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MMTP-302(A)

M.E./M.Tech. III Semester

Examination, June 2017

Gas Flow Through Turbo Machines

(Elective-II)

Time : Three Hours

Maximum Marks : 70

Note : i) Solve any five questions.
ii) All questions carry equal marks.
iii) Assume suitable data if necessary.

1. a) Derive Euler's equation of motion along a streamline and hence derive the Bernolli's theorem.

   b) A uniform tapering pipe is 20 cm diameter at one end A and 10 cm at the other end B. The pipe is 3m long is inclined to the horizontal at an angle $\alpha = \tan^{-1}(1/4)$ with end A and above B. If the flow velocity at section 'B' is 0.6 m/s. determine the difference of pressure between the two sections.

2. a) The x– and y– components of a fluid velocity in a two dimensional flow field are given as:

   $u = x$ and $v = -y$

   If a uniform flow field defined by $\Psi = y$ is superimposed on this flow, determine the stream function and the velocity potential for the combined flow.

   b) A source - sinkpair is placed in a uniform stream flowing in the direction of the line joining the force and sink. If $2a$ be the distance between source and sink and 2b and 2h be the axes of the resulting Rankine oval in the direction of free stream and normal to the direction of free stream respectively. show that

$$h^2 - a^2 = 2ah \cot\left(\frac{2ah}{b^2 - a^2}\right)$$

3. a) A steam function is given by $\phi = 2x - 5y$ calculate the velocity components and also magnitude and direction of the resultant velocity at any point.

   b) The steam function for a two-dimensional flow is given by $\phi = 8xy$. Calculate the velocity at the point p(4, 5). Find the velocity potential function ϕ.

4. a) Show that the difference of pressure head for a given length of the two parallel plates which are fixed and through which viscous fluid is flowing is given by

$$h_f = \frac{12\mu\bar{u}L}{\rho g t^2}$$

   where μ = viscosity of fluid
   $\bar{u}$ = Average velocity
   t = Distance between the two parallel plates
   L = Length of plates

   b) Obtain expression for the velocity distribution for turbulent flow in smooth pipes.

5. a) A fluid of density ρ and viscosity μ flows at an average velocity V through a circular pipe of diameter D. Show by dimensional analysis that the shear stress at the pipe wall is given as

$$\tau_0 = \rho v^2 \phi \left[\frac{\rho VD}{\mu} \right]$$

   b) Discuss the effect of area change in subsonic and supersonic flow by deriving the governing equation.

6. a) Air while flowing through a nozzle encounter a shock. The mach number upstream of the shock is 1.8 and the static temperature downstream of the shock is 450K. Calculate the velocity changed across the shock.

   b) Discuss the Fanno and Rayleigh lines on h-s diagram as a solution to normal shock equation.

7. a) What are the various parameters that effect the losses in the cascade of blade of axial machine.

   b) Describe the working of the annular suction and the blower type cascade tunnels for axial machine. What are their advantage over straight type.

8. Short notes on:

   i) Surging and chocking

   ii) Prandtl meyer and Rankine Hygoneit relations.

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