National Institute of Technology Silchar Mid-Semester (UG) Examination, March, 2021

Subject Code: ME-207 Sub.: Fluid Mechanics-II
Semester: 4th Department: Mechanical
Duration: One Hour Total Marks: 20

(Answer all questions)

Fill in the blanks, 1 To 6, $(6 \times 0.5 = 3)$

- 1. Tendency of separation is ------when a flow takes place with favourable pressure gradient as compared to adverse pressure gradient.
- 2. For a flow over a flat plate the velocity profile within boundary layer is assumed as $\frac{u}{U_{\infty}} = (y/\delta)$, then, Momentum thickness (θ) is ------.
- 3. Incompressible and irrotational flow is usually termed as -----.
- 4. Shear stress distribution across a section for a flow through pipe with no pressure gradient is -- .
- 5. Beyond the boundary layer thickness, the rate of change of velocity i.e. $\frac{\partial u}{\partial y} = ----$
- 6. For a flow over a flat plate the velocity profile within boundary layer is assumed as $\frac{u}{U_{\infty}} = \frac{2y}{\delta} \frac{y^2}{\delta^2}$ Then the displacement thickness is ------

Choose the correct answer. 7 to 20, $(14 \times 0.5 = 7)$

- 7. For incompressible flow fields without free surface, ______ does not contribute to the dynamics of the flow field.
 - a) Hydrostatic pressure
 - b) Dynamic pressure
 - c) Thermodynamic pressure
 - d) None of these
- 8. Continuity equation is

a)
$$\frac{1}{\rho} \frac{D\rho}{Dt} + \overline{\nabla} \cdot \overline{V} = 0$$

b)
$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho V) = 0$$

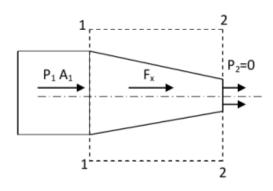
- c) All the above
- d) None of these
- 9. For interface boundary condition
 - a) Velocity is continuous across the interface, but its slop is not.
 - b) Both velocity and its slope are continuous across the interface
 - c) Temperature is continuous across the interface ,but its slop is not
 - d) Both (a),(c)

- 10. The boundary layer equations are not valid downstream of the separation point because of
 - a) Reverse flow
 - b) Favourable pressure gradient
 - c) Unfavourable pressure gradient
 - d) None of the above
- 11. If a stream function exists for a flow and satisfies Laplace's equation, then
 - a) flow is rotational
 - b) flow is irrotational and satisfies continuity equation
 - c) flow is irrotational but does not satisfy continuity equation
 - d) flow satisfies continuity equation but does not necessarily satisfy irrotational flow condition
- 12. Bernoulli's equation is applicable between any two points
 - a) when flow is rotational and incompressible
 - b) when flow is irrotational belonging to any type of fluid
 - c) when flow is steady rotational and compressible
 - d) when flow is Steady irrotational and incompressible
- 13. A high viscous flow is known as
 - a) creep flow
 - b) boundary layer flow
 - c) Couette flow
 - d) Hagen Poiseuille flow
- 14. In a boundary layer development along the flow, the pressure decreases in the downstream direction. The boundary layer thickness would:
 - a) tend to decrease
 - b) remain constant
 - c) increase rapidly
 - d) increase gradually
- 15. Velocity defect in boundary layer theory is defined as
 - a) The error in the measurement of velocity at any point in the boundary layer
 - b) The difference between the velocity at a point within the boundary layer and the free stream velocity
 - c) The difference between the velocity at any point within the boundary layer and the velocity nearer the boundary
 - d) The ratio between the velocity at a point in the boundary layer and the free stream velocity
- 16. In the boundary layer, the flow is
 - a) Viscous and rotational
 - b) Inviscid and irrotational
 - c) Inviscid and rotational
 - d) Viscous and irrotational
- 17. The injection of air through a porous wall can control the boundary layer separation on the upper curved surface of an airfoil wing. The injection of fluid also promotes turbulence. The final result is:
 - a) increase in the skin friction and decrease in the form drag.
 - b) increase in the foam drag and decrease in the skin friction.
 - c) decrease both skin friction and form drag.
 - d) increase both skin friction and form drag.

- 18. In the entrance region of a pipe, the boundary layer grows and the inviscid core accelerates. This is accompanied by a
 - a) Rise in pressure.
 - b) Constant pressure gradient.
 - c) Fall in pressure in the flow direction.
 - d) Pressure pulse.
- 19. A laminar boundary layer is ______ than a turbulent boundary layer.
 - a) Less likely to separate
 - b) More likely to separate
 - c) Having higher growth rate
 - d) None of the above
- 20. If $\psi = 2xy$, the magnitude of the velocity vector at (2,-2) is (a) $4\sqrt{2}$ (b) 4 (c) -8 (d) $\sqrt{2}$

State whether the following statements are TRUE or FALSE with proper justifications. No credit for a correct answer with incorrect justification. 21 to 30, $(10\times1.0=10)$

- 21. For free vortex flow circulation along any closed contour excluding the singular point is constant $(2\pi C)$; C = circulation constant.
- 22. For two dimensional flow between two straight and parallel plates, the relation between pressure and shear stress in x-direction is $\frac{dp}{dx} = \mu \frac{d\tau}{dy}$
- 23. The lift force per unit length for flow past a cylinder depends on density and velocity of the fluid, not on the size and shape of the cylinder.
- 24. A doublet refers to the source-sink pair wherein source and sink approaches one another and the distance between them tends to zero.
- 25. Flow with a profile $\frac{u}{U_{\infty}} = \sin (\pi y/2\delta)$ satisfies the boundary layer flow assumptions.
- 26. Circulation around any point in potential flow is zero.
- 27. Inviscid fluid flow analysis for a viscous fluid is never possible.
- 28. All incompressible flows are constant density fluid flows.
- 29. If a stream function exists for a flow and satisfies Laplace's equation, then the flow is rotational
- 30. The force exerted by the nozzle in the direction of flow is $F_x = \rho Q(V_2 V_1) p_1 A_1$



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