The velocity potential is given by

$$\phi = x^2 - y^2$$

Does this represent possible flow field ? If it is so, prove that the flow is irrotational Derive the Laplace equation to be used. *5+5*

3. (a) Define nominal thickness of boundary layer.

(b) Air flows steadily and at low speed through a horizontal nozzle which discharges into the atmosphere. At the nozzle inlet, area is 0·1 m^2 and at exit, area is 0·02 m^2. Assuming flow incompressible, determine gauge pressure required at the inlet to produce 50 m/s speed at the outlet. Neglect effects of friction. Take $\rho = 1{\cdot}23$ kg/m^3. *3+7*

4. (a) What do you mean by 'Hydraulic Jump' ? Derive the formula for jump. 15 m^3/s of water per meter of width flows down a spillway onto a horizontal floor. If velocity is 25 m/s, determine the downstream depth required to cause a hydraulic jump.

(b) Determine the power that can be obtained from a series of vanes curved through 155°, moving at speed 18 m/s away from a 75 *l*/s water jet having a cross-section of 25 cm^2. Calculate the energy remaining in the jet. *5+5*

5. (a) What do you mean by an 'Orifice' ? Derive expression for velocity coefficient. A water tank has water up to the height of 8 m. A circular orifice of 12 mm diameter is located 2 m above the ground level. Determine the discharge. Assume $C_v = 0{\cdot}97$ and $C_c = 0{\cdot}61$.

(b) An oil of viscosity 2×10^{-3} kg/ms and mass density 900 kg/m^3 passes through a pipe of 7·5 cm diameter and 100 m length. It is inclined upwards at an angle of 30° to the horizontal. If supply pressure at the lower end is 1 MPa, find the discharge and average velocity at the upper end. Also determine pipe resistance factor and power required. *5+5*

6. (a) Using π theorem, obtains an expression for drop in pressure 'Δp' in a pipe of diameter 'D' and length 'L' due to turbulent flow. Assume that Δp depends on velocity 'V', viscosity 'μ', density 'ρ' and roughness 'K'.

(b) The density and viscosity of air at 20°C are 1·208 kg/m^3 and $1{\cdot}85 \times 10^{-5}$ kg/ms respectively. It flows over a 2 m wide plate at 10 m/s. Determine

(i) τ_0 and δ at a place where the boundary layer ceases to be laminar.

(ii) Drag force on one side of plate in the laminar region. *4+6*

7. (a) Explain pipe network for supply of water in cities.

(b) Determine the diameter of galvanised steel pipe which is needed to carry water for a distance of 180 m at a rate of 85 *l*/s with a head loss of 9 m. Assume K_s = 0·15 mm. *3+7*

8. (a) Derive expression for lift and drag for aerofoil section.

(b) A metallic sphere of sp. gr. 7·0 falls in an oil of density 800 kg/m^3. The diameter of sphere is 8 mm. It attains a terminal velocity of 40 mm/s. Find viscosity of oil in poise. *4+6*

9. Write short notes on any ***five*** of the following : *2+2+2+2+2=10*

(a) Comparison between laminar and turbulent flow

(b) Karman Vortex Trail

(c) Mouth pieces

(d) Water Hammer

(e) Viscosity

(f) Surge tanks

(g) Rotational and Irrotational flow