Modelagem e Análise de Sistemas Lineares

Roteiro 4

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a) $J_m \ddot{\theta}_m + D_m \dot{\theta}_m = T_m$

$$T_m(s) = (J_m s^2 + D_m s)\,\theta_m(s)$$

b) $$\frac{(R_a + L_a s)\,T_m}{K_t} + K_{ce} s\,\theta_m = E_a(s) \quad \text{Equação (8.)}$$

$$\frac{(R_a + L_a s)}{K_t}(J_m s^2 + D_m s)\,\theta_m + K_{ce} s\,\theta_m = E_a(s)$$

c) $L_a = 0$

$$\left[\frac{R_a}{K_t}(J_m s + D_m) + K_{ce}\right] s\,\theta_m(s) = E_a(s)$$

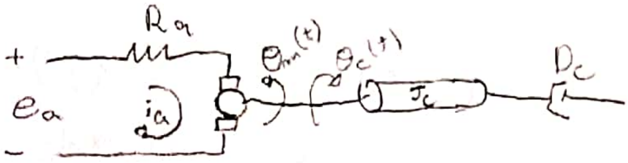
$$\frac{\theta_m(s)}{E_a(s)} = \frac{1}{s\left[\frac{R_a}{K_t}(J_m s + D_m) + K_{ce}\right]} \rightsquigarrow \frac{\frac{K_t}{R_a J_m}}{s\left[s + \frac{1}{J_m}\left(D_m + \frac{K_t K_{ce}}{R_a}\right)\right]}$$

d) Refletindo J_c e D_c p/ armadura

$$J_{c\,eq} = J_a + J_c\left(\frac{N_1}{N_2}\right)^2$$

$$D_{c\,eq} = D_a + D_c\left(\frac{N_1}{N_2}\right)^2$$

① $\frac{\Theta_c(s)}{E_a(s)} = ?$; refletindo J_c e D_c p/ armadura



Pelo gráfico:

$$\begin{cases} e_a = 100\ V \\ \omega_m = 50\ rad/s \\ T_m = 500\ N\text{-}m \end{cases}$$

$$J_e = J_a + J_c\left(\frac{N_1}{N_2}\right)^2 \rightsquigarrow 5 + 700\left(\frac{100}{1000}\right)^2 \rightsquigarrow \boxed{J_m = 12}$$

$$D_e = D_a + D_c\left(\frac{N_1}{N_2}\right)^2 \rightsquigarrow 2 + 800\left(\frac{1}{10}\right)^2 \rightsquigarrow \boxed{D_m = 10}$$

$$\Theta_c = \frac{N_1}{N_2}\Theta_m \rightsquigarrow \Theta_c = \frac{1}{10}\Theta_m \rightsquigarrow \boxed{\Theta_m = 10\,\Theta_c}$$

$$\frac{K_T}{R_a} = \frac{T_m}{e_a} \rightsquigarrow \frac{500}{100} = 5$$

$$K_{ce} = \frac{e_a}{\omega_m} \rightsquigarrow \frac{100}{50} = 2$$

$$\frac{\Theta_m(s)}{E_a(s)} = \frac{K_T / R_a J_m}{s\left[s + \frac{1}{J_m}\left(D_m + \frac{K_T K_{ce}}{R_a}\right)\right]}$$

$$\frac{\Theta_m(s)}{E_a(s)} = \frac{5/12}{s\left[s + \frac{1}{12}(10 + 5,2)\right]} \rightsquigarrow \frac{5/12}{s\left[s + 20/12\right]}$$

$$\frac{10\,\Theta_c(s)}{E_a} = \frac{5/12}{s\left[s + 20/12\right]} \rightsquigarrow \boxed{\frac{\Theta_c(s)}{E_a(s)} = \frac{5/120}{s(s + 20/12)}}$$

② $\dfrac{\Theta_c(s)}{E_a(s)}$; $T_m = -8\omega_m + 200$, $e_a = 100V$

$J_m = J_a + J_c\left(\frac{N_1}{N_2}\right)^2 \rightsquigarrow 1 + 400\left(\frac{25}{1000}\right)^2 \rightsquigarrow \boxed{2}$

$D_m = D_a + D_c\left(\frac{N_1}{N_2}\right)^2 \rightsquigarrow 5 + 800\left(\frac{25}{1000}\right)^2 \rightsquigarrow \boxed{7}$

$\dfrac{K_T}{R_a} = \dfrac{T_m}{e_a} \rightsquigarrow \dfrac{200}{100} = \boxed{2}$

$K_{ce} = \dfrac{e_a}{\omega_{vacio}} \rightsquigarrow \dfrac{100}{\frac{200}{8}} = \boxed{4}$

$\Theta_c = \dfrac{N_1 N_3}{N_2 \cdot N_4}\Theta_m \rightsquigarrow \boxed{\Theta_m = 20\,\Theta_c}$

$$\frac{\Theta_m(s)}{E_a(s)} = \frac{\frac{K_T}{R_a}\cdot\frac{1}{J_m}}{s\left[s + \frac{1}{J_m}\left(D_m + \frac{K_T}{R_a}K_{ce}\right)\right]} \rightsquigarrow \frac{2/2}{s\left[s + \frac{1}{2}(7 + 2\cdot 4)\right]}$$

$$\frac{20\Theta_c(s)}{E_a(s)} = \frac{1}{s\left[s + \frac{15}{2}\right]} \rightsquigarrow \boxed{\frac{\Theta_c(s)}{E_a(s)} = \frac{1/20}{s\left[s + \frac{15}{2}\right]}}$$