PG – 140

III Semester M.Sc. Degree Examination, December 2014
(RNS) (Y2K11 Scheme)
MATHEMATICS
Paper – M 304 : Fluid Mechanics

Time : 3 Hours   Max. Marks : 80

Instruction : *1) Answer **any five full** questions. Choosing at least **one** from **each** Part.*
*2) **All** questions carry **equal** marks.*

PART – A

1. a) Define vorticity. Establish the permanence of irrotational motion for an inviscid fluid. **6**

   b) Obtain the general equation for an impulsive motion and further show that the pressure is harmonic in the absence of impulsive body forces. **6**

   c) Write a short note on dimensional analysis. **4**

2. a) Discuss the flow whose complex potential is given by

   $w = -Uz - m\ln(z - z_0) + m\ln(z + z_0)$,

   where U and m are constants. **8**

   b) Obtain the image of a flow system having a uniform flow in the negative x-direction and a sink of strength m at z = c, where c is a real constant. **8**

3. State and prove Blasius theorem. Discuss any two consequences of the theorem. **16**

PART – B

4. a) Obtain the velocity distribution for a poiseuille flow. **8**

   b) Explain stokes first problem and show that $u = U[1 - \text{erf}(\eta)]$ is the velocity distribution for such a flow. **8**

5. a) Show that the vorticity diffuses rapidly with time for an unsteady motion of an incompressible viscous fluid in circles with centres on the z-axis. **8**

   b) Discuss the show and steady flow of an incompressible viscous fluid past a fixed rigid circular cylinder. **8**

P.T.O.

6. a) Explain briefly the concept of boundary layer. Derive Von-Karman's integral equation in its standard form. **10**

   b) Write a short on :

      i) Energy dissipation due to viscosity

      ii) Reynolds number. **6**

PART – C

7. a) Using the definition of Mach number, discuss the classification of flows into subsonic, sonic and supersonic. **4**

   b) Using Charle's law and Boyle's law, arrive at the standard form of the equation of state $P = \rho RT$, where the quantities have their standard meaning. **6**

   c) Derive the equation of conservation of linear momentum for a viscous, compressible fluid flow. **6**

8. Starting from the Navier-Stokes equation with no body forces and the conservation of energy, derive the turbulence equations using Reynolds averaging procedure and the gradient diffusion model for closure. **16**
