29-10-2020 DIY Lecture 20 Assignment S. Tarun Prasad
ME17B114

(1.) $^{0}p = {}^{0}_{1}O + {}^{0}_{1}R\,{}^{1}p$

diff. w.r.t time.

$$\Rightarrow \frac{d\,{}^{0}p}{dt} = {}^{0}v_p = {}^{0}_{1}v + \frac{d\,{}^{0}_{1}R\,{}^{1}p}{dt} + {}^{0}_{1}R\frac{d\,{}^{1}p}{dt}$$

$$\Rightarrow {}^{0}_{p}v = {}^{0}_{1}v + {}^{0}_{1}\Omega\,{}^{0}_{1}R\,{}^{1}p + {}^{0}_{1}R\frac{d\,{}^{1}p}{dt}$$

diff. w.r.t time.

$$\Rightarrow \frac{d\,{}^{0}v_p}{dt} = {}^{0}_{p}a = {}^{0}_{1}a + \frac{d\,{}^{0}_{1}\Omega\,{}^{0}_{1}R\,{}^{1}p}{dt} + 2\frac{d\,{}^{0}_{1}\Omega}{dt}\frac{d\,{}^{1}p}{dt} + {}^{0}_{1}R\frac{d^2\,{}^{1}p}{dt}$$

$$\frac{d\,{}^{0}v_p}{dt} = {}^{0}_{p}a = {}^{0}_{1}a + \frac{d\,{}^{0}_{1}\Omega}{dt}\,{}^{0}_{1}R\,{}^{1}p + {}^{0}_{1}\Omega\frac{d\,{}^{0}_{1}R\,{}^{1}p}{dt} + 2\,{}^{0}_{1}\Omega\,{}^{0}_{1}R\frac{d\,{}^{1}p}{dt} + {}^{0}_{1}R\frac{d^2\,{}^{1}p}{dt}.$$

$${}^{0}_{1}a + {}^{0}_{1}\dot{\Omega}\,{}^{0}_{1}R\,{}^{1}p + {}^{0}_{1}\Omega^2\,{}^{0}_{1}R\,{}^{1}p + 2\,{}^{0}_{1}\Omega\,{}^{0}_{1}R\,{}^{1}\dot{p} + {}^{0}_{1}R\,{}^{1}\ddot{p}$$

- ${}^{0}_{1}a$ → acceleration of frame '1' w.r.t '0'
- ${}^{0}_{1}\dot{\Omega}\,{}^{0}_{1}R\,{}^{1}p$ → Angular acceleration component.
- ${}^{0}_{1}\Omega^2\,{}^{0}_{1}R\,{}^{1}p$ → Centripetal acceleration component.
- $2\,{}^{0}_{1}\Omega\,{}^{0}_{1}R\,{}^{1}\dot{p}$ → Coriolis acceleration component
- ${}^{0}_{1}R\,{}^{1}\ddot{p}$ → Frame 1 relative acceleration component