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Roll No .....

MMTP - 104

M.E./M.Tech. I Semester

Examination, December 2014

Advanced Fluid Mechanics

Time : Three Hours

 Maximum Marks : 70

Note : Attempt any five questions out of eight. All questions carry equal marks.

1. a) Explain Navier-Stokes equation and prove that?
   b) A hydraulic lift used for lifting automobiles has 20 cm diameter ram which slides in a 20.016 cm diameter cylinder. The annular space between the cylinder and ram is filled with an oil of Kinematics viscosity 3.5 stokes and relative density 0.85. If the travel of 3.2 m long ram has a uniform rate of 15 cm/s, estimate the friction resistance experienced by the ram.

2. a) In a 2-D incompressible flow, the fluid velocity components are given by
   $u = x - 4y$ and $v = -y - 4x$
   show that velocity potential exists and determine its form.
   b) Explain concept of control volume analysis.

3. a) Explain super-imposed flow and their types?
   b) A point P(0.5, 1) is situated in the flow field of a doublet of strength 5 m^2/s. Calculate the velocity at this point and also the value of the stream function.

4. a) Atmospheric air at 25°C flows parallel to a flat plate at a velocity of 3m/s. Use the exact Blasius solution to estimate the boundary layer thickness and the local skin friction coefficient at $x = 1$ m from the leading edge of the plate. How these values would compare with the corresponding values obtained from the approximate values obtained from the approximate van-Karman integral technique? Assume cubic velocity profile for air at 25°C, $\nu = 15.53 \times 10^{-6}$ m^2/s
   b) Explain boundary layer separation.

5. a) Show that for isentropic flow

$$\frac{T_2}{T_1} = \frac{1 + \frac{\gamma - 1}{2} M_1^2}{1 + \frac{\gamma - 1}{2} M_2^2}$$

   b) Explain pressure wave propagation.

6. The following data pertains to an inward flow reaction turbine:
   Net head - 60 m; speed - 650 rpm; Brake power - 275 kw
   Ratio of wheel width to wheel diameter at inlet = 0.10.
   Ratio of inner diameter to outer diameter = 0.5
   Flow ratio $K_f = 0.17$; $\eta_n = 0.95$ and $\eta_o = 0.85$
   The flow velocity remains constant and the discharge is radial. Neglecting area blockage by blades, work out the main dimensions and blade angles of the turbine?

7. a) Explain draft tube, its function and types of draft tube.
   b) Establish model testing relations of a centrifugal pump.

8. Write short note (any four)
   i) Reynold transport theorem
   ii) Flow nets
   iii) Lift and Drag
   iv) Mach No. and Mach angle
   v) Cavitation