Code No: 43035/43036 **R07** **Set No - 4**

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. Starting from basic principles derive Euler's equation motion for a three dimensional flow, explaining the assumptions made. [16]

2. (a) For the laminar flow through a circular pipe, prove that:
   i. The shear stress variation across the section of the pipe is linear and
   ii. The velocity variation is parabolic.
   (b) Water is flowing between two large parallel plates which are 2.0 mm apart. Determine:
   i. Maximum velocity,
   ii. The pressure drop per unit length and
   iii. The shear stress at walls of the plate if the average velocity is 0.4 m/s. Take viscosity of water as 0.01 poise. [16]

3. A venturimeter 300 mm × 150 mm is used to measure the discharge of water in a 300 mm diameter horizontal pipe. If the pressure difference between entrance and throat is 3 m of water and if loss of head between the same sections is 1/8 of velocity head at the throat, calculate the discharge in pipe and the coefficient of the meter. [16]

4. Inside a 60 mm diameter cylinder a piston of 59 mm diameter rotates concentrically. Both the cylinder and piston are 80 mm long. If the space between the cylinder and piston is filled with oil of viscosity 0.3 N-s/m^2 and a torque of 1.5 Nm is applied find the speed of the piston and the power required. [16]

5. (a) Derive an expression for the loss of head due to:
   i. Sudden enlargement,
   ii. Sudden contraction of a pipe.
   (b) The rate of flow of water through a horizontal pipe is 0.3 m^3/s. The diameter of the pipe is suddenly enlarged from 250 mm to 500 mm. The pressure intensity in the smaller pipe is 13.734 N/cm^2. Determine:
   i. Loss of head due to sudden enlargement,
   ii. Pressure intensity in the large pipe and
   iii. Power lost due to enlargement. [8+8]

6. (a) Derive an expression for lift for uniform flow around a circular cylinder with clockwise circulation.

(b) A cylinder of 300 mm diameter is rotated at 150 rpm fully immersed in water of velocity 5 m/s. The velocity of water is normal to the axis of the cylinder. Determine:

i. The magnitude of the lift force experienced by the cylinder,

ii. The position of the stagnation points,

iii. The minimum rotational speed for the detached stagnation in the flow and

iv. The maximum uniform velocity for detached stagnation on the cylinder if the rotational speed is kept at 150 rpm. [8+8]

7. (a) The velocity at a point is given by V = $(4t+3x^2+2y)i+(t^2+2xy+3y^2)j$. Determine the local acceleration and total acceleration at a point (2,3) for t = 1.5 second

(b) Define a stream line and obtain an equation for it. Enumerate the properties of stream lines. [8+8]

8. (a) Describe compressible flow through a convergent-divergent nozzle. How and where does the shock wave occur in the nozzle?

(b) For a normal shock wave in air Mach number is 2. If the atmospheric pressure and air density are 26.5 kN/m^2 and 0.413 kg/m^3 respectively, determine the flow conditions before and after the shock wave. Take $\gamma = 1.4$. [4+12]

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