Code No: 43035/43036 **R07** **Set No - 2**

II B.Tech I Semester Regular Examinations,Nov/Dec 2009
MECHANICS OF FLUIDS
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The velocity vector in an incompressible flow is given by
   V = (6xt+yz^2)i+(3t+xy^2)j+(xy-2xyz-6tz)k
   (a) Verify whether the continuity equitation is satisfied
   (b) Determine the acceleration vector at point A(1,1,1) at t = 1.0 [8+8]

2. (a) Explain why the drag of a rough sphere or cylinder is less than the drag of a smooth sphere or cylinder at Reynolds number 2×10^5?
   (b) A rotational mixing device is constructed with two circular disks each 10 cm in diameter. These disks are spaced 1 m apart on the two ends of a horizontal rod whose centre has a vertical shaft attached to it. Estimate the power required for rotation when this mixer turns 60 revolutions per minute in a solution having the following fluid properties: ρ = 950 kg/m^3, and μ = 0.08075 kg m/s. For 3000 < Re < 5000, take C_D = 1.2. [6+10]

3. (a) Define Reynold's number. What is the relationship of friction factor with Reynold number for different types of pipes?
   (b) Water is flowing through a pipe of 40 cm diameter pipe and of 60 m length with a velocity of 4 m/s. Find the head loss using Darcy's formula and Chezy's formula where C_h = 60. Take v = 0.012 stokes for water. [8+8]

4. A 7.2m high and 15m long spillway discharges 94 m^3/s under a head of 2.0m. If a 1:9 scale model of this spillway is to be constructed, find the model dimensions, head over the model and the model discharge. [16]

5. The space between two large flat and parallel walls, 25 mm apart is filled with a liquid of viscosity 0.7 Pa.s. Within this space a thin flat plate, 250 mm × 250 mm is towed at a velocity of 15 cm/s at a distance 6 mm from one wall, the plate and the movement parallel to the walls. Assuming linear variation of velocity between the plate and the walls, determine the force exerted by the liquid on the plate.[16]

6. In a vertical pipe carrying water, pressure gauges are inserted at points A and B where the pipe diameters are 0.15m and 0.075m respectively. The point B is 2.5m below A and when the flow rate down the pipe is 0.02 cumecs, the pressure at B is 14715 N/m2 greater than that at A.
   Assuming the losses in the pipe between A and B can be expressed as $k\frac{v^2}{2g}$ where v is the velocity at A, find the value of k.If the gauges at A and B are replaced by tubes filled with water and connected to a U-tube containing mercury of relative density 13.6, give a sketch showing how the levels in the two limbs of the U-tube

differ and calculate the value of this difference in metres. [16]

7. At some section in the convergent-divergent nozzle, in which air is flowing, pressure, velocity, temperature and cross-sectional area are 200 kN/m^2, 170 m/s, 200 ^{0}C and 1000 mm^2 respectively. If the flow conditions are isentropic, determine:
   (a) Stagnation temperature and stagnation pressure,
   (b) Sonic velocity and Mach number at this section,
   (c) Velocity, Mach number and flow area at outlet section where pressure is 110 kN/m^2
   (d) Pressure, temperature, velocity and flow area at throat of the nozzle. [16]
8. (a) What are the characteristics of turbulent flow?
   (b) A pipeline carrying water has surface protrusions of average height of 0.15 mm. If the shear stress developed is 4.9 N/m^2, determine whether the pipe surface acts a smooth, rough or in transition. The kinematic viscosity of water may be taken as 0.01 stokes. [8+8]

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