1. If momentum flux is written as τ_{yx}, subscripts x and y indicate:
   a) x indicates velocity component and y indicates direction component
   b) x indicates direction component and y indicates velocity component
   c) x and y indicates direction component
   d) x and y indicates velocity component

Ans. (a)

2. If an incompressible fluid is flowing between two vertical coaxial cylinders, and the outer one is rotating with an angular velocity ω. Then, it can be stated that

a) ρ is variable, $v_r = 0$, $v_z = 0$ and $\partial v_\theta/\partial \theta = 0$

b) ρ is constant, $v_r = 0$, $v_z = 0$ and $\partial v_\theta/\partial \theta = 0$

c) ρ is constant, $v_r = 0$, $v_z = 0$ and $\partial v_\theta/\partial r = 0$

d) ρ is variable, $v_r = 0$, $v_z = 0$ and $\partial v_\theta/\partial r = 0$

Ans. (b)

Incompressible fluid, so ρ is constant. Flow is laminar so no velocity in r direction and z direction. So, $v_r = 0$ and $v_z = 0$. No velocity component in Θ direction, so, $\partial v_\theta/\partial \theta = 0$.

3. A cylindrical container of radius R containing a fluid of constant density and viscosity is caused to rotate about its own axis at an angular velocity Ω . The cylinder axis is vertical. Then,

a) $g_r = g_\theta = g_z = 0$

b) $g_r = g_\theta = 0$ and, $g_z = -g$

c) Only $g_r = 0$ and, $g_z = -g$

d) None of these

Ans. (b)

Since cylinder axis is vertical, so $g_r = g_\theta = 0$. And $g_z = -g$.

4. In Question 3, velocity components will be:

a) $v_r = v_z = 0$; $v_\theta = f(r)$; and $\partial v_\theta/\partial \theta = 0$

b) $v_r = v_z = v_\theta = 0$; and $\partial v_\theta/\partial \theta = 0$

c) $\partial v_r/\partial r = \partial v_z/\partial z = 0$; and $\partial v_\theta/\partial \theta = 0$

d) $v_r = v_\theta = 0$; and $\partial v_z/\partial z = 0$

Ans. (a)

Flow is laminar. So interaction of v_r and v_z is not there so $v_r = v_z = 0$. And v_θ vary with the radius so, $v_\theta = f(r)$. There is no interaction between v_θ in Θ direction, so, $\partial v_\theta/\partial \theta = 0$

5. A cylindrical container of radius "r" containing a fluid of constant density and viscosity is caused to rotate about its own axis at an angular velocity **Ω**. The cylinder axis is vertical. Then which of the following condition is true for the pressure 'p' at the surface w.r.t normal atmospheric pressure?

a) $p < p_o$

b) $p > p_o$

c) $p = p_o$

d) None of the above

Ans. (c)

6. The major forces considered for deriving Navier Stokes equation are

a) pressure, gravity and viscous

b) gravity, viscous and turbulent

c) pressure, viscous and turbulent

d) pressure, gravity and turbulent

Answer: a

When we consider any element, pressure forces act normal to the surface of element. Gravity forces act downwards and viscous forces is due to friction acting on the fluid element because of viscosity in the fluid.

7. An incompressible fluid is flowing in between the two vertical coaxial cylinders such that outer one is rotating with an angular velocity ω and inner one is stationary. The equation for velocity for the tangential laminar flow will be

a) $v_\theta = \omega k^2 [\, R^2 - r^2 / (1- k^2)r \,]$
b) $v_\theta = \omega k[\, R^2 - r^2 / (1- k^2)r \,]$
c) $v_\theta = \omega k^2 [\, R^2 - r^2 / (1- k)r \,]$

d) $v_\theta = \omega k [R^2 - r^2 / (1- k)r]$

Answer: a

8. An in-compressible fluid is flowing in between the two coaxial cylinders such that outer one is rotating and inner one is stationary. For deriving the equation to get the velocity, which of the following is correct

a) Flow is steady

b) density is constant

c) flow is assumed to be laminar

d) All the above

Answer: d

Since the fluid is incompressible therefore density will remain constant. Since the density is constant, therefore there will be no interaction between the layers and the flow will be steady and laminar.

9. A cylindrical container of radius containing a fluid of constant density and viscosity is caused to rotate about its own axis at an angular velocity **Ω**. The cylinder axis is vertical. Then what will be the equation of locus of the free surface at steady state

a) $(z - z_0) = \Omega^2 r/2g$

b) $(z - z_0) = \Omega^2 r^2/2$

c) $(z - z_0) = \Omega^2 r^2/2g$

d) $(z_0 - z) = \Omega^2 r^2/2g$

Answer: c

10. An incompressible fluid is flowing in between the two vertical coaxial cylinders such that outer one is rotating with an angular velocity ω and inner one is stationary. Then the velocity at the surface of inner cylinder will be

a) Minimum

b) maximum

c) zero

d) None of the above

Answer: c

If at steady state condition we look at the velocity distribution profile, we can say that angular velocity at the surface of inner cylinder is zero.