11-12-17

M.Sc. (Mathematics)-II (Third Semester)

End Semester Theory Examination 2017-18

Department of Mathematics, SOPS, Doon University Dehradun

Core Course, Fluid Dynamics (MAC-502)

Time: 03 hrs **Total Marks: 100**

Note: (i) Attempt ALL the questions. (ii) Do neat and clean work.

Section A

Attempt ALL: **(1x10=10)**

1. According to equation of continuity, when water falls its speed increases, while its cross sectional area---(a) Increases (b) Decreases (c) remain same (d) different
2. If layers of fluid have frictional force between them, then it is known as- (a) Viscous (b) non-viscous (c) incompressible (c) both a and b
3. Venturi relation is one of applications of- (a) equation of continuity (b) Bernoulli's equation (c) light equation (d) speed equation
4. Simplified equation of continuity is represented as- (a) $A_1V_1 = A_2V_2$ (b) $A_1V_2 = A_2V_2$ (c) $A_1V_1 = A_1V_2$ (d) $A_2V_1 = A_1V_1$
5. If every particle of fluid has irregular flow, then flow is said to be- (a) laminar flow (b) turbulent flow (c) fluid flow (d) both a and b
6. Viscosity of air at 30 °C is- (a) 0.019 (b) 1.295 (c) 0.514 (d) 2.564
7. If every particle of fluid follows same path, then flow is said to be- (a) laminar flow (b) turbulent flow (c) fluid flow 4. both a and b
8. Chimney works best on principle of- (a) equation of continuity (b) Bernoulli's equation (c) light equation (d) speed equation
9. If fluid has constant density, it is said to be- (a) thick (b) in-viscous (c) compressible (d) Incompressible
10. Fundamental equation that relates pressure to fluid's speed and height is known as-(a) equation of continuity (b) Bernoulli's equation (c) light equation (d) speed equation

Section B

Attempt any FIVE: **(5x10=50)**

1. **(a)** Show that the velocity potential $\emptyset = \frac{1}{2}a(x^2 + y^2 - 2z^2)$ satisfies the Laplace equation and represents the flow against a fixed plane wall. Also find the stream lines.
   (b) Show that $u = 2Cxy, v = C(a^2 + x^2 - y^2)$ are the velocity components of a possible fluid motion. Determine the stream function.
2. Derive Bernoulli's pressure equation.

3. A stream is rushing from a boiler through a canonical pipe, the diameter of the ends of which are D and d; if V and v be the corresponding velocities of the stream and if the motion be supposed to be that of the divergence from the vertex of the come, prove that $\frac{v}{V} = \frac{D^2}{d^2} e^{(v^2-V^2)/2k}$, where k is the pressure divided by the density and supposed constant.
4. Define a doublet. Derive the complex potential due to a doublet in two-dimensions.
5. State and prove the theorem of Blasius.
6. In Ir-rotational motion in 2-D, prove that $(\frac{\partial q}{\partial x})^2 + (\frac{\partial q}{\partial y})^2 = q.\nabla^2 q$

Section C

Attempt any FOUR: **(4x10=40)**

1. Discuss the flow from a tank through a small orifice.
2. State and prove Kelvin's circulation theorem.
3. What do you understand by source and sink in 2-D. Find the complex potential due to a source?
4. Derive the Navier-Stokes equations in Cartesian form.
5. If the motion of an ideal fluid, for which density is a function of pressure p only, is steady and the external forces are conservative, then there exists a family of surfaces which contain the stream lines and vortex lines, prove this.

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