PID Controller

Monday, January 11, 2021 12:54 PM

Note Title 1/11/2021

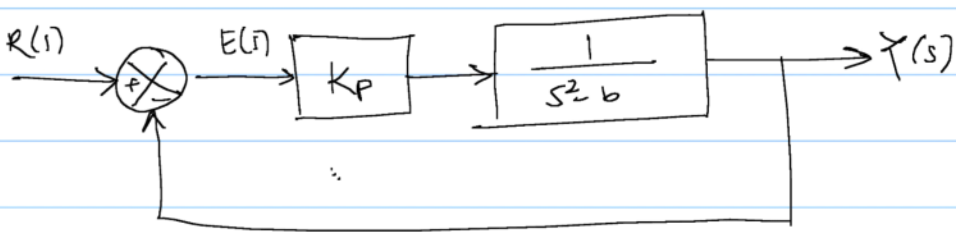
* Proportional Integral Derivative Controller / PID controller.

Consider a second order system

$$G(s) = \frac{1}{s^2 - b}$$

With $b > 0$, the system will be U.S. & poles location will be at $s = \pm\sqrt{b}$

Let's begin with Proportional Controller

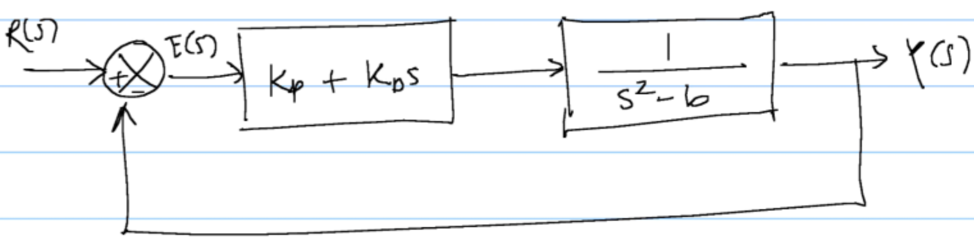


$$C.L.T.F = \frac{Y(s)}{R(s)} = \frac{K_p}{s^2 - b + K_p}$$

K_p $K_D s$

still the system is unstable ∴ we go for P+D controller

∴ The Block diag of PD controller is,



$$C.L.T.F = \frac{Y(s)}{R(s)} = \frac{K_P + K_D s}{s^2 + K_D s + K_P - b}$$

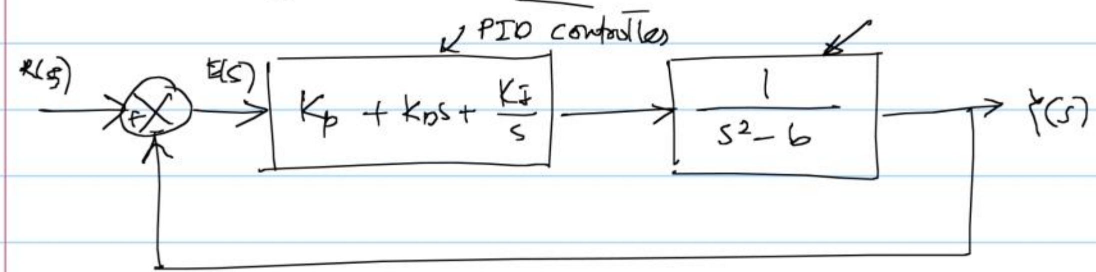
Thus PD controller adds the coeff. of 's' i.e. damping to the system $\frac{1}{s^2 - b}$ & make the system more stable

Now, $e_{ss} = \lim_{t \to \infty} e(t) = \lim_{s \to 0} s \cdot E(s)$

$$\boxed{e_{ss} = \frac{K_P}{K_P - b}}$$

To minimize the error e_{ss} we need to add integral controller.

∴ Block diagram of PID controller is,



$e_{ss} = \lim_{t \to \infty} e(t) = \lim_{s \to 0} s \cdot E(s)$

$$= \lim_{s \to 0} \cancel{s} \left[\frac{K_D s^2 + K_P s + K_I}{s^3 + K_D s^2 + (K_P - b)s + K_I} \right] \frac{1}{\cancel{s}}$$

$$\boxed{e_{ss} = 1}$$

→ Thus PID controller make the unstable system stable & also reduces the steady state error.