PG – 587

III Semester M.Sc. Degree Examination, December 2015
(Y2K11 Scheme)(RNS)
MATHEMATICS
M 304 : Fluid Mechanics

Time : 3 Hours Max. Marks : 80

Instructions : 1) *All questions have* ***equal*** *marks.*
2) *Answer* ***any five*** *questions, choosing* ***atleast one*** *from* ***each*** *Part*

PART - A

1. a) Explain the vortex motion. Show that the vortex lines move with an inviscid fluid. 6

   b) State and prove Kelvin's minimum energy theorem. 7

   c) Discuss briefly the importance of dimensional analysis. 3

2. a) Find the stream function and the potential function of a flow system having a uniform flow in the positive direction of x-axis and a source of strength 'm' at $z = 0$. 8

   b) Obtain the image of a flow system having a doublet. 8

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

PART - B

4. a) With usual notations, derive the energy equation for an incompressible viscous fluid in its standard form. 12

   b) Explain Stokes first and second problems. 4

5. a) Discuss in detail the slow and steady flow of an incompressible viscous fluid past a fixed rigid sphere of radius 'a'. 16

6. Derive

   i) Prandtl boundary layer equations for a steady flow of an incompressible viscous fluid over a flat plate.

   ii) Von-Karman's momentum integral equation. 16

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PART – C

7 a) Starting from Euler's equation and the continuity equation, obtain the expression for speed of sound in a gas. 8

b) Derive the Navier-Stokes equation for a viscous, compressible fluid flow. 8

8 a) Define Reynolds number and thereby discuss laminar, turbulent and transition flows. 5

b) Discuss about spatial, time and ensemble averages used in the study of turbulence. Mention about their basic properties and about Reynolds averaging procedure. 5

c) Starting from Navier-Stokes equation for an incompressible fluid, derive the turbulence equation using Reynolds decomposition and K-model for closure. Assume there are no body forces. 6