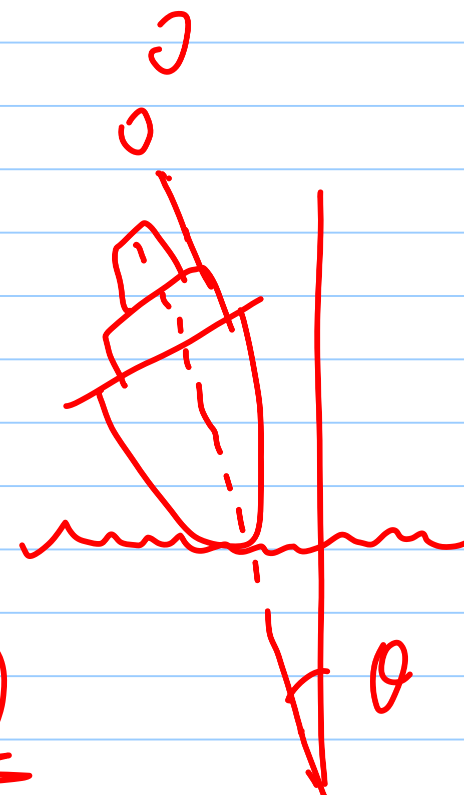
Note Title 2011-10-26

ζ ω_n

$$G(s) = \frac{\omega_n^2}{\underbrace{s^2 + 2\zeta\omega_n s + \omega_n^2}}$$



Open loop :

$$\lim_{t\to\infty} e(t) = \lim_{t\to\infty} \cancel{\theta_d(t)}^{=0} - \theta(t)$$

$$= \lim_{t\to\infty} -\theta(t) \overset{FVT}{=} -\lim_{s\to 0} s\,\underline{\underline{\Theta(s)}}$$

$$= -\lim_{s\to 0} \cancel{s}\, G(s)\cdot \frac{A}{\cancel{s}}$$

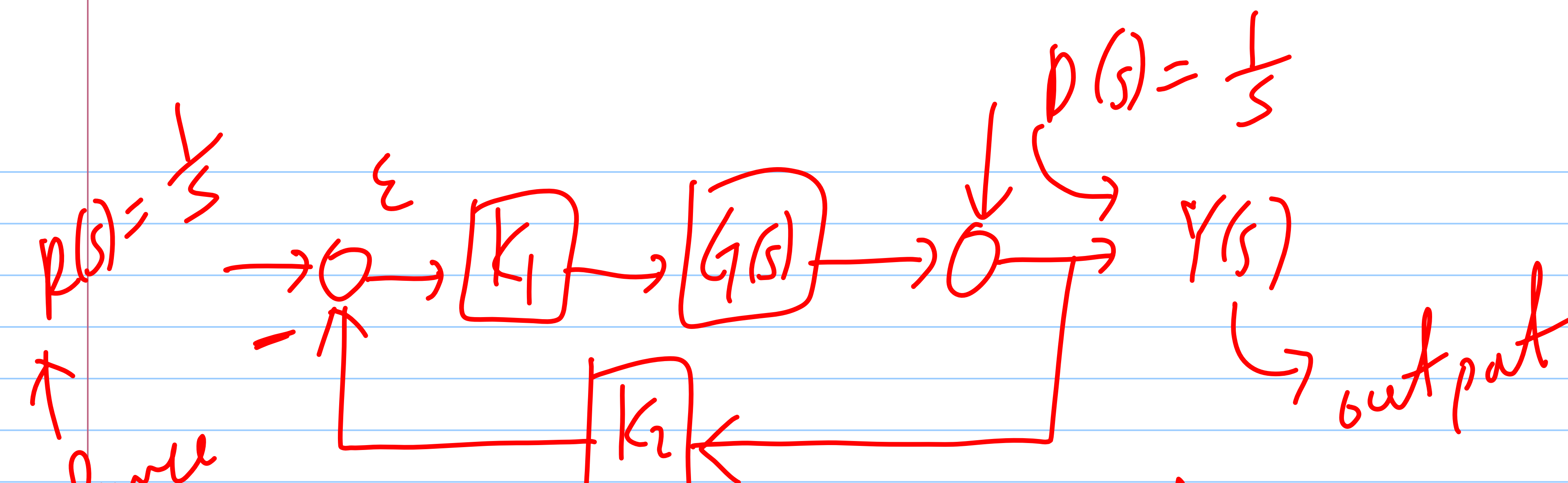
C.L

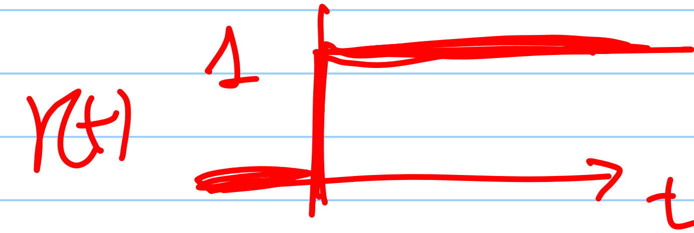
$$\lim_{t\to\infty} e(t) = \lim_{t\to\infty} \underbrace{\theta_d(t)}_{=0} - \theta(t)$$

$$\text{FVT} = \lim_{s\to 0} s\,\Theta(s)$$

$$= -\lim_{s\to 0} \cancel{s}\left[\Theta(s) = \overbrace{\left[\frac{G(s)}{1 + K_a G(s) K_1}\right]}^{T(s)\big|_{T_d\to 0}}\left(\frac{A}{\cancel{s}}\right)\right]$$

$$= \boxed{\;?\;}$$





$$e = r - y$$

$$e_{ss} = \lim_{t \to \infty} e(t) = \lim_{t \to \infty} \left(r(t) - y(t) \right)$$

$$\text{with } r(t) = 1$$

$$= 1 - \lim_{t \to \infty} y(t)$$

FVT $\swarrow$ $\rightarrow$ $\lim_{s \to 0} s \cdot Y(s) = y_{ss}$

$$Y(s) = Y_r(s) + Y_d(s) = T_{r\to y}(s)\,R(s) + T_{d\to y}(s)\,D(s)$$

$$Y_r(s) = T_{r\to y}(s) \cdot R(s)$$

$$Y_d(s) = T_{d\to y}(s) \cdot D(s)$$

$$T_{r\to y}(s) = \frac{k_1 G(s)}{1 + k_1 k_2 G(s)} \qquad T_{d\to y}(s) = \frac{1}{1 + k_1 k_2 G(s)}$$

$$\left(G(s) = \frac{1}{s+1} \right) \Big/ \quad k_1 = 2 \quad k_2 = 3 \quad \Big|$$

$$= \frac{2\,\frac{1}{s+1}}{1+6\cdot\frac{1}{s+1}} = \frac{2}{s+1+6}$$

$$\frac{1}{1+6\,\frac{1}{s+1}} = \frac{s+1}{s+1+6}$$

$$\lim_{s\to 0} sY(s) = \lim_{s\to 0} \cancel{s}\left[\left(\frac{2}{s+7}\right)\frac{1}{\cancel{s}} + \left(\frac{s+1}{s+7}\right)\frac{1}{\cancel{s}}\right]$$

$$= \frac{2}{7} + \frac{1}{7} = \frac{3}{7} \qquad e_{ss} = 1 - \frac{3}{7} = \frac{4}{7}$$