NDAE18052

Assignment := 1 { Maglev Simulation }

$$m\ddot{x} = mg - \hat{k}\frac{i^2}{x^2}$$

$$\hat{k} = Km$$

$$\cancel{m}\ddot{x} = \cancel{m}g - K\cancel{m}\frac{i^2}{x^2}$$

$$\ddot{x} = g - K\frac{i^2}{x^2}.$$

$$x = x_0 + \Delta x \quad \& \quad i = i_0 + \Delta i$$

$$\therefore \frac{d^2}{dt^2}\{x_0 + \Delta x\} = g - K\frac{(i_0 + \Delta i)^2}{(x_0 + \Delta x)^2} \quad \text{-------- (1)}$$

Now,

$$\frac{(i_0 + \Delta i)^2}{(x_0 + \Delta x)^2} = \frac{i_0^2}{x_0^2} - 2\frac{i_0^2}{x_0^3}(x - x_0) + 2\frac{i_0}{x_0^2}(i - i_0) + \dots$$

but $i = i_0 + \Delta i$, $x = x_0 + \Delta x$

↑ 2 variable Tayler's expension

$$\therefore \frac{(i_0 + \Delta i)^2}{(x_0 + \Delta x)^2} = \left(\frac{i_0}{x_0}\right)^2 - 2\frac{i_0^2}{x_0^3}(\cancel{x_0} + \Delta x - \cancel{x_0}) + 2\frac{i_0}{x_0^2}(\cancel{i_0} + \Delta i - \cancel{i_0})$$

$$= \left(\frac{i_0}{x_0}\right)^2 - 2\frac{i_0^2}{x_0^3}\Delta x + 2\frac{i_0}{x_0^2}\Delta i \quad \text{----- (2)}$$

from (1).

$$\frac{d^2 \Delta x}{dt^2} = g - K\left[\frac{i_0^2}{x_0^2} - 2\frac{i_0^2}{x_0^3}\Delta x + 2\frac{i_0}{x_0^2}\Delta i\right]$$

$\lim_{\Delta x \to 0}$ & $\lim_{\Delta i \to 0}$ $\quad \Delta x \simeq x$, $\Delta i \simeq i$

$$\therefore \frac{d^2 x}{dt^2} = g - \frac{K i_0^2}{x_0^2} + \frac{2K i_0^2}{x_0^3} x - 2K\frac{i_0}{x_0^2} i$$

putting $K = 1.24 \times 10^{-3}$

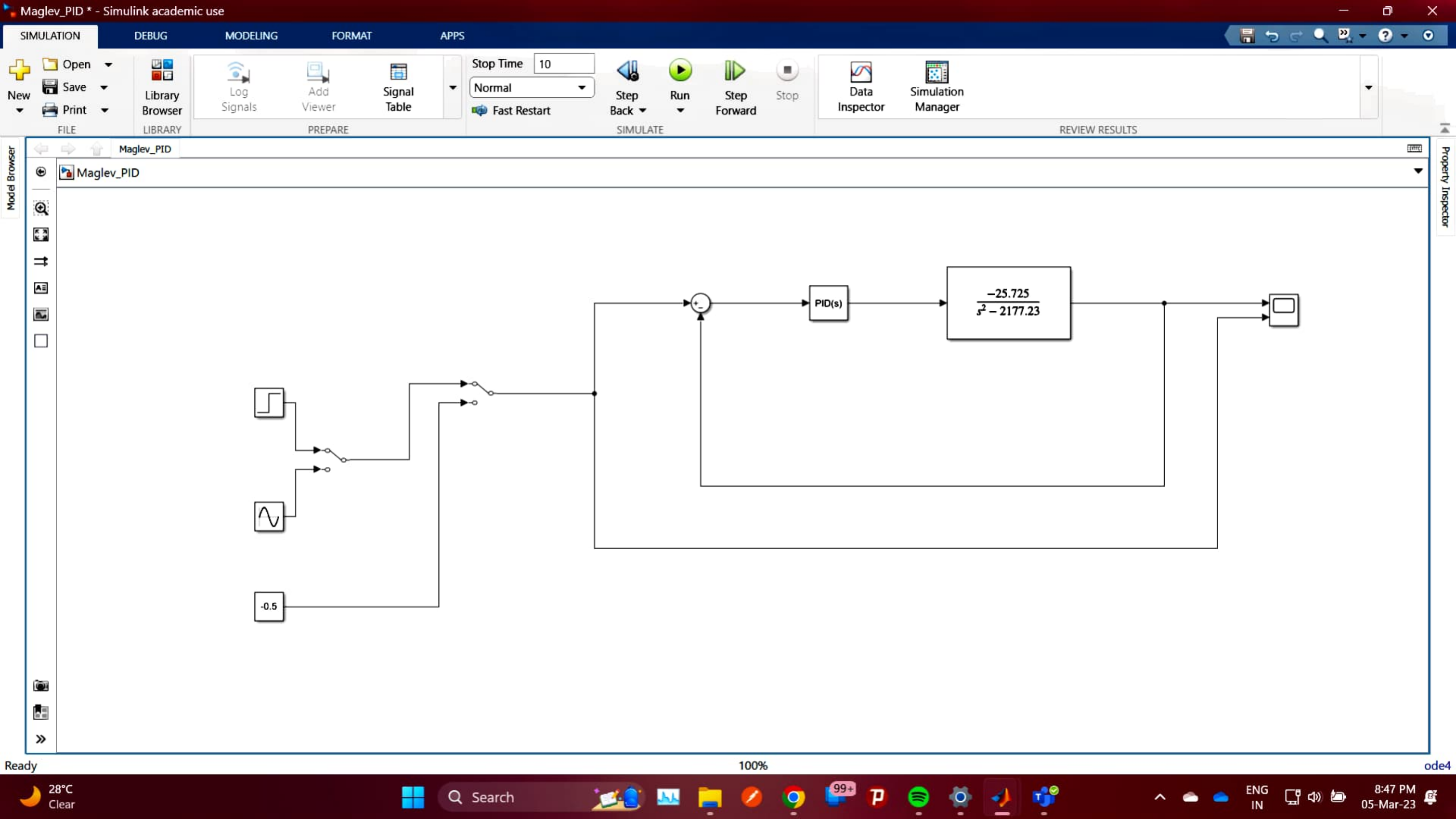
$i_0 = 0.8\ A$

$x_0 = 0.009\ m$

$$\frac{d^2 x}{dt^2} = \cancel{9.8} - \cancel{9.8} + 2177.23\, x - 25.725\, i$$

$$\therefore \ddot{x} = 2177.23\, x - 25.725\, i$$

$$\frac{X(s)}{I(s)} = \frac{-25.725}{s^2 - 2177.23} = G(s) \left\{ \text{Transfer function} \right\}$$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Step Forward
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SIMULATE
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PID(s)
−25.725
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