White, Michael | Lab #2, Activity #4 | ME 421 L

① $\omega_0 = 0 \quad t_0 = 0 \rightarrow \omega_0 = C_2 e^{-t/\tau} + C_1$

$0 = C_2 e^0 + C_1 \rightarrow C_1 = -C_2 \rightarrow \omega_0 = -C_1 e^{-t/\tau} + C_1$

so... $\omega_0 = C_1(1 - e^{-t/\tau})$

$J_{eq}(\dot{\omega}_m) + b_{eq}(\omega_m) = \frac{K_t}{R_a} V_a(s)$

↓ Laplace transform

$J_{eq}(sW(s) - W(0)) + b_{eq} W(s) = \frac{K_t}{R_a} V_a(s) \rightarrow V_a(s) = \frac{1}{s}$ (step)

$W(s) = \dfrac{\frac{K_t}{R_a}}{J_{eq} s + b_{eq}} \cdot \frac{1}{s} = \frac{A}{s} + \frac{B}{J_{eq} s + b_{eq}}$

$\frac{K_t}{R_a} = A_{b_{eq}} \rightarrow A = \frac{K_t}{R_A b_{eq}}$; $B = -\frac{K_t J_{eq}}{R_A b_{eq}}$

$\dfrac{\frac{K_t}{R_A b_{eq}}}{s} - \dfrac{\frac{K_t J_{eq}}{R_A b_{eq}}}{J_{eq} s + b_{eq}} \rightarrow \frac{K_t}{R_a b_{eq}}\left(\frac{1}{s + \frac{b_{eq}}{J_{eq}}}\right)$

Laplace Inverse:

$\frac{K_t}{R_a b_{eq}} - \frac{K_t}{R_a b_{eq}} e^{-t\frac{b_{eq}}{J_{eq}}} \rightarrow$ Max Velocity $= \frac{K_t}{R_a b_{eq}} = C_1$; $\tau = \frac{J_{eq}}{b_{eq}}$

$(1 - e^{-t/\tau})\left(\frac{K_t}{R_a b_{eq}}\right) = \omega$ @ 63.2% where $t \approx \tau$

$b_{eq} = (1 - e^{-1})\left(\frac{K_t}{R_a b_{eq}}\right)$

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