Course of
"Automatic Control Systems"
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Analytic results for P and I controllers

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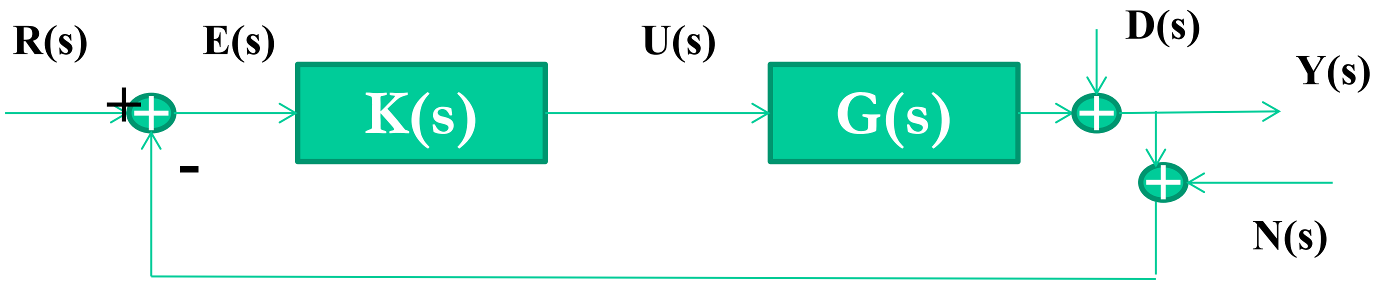
P controller with a plant of first order

- Let us consider a closed loop system in the form

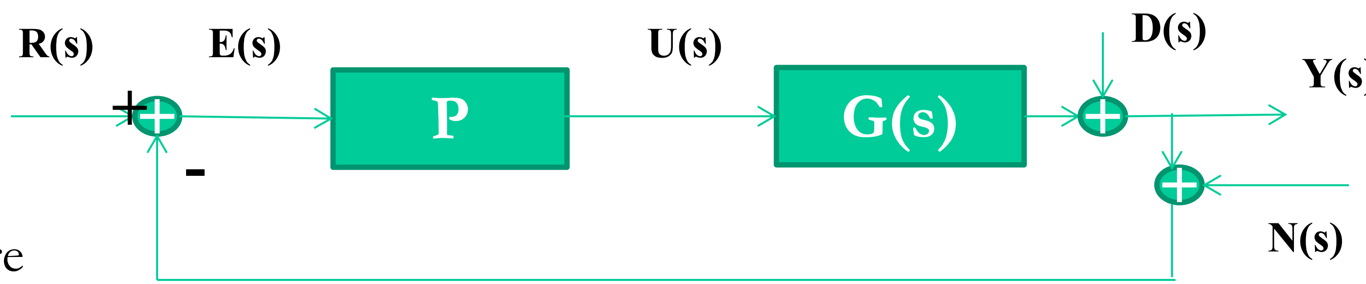


where

$$G(s) = \frac{G_0}{(1 + s\tau)}$$

$$W(s) = \frac{\boldsymbol{Y(s)}}{\boldsymbol{R(s)}} = \frac{\dfrac{G_0 K_p}{1 + G_0 K_p}}{(1 + s\,\dfrac{\tau}{1 + G_0 k_p})}$$

- Let us consider a closed loop system in the form



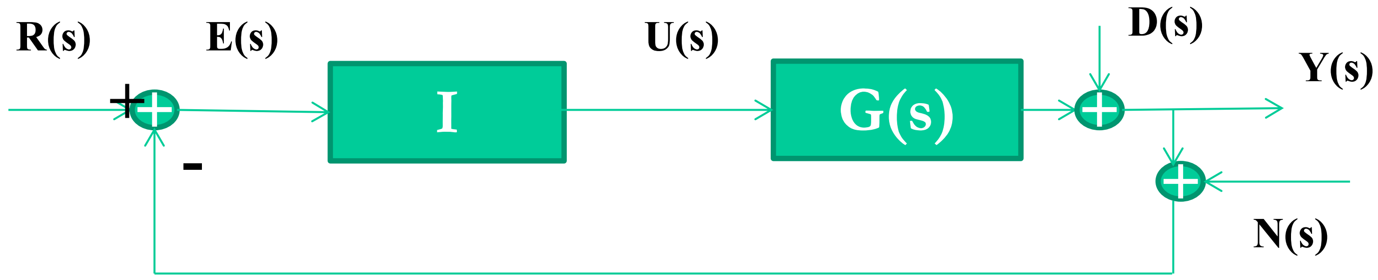
where

$$G(s) = \frac{G_0}{\frac{s^2}{\omega_n^2} + \frac{2\zeta}{\omega_n} s + 1}$$

$$\Rightarrow \quad W(s) = \frac{\frac{G_0 K_p}{1 + G_0 K_p}}{\left(\frac{s^2}{(1 + G_0 K_p)\omega_n^2} + \frac{2\zeta}{(1 + G_0 K_p)\omega_n} s + 1 \right)}$$

- $\omega_{nc} = \omega_n \sqrt{1 + G_0 K_p}$
- $\zeta_c = \zeta / \sqrt{1 + G_0 K_p}$

- Let us consider a closed loop system in the form



where

$$G(s) = \frac{G_0}{(1 + s\tau)}$$

$$W(s) = \frac{\mathbf{1}}{\left(\frac{\tau}{G_0 K_I} s^2 + \frac{\mathbf{1}}{G_0 K_I} s + 1\right)}$$

- $\omega_{nc} = \sqrt{G_0 K_I / \tau}$
- $\zeta_c = \frac{\mathbf{1}}{\mathbf{2}\sqrt{G_0 K_I \tau}}$