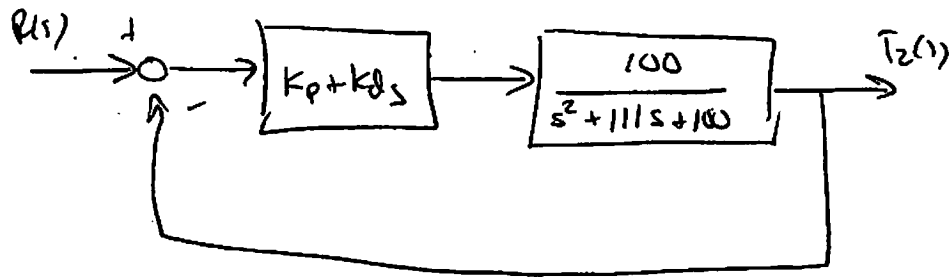(b)

want $t_r = 0.1 s$ $\%os = 10\%$

$$\Rightarrow 0.1 = \frac{2.2}{\omega_n} \quad \text{or} \quad \omega_n = 22$$

$$\zeta = \frac{\ln(.1)}{\sqrt{\ln(.1)^2 + \pi^2}} = 0.59$$

desired closed loop denominator: $s^2 + 2\zeta\omega_n s + \omega_n^2 = s^2 + 26s + 484$

Closed loop denominator as function of k_p, k_d:

$$\frac{T_z(s)}{R(s)} = \frac{\dfrac{100(k_p + k_d s)}{s^2 + 111s + 100}}{1 + \dfrac{100(k_p + k_d s)}{s^2 + 111s + 100}} = \frac{100(k_p + k_d s)}{s^2 + (111 + 100 k_d)s + 100(1 + k_p)}$$

$$100(1 + k_p) = 484 \quad \Rightarrow \quad \underline{k_p = 3.84}$$

$$111 + 100 k_d = 26 \quad \Rightarrow \quad \underline{k_d = -0.85}$$