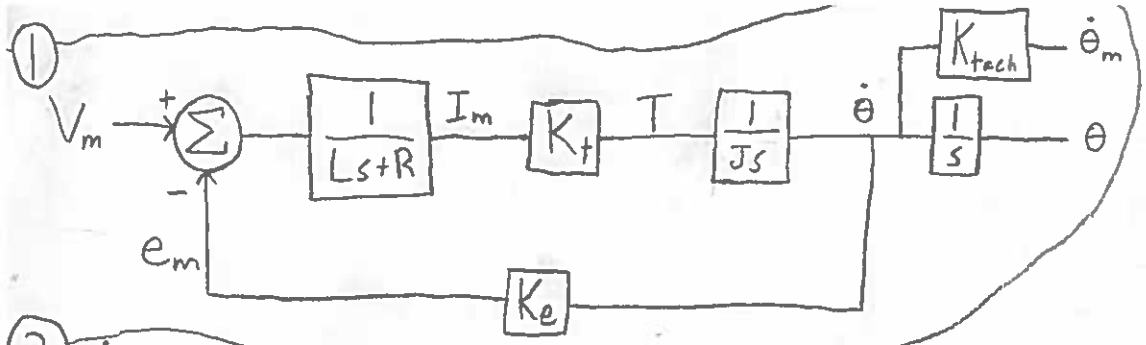
# Lab 2
## Prelab
Evan Donley

(1)



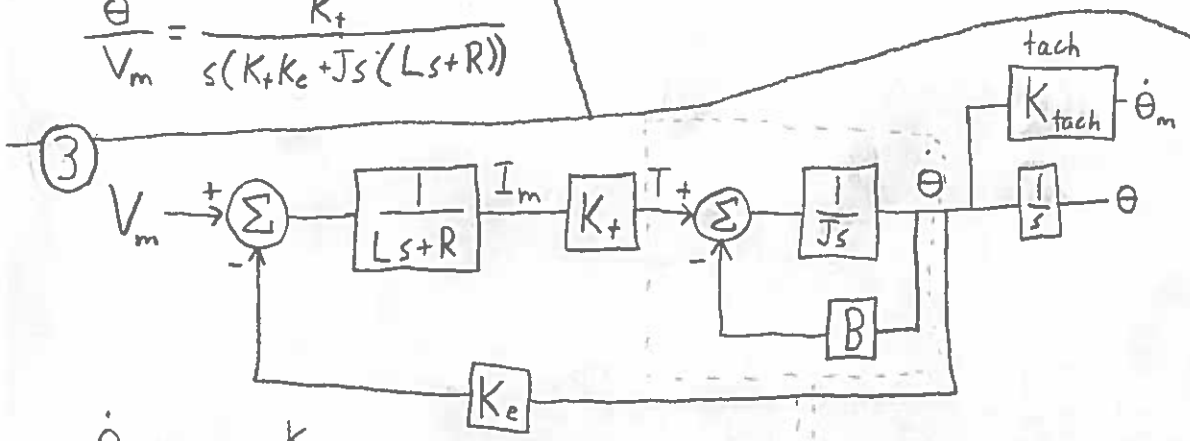

(2)

$$\frac{\dot{\theta}}{I_m} = \frac{K_t}{Js}$$

$$\frac{\dot{\theta}}{V_m} = \frac{K_t}{K_tK_e + Js(Ls+R)}$$

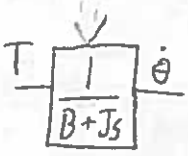
$$\frac{\theta}{V_m} = \frac{K_t}{s(K_tK_e + Js(Ls+R))}$$

(3)




$$\frac{\dot{\theta}}{V_m} = \frac{K_t}{K_tK_e + Js(Ls+R)(Js+B)}$$

$$\frac{\dot{\theta}}{I_m} = \frac{K_t}{B+Js}$$

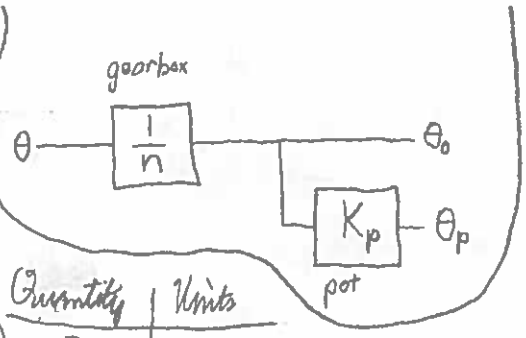



(4) Damping shifts the pole into the LHP, making it more stable and slowing the whole system down.

(5) $\tau = \frac{L}{R}$

(6) $T \gg T_F \left(= \frac{J}{B}\right) \Rightarrow \frac{K_t}{K_tK_e + JRs\left(\frac{L}{R}s+1\right)} \Rightarrow \frac{K_t}{K_tK_e + JRs} \cdot \left(\frac{\frac{1}{K_tK_e}}{\frac{1}{K_tK_e}}\right) \Rightarrow \boxed{\frac{K_e^{-1}}{1 + \frac{JR}{K_tK_e}s}}$ $\boxed{T = \frac{JR}{K_tK_e}}$

(7)




(8)

| Quantity | Units |
|---|---|
| $R_m$ | $\Omega$ |
| $L_m$ | H |
| $I_m$ | A |
| $V_m$ | V |
| $\theta_p$ | V |
| $\dot{\theta}_m$ | V |
| $K_{tach}$ | $\frac{V \cdot sec}{rad}$ |
| $K_e$ | $\frac{V \cdot sec}{rad}$ |
| $K_t$ | $\frac{N \cdot m}{A}$ |
| $K_p$ | $\frac{V}{rad}$ |
| $T$ | $N \cdot m$ |
| $J_m$ | $\frac{kg \cdot m^2}{rad}$ |
| $J_F$ | $\frac{kg \cdot m^2}{rad}$ |
| $B$ | $\frac{kg \cdot m^2}{rad \cdot sec}$ |
| $n$ | ~~numbers~~ |
| $\theta$ | rad |
| $\theta_0$ | rad |

$$[N] = \frac{kg \cdot m}{s^2}$$

$$[J] = \frac{[T]}{[\ddot{\theta}]} = \frac{N \cdot m}{\frac{rad}{sec^2}} = \frac{N \cdot m \cdot sec^2}{rad} \Rightarrow \frac{kg \cdot m^2}{rad}$$

$$[B] = \frac{[T]}{[\dot{\theta}]} = \frac{N \cdot m}{\frac{rad}{sec}} = \frac{N \cdot m \cdot sec}{rad} \Rightarrow \frac{kg \cdot m^2}{rad \cdot sec}$$