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- Exercícios do dia 17/09 -

1- Linearizar $f(x) = \cos(x)$:

a) Em torno de $\bar{x} = 0$:

$$f(x) \approx f(\bar{x}) + \left. \frac{df(x)}{dx} \right|_{x=\bar{x}} (x - \bar{x})$$

$$= \cos(\bar{x}) + (-\sin(\bar{x}))(x - \bar{x})$$

$$= \cos 0 - \sin 0 (x - 0) = 1 - 0 (x - 0) = 1$$

$$\therefore f(x) \approx 1 //$$

b) Em torno de $\bar{x} = \frac{\pi}{4}$:

$$f(x) \approx \cos \frac{\pi}{4} - \sin \frac{\pi}{4} (x - \frac{\pi}{4}) = \frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2} (x - \frac{\pi}{4})$$

$$\therefore f(x) \approx \frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2} (x - \frac{\pi}{4}) //$$

2- Linearizar $m\ddot{v} = F(t) - m\ddot{u} + m\ddot{x}$:

$$f(r, \dot{r}, \ddot{v}, u, x) = -m\ddot{v} - m\ddot{u} + m\ddot{x} = -F(t)$$

$$f(r, \dot{r}, \ddot{v}, u, x) \approx f(\bar{r}, \dot{\bar{r}}, \ddot{\bar{v}}, \bar{u}, \bar{x}) + \left. \frac{df}{dr} \right|_{eq} (r - \bar{r}) + \left. \frac{df}{d\dot{r}} \right|_{eq} (\dot{r} - \dot{\bar{r}}) + \\ + \left. \frac{df}{d\ddot{v}} \right|_{eq} (\ddot{v} - \ddot{\bar{v}}) + \left. \frac{df}{du} \right|_{eq} (u - \bar{u}) + \left. \frac{df}{dx} \right|_{eq} (x - \bar{x})$$

Como, no equilíbrio, $\bar{r} = \dot{\bar{r}} = \ddot{\bar{v}} = 0$:

$$f(\bar{r}, \dot{\bar{r}}, \ddot{\bar{v}}, \bar{u}, \bar{x}) = -\cancel{m\ddot{v}}^0 - \cancel{m\ddot{u}}^0 + \cancel{m\ddot{x}}^0 = 0$$

$$\therefore f(r, \dot{r}, \ddot{v}, u, x) \approx 0 + (-m\ddot{u})(r - 0) + m\ddot{x}(\dot{r} - 0) + \\ + (-m)(\ddot{v} - 0) + \cancel{(-m\ddot{u})}^0(u - \bar{u}) + \cancel{(m\ddot{x})}^0(x - \bar{x})$$

$$\Rightarrow f(r, \dot{r}, \ddot{v}, u, x) \approx -m\ddot{u}r + m\ddot{x}\dot{r} - m\ddot{v} = -F(t)$$

$$\therefore m\ddot{v} = F(t) - m\ddot{u}r + m\ddot{x}\dot{r}$$