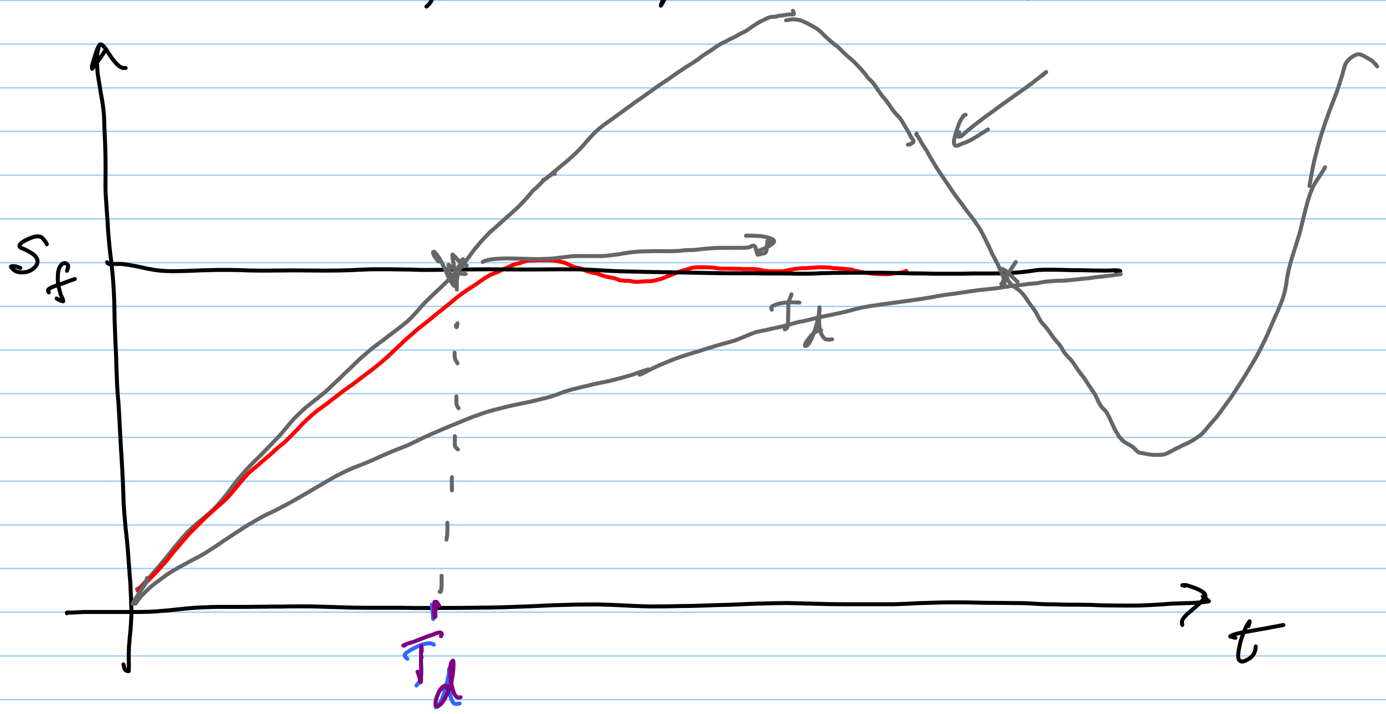
11-2-13

Lec 18

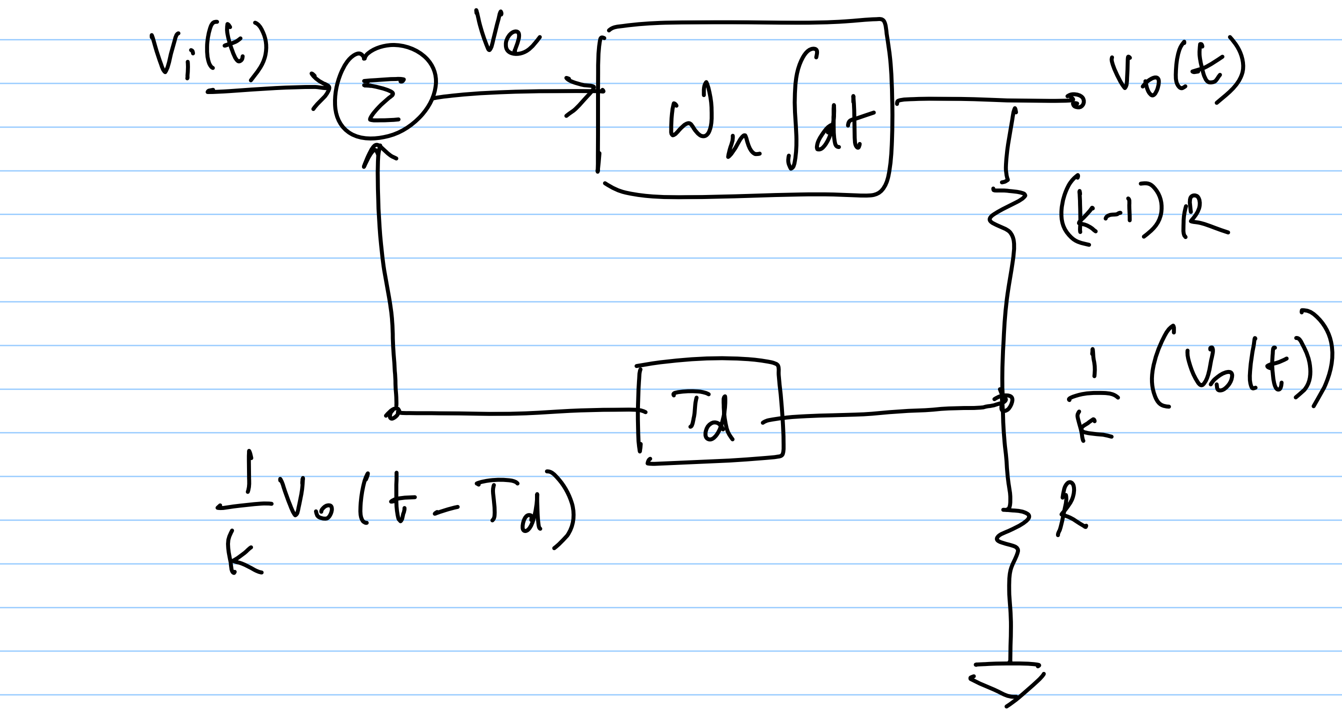
$$\boxed{\begin{aligned} \tau &= \frac{k}{\omega_n} \\ \text{pole} &= -\frac{\omega_n}{k} \\ BW &= \frac{\omega_n}{k} \end{aligned}}$$

larger ω_n leads to faster settling, need to burn more <u>power</u> in integrator

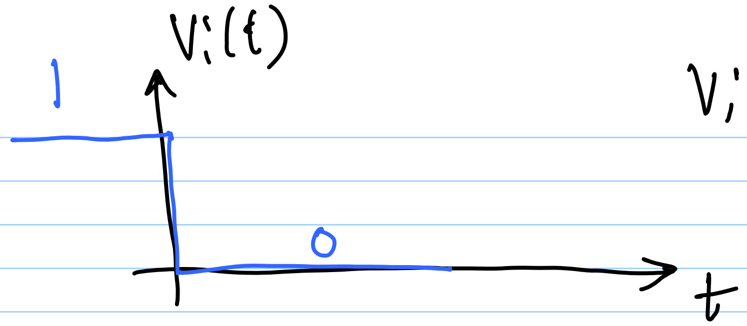
<u>Effects of delay in f/b. path</u>



* reduce rate of acceleration (ω_n)



$$\frac{1}{\omega_n}\frac{dV_o(t)}{dt} = V_i(t) - \frac{V_o(t-T_d)}{k}$$



$V_i(t) = 0$ for $t > 0$

$$\frac{1}{\omega_n}\frac{dV_o(t)}{dt} = -\frac{V_o(t-T_d)}{k}$$

* exponential solution is possible
* sinusoidal solution is also possible

1) Assume solution has an exp. form

$$V_0 = e^{\sigma t}$$

$$\frac{1}{\omega_n} \sigma e^{\sigma t} = -\frac{e^{\sigma t} \cdot e^{-\sigma T_d}}{k}$$

$$\boxed{\sigma + \frac{\omega_n}{k} e^{-\sigma T_d} = 0}$$

$$\frac{\sigma}{(\omega_n/k)} + e^{-\left(\frac{\sigma}{\omega_n/k}\right) \cdot \left(\frac{\omega_n}{k} \cdot T_d\right)} = 0$$

$$\sigma' = \frac{\sigma}{\omega_n/k} \; ; \; \tau = \frac{\omega_n}{k} \cdot T_d$$

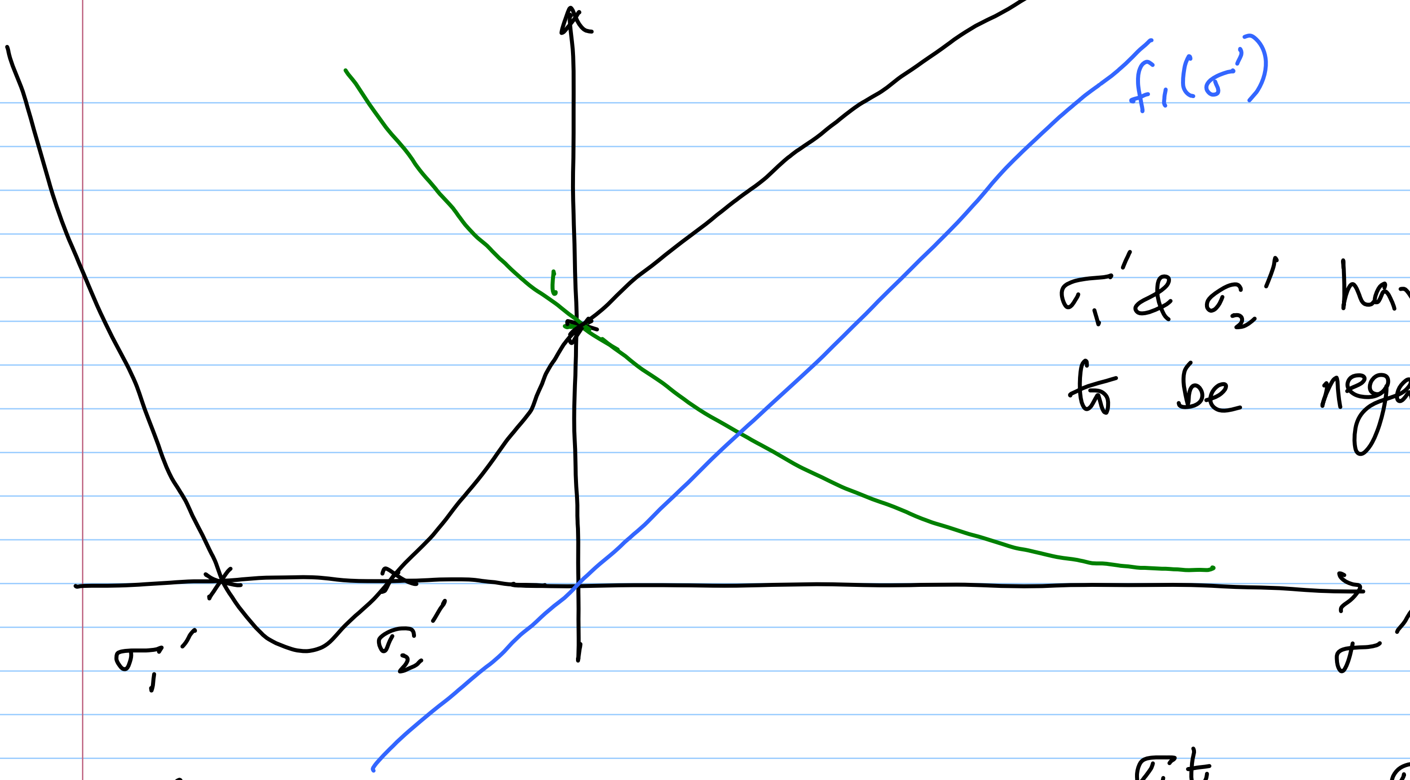
$$\underbrace{\sigma'}_{f_1(\sigma')} + \underbrace{e^{-\sigma' \tau}}_{f_2(\sigma')} = 0$$

; σ' & τ are dimensionless

$$T_d = 0 \Rightarrow \tau = 0$$

$$\sigma' = -1 \Rightarrow \sigma = -\frac{\omega_n}{k}$$

$$f_1(\sigma') + f_2(\sigma') = 0$$



σ_1' & σ_2' have to be negative

General solution: $V_o(t) = \alpha_1 e^{\sigma_1 t} + \alpha_2 e^{\sigma_2 t}$

α_1, α_2 from boundary conditions