Total No. of Questions : 5] *[Total No. of Printed Pages :2*

Roll No .....

MMTP - 104

M.E./M.Tech. I Semester

Examination, December 2013

Advanced Fluid Mechanics

Time : Three Hours

Maximum Marks : 70

Note : 1. Attempt all the questions.
2. Solve any two out of three from each question.
3. All questions carry equal marks.

1. a) Discuss Reynolds transport theorem in brief.

   b) Explain what you understand by total acceleration, local acceleration and convective acceleration for any fluid flow field.

   c) Determine the velocity and acceleration of fluid particle at (2,3,4) and $t = 0.2$ for the velocity field given by $U = 10x^2z + 15xyj + 100t$.

2. a) Prove that the stream lines and potential lines are orthogonal to each other.

   b) The following velocity components for steady, incompressible flow describe the fluid motion: $u = zx - xy + z$, $v = x - 4xy + y$, $w = 2xy - yz + y^2$, check whether the continuity equation is satisfied or not?

   c) Briefly explain the doublet.

3. a) Stating assumptions derive Hagen-Poiseuille equation for laminar flow. Also derive expressions for shear stress and velocity distribution.

   b) Write short notes on any two of the following:

      i) Boundary layer separation and its control

      ii) Plane couette flow

   c) Explain Navier-Stokes Theorem and its significance.

4. a) Explain Mach number. Mach angle and Mach cone. Derive energy equation and describe various regions of flow.

   b) Air flows from a reservoir ($p_0 = 1MN/m^2$ and $T_0 = 40°C$) through delaval nozzle with a throat diameter of 0.1m and a maximum Mach number of 0.75. Calculate the mass flow rate, nozzle diameter, velocity pressure and temperature at the exit where M = 0.50.

   c) Write short notes on any two of the following:

      i) Shock waves

      ii) Wind tunnel

      iii) Fanno lines / curve and its importance.

5. a) Differentiate between Impulse and Reaction turbines.

   b) The diameter of a centrifugal pump, which is discharging $0.03m^3/s$ of water against a total head of 20m, is 0.40m. The pump is running at 1500rpm. Find the head, discharge and ratio of powers of a geometrically similar pump of diameter 0.25m when it is running at 3000 rpm.

   c) Derive and explain the significance of specific speed of turbines?

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