B.Sc - I 20/1/22

Coriolis Force

It is a fictitious force which appears to be acting on a particle moving with velocity $\vec{v}$ with respect to observer connected to rotating frame.

We obtain relation connecting inertial acceleration of particle of mass m at P and its acceleration relative to rotating frame, we have

$$\left(\frac{dV_s}{dt}\right)_s = \left(\frac{dV_s}{dt}\right)_r + \omega \times V_s$$

Replacing V_s on right side we get

$$V_s = V_r + \omega \times r$$

$$\left(\frac{dV_s}{dt}\right)_s = \left(\frac{dV_r}{dt}\right)_r + \left(\frac{d(\omega \times r)}{dt}\right)_r + \omega \times V_r + \omega \times (\omega \times r)$$

$$= \left(\frac{dV_r}{dt}\right)_r + \left(\frac{d\omega}{dt} \times r\right) + \omega \times V_r + \omega \times V_r + \omega \times (\omega \times r)$$

When angular velocity is constant $\left(\frac{\partial \omega}{dt}\right) = 0$

Then factor $\left(\frac{dV_s}{dt}\right)_s$ is inertial acceleration a_s

$\left(\frac{dV_r}{dt}\right)_r$ is acceleration a_r

$$\therefore a_s = a_r + 2(\omega \times V_r) + \omega \times (\omega \times r)$$

Equation of motion in inertial system

$$F = m a_s$$

Multiplying m

$$m a_s = m a_r + 2m(\omega \times V_r) + m\omega \times (\omega \times r)$$

$$F - 2m(\omega \times V_r) - m\omega \times (\omega \times r) = m a_r$$

To observer rotating system appears as particle is moving under effective force

$$F_{eff} = F - 2m(\omega \times V_r) - m\omega \times (\omega \times r)$$

Third term $-m\omega \times (\omega \times r)$ is called centrifugal force.

$$|m\omega \times (\omega \times r)| = m r \omega^2 \sin\theta$$

θ is angle b/w ω and r

second term $2m(\omega \times V_r)$ is called coriolis force.

Directly proportional to V_r and will disappear when there is no motion