

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, (6×0.5=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. $\frac{\partial u}{\partial y} = \text{-----}$
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 ×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) $\frac{1}{\rho} \frac{D\rho}{Dt} + \nabla \cdot \bar{V} = 0$
 - b) $\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \bar{V}) = 0$
 - 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
- Reverse flow
 - Favourable pressure gradient
 - Unfavourable pressure gradient
 - None of the above
11. If a stream function exists for a flow and satisfies Laplace's equation, then-
- flow is rotational
 - flow is irrotational and satisfies continuity equation
 - flow is irrotational but does not satisfy continuity equation
 - flow satisfies continuity equation but does not necessarily satisfy irrotational flow condition
12. Bernoulli's equation is applicable between any two points-
- when flow is rotational and incompressible
 - when flow is irrotational belonging to any type of fluid
 - when flow is steady rotational and compressible
 - when flow is Steady irrotational and incompressible
13. A high viscous flow is known as-
- creep flow
 - boundary layer flow
 - Couette flow
 - Hagen Poiseuille flow
14. In a boundary layer development along the flow, the pressure decreases in the downstream direction. The boundary layer thickness would:
- tend to decrease
 - remain constant
 - increase rapidly
 - increase gradually
15. Velocity defect in boundary layer theory is defined as
- The error in the measurement of velocity at any point in the boundary layer
 - The difference between the velocity at a point within the boundary layer and the free stream velocity
 - The difference between the velocity at any point within the boundary layer and the velocity nearer the boundary
 - 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
- Viscous and rotational
 - Inviscid and irrotational
 - Inviscid and rotational
 - 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:
- increase in the skin friction and decrease in the form drag.
 - increase in the foam drag and decrease in the skin friction.
 - decrease both skin friction and form drag.
 - 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
- Rise in pressure.
 - Constant pressure gradient.
 - Fall in pressure in the flow direction.
 - Pressure pulse.
19. A laminar boundary layer is _____ than a turbulent boundary layer.
- Less likely to separate
 - More likely to separate
 - Having higher growth rate
 - 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, (10×1.0=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 $F_x = \rho Q(V_2 - V_1) - p_1 A_1$

