

Homework-3

Problem 11

Due : 11 - Feb - 2025

Time Spent : 1 Hour 30 Min

$$\vec{r} = r\hat{e}_r$$

$$\Rightarrow \dot{\vec{r}} = \dot{r}\hat{e}_r + r\dot{\theta}\hat{e}_\theta$$

For circular motion,  $\dot{r} = 0$

$$\Rightarrow \dot{\vec{r}} = r\dot{\theta}\hat{e}_\theta = v\hat{e}_\theta$$

$$\Rightarrow \ddot{\vec{r}} = r\ddot{\theta}\hat{e}_\theta - r\dot{\theta}^2\hat{e}_r = \vec{a}$$

Apply LMB,

$$\sum \vec{F} = \vec{L}$$

$$\Rightarrow F\hat{e}_r = m\vec{a}$$

$$F\hat{e}_r = mr\ddot{\theta}\hat{e}_\theta - mr\dot{\theta}^2\hat{e}_r$$

$$= mr\ddot{\theta}\hat{e}_\theta - m\dot{\theta}v\hat{e}_r \quad \text{--- (1)}$$

Dot (1) with  $\hat{e}_\theta$ ,

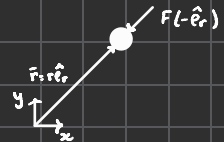
$$mr\ddot{\theta} = 0$$

$$\Rightarrow \ddot{\theta} = 0$$

Dot (1) with  $\hat{e}_r$ ,

$$\boxed{F = m\dot{\theta}^2 r}$$

Sketch :



FBD : Mass

