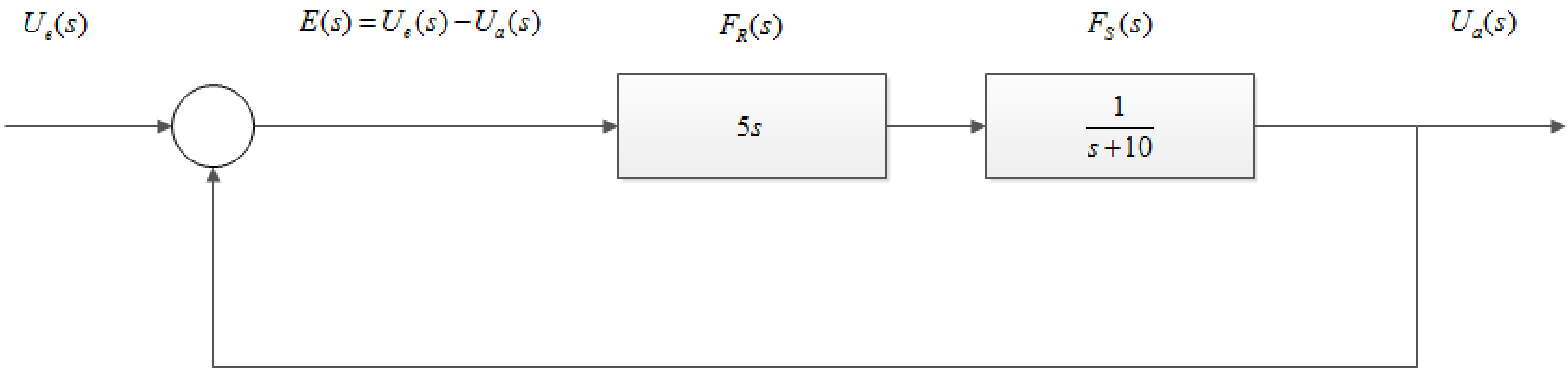


Übungsblatt 4
Aufgabe 3



a) $PD - Regler$

b)
$$G(s) = \frac{F_0(s)}{1 + F_0(s)} \qquad F_0(s) = F_r(s) \cdot F_s(s) = 5s \cdot \frac{1}{s + 10} = \frac{5s}{s + 10}$$

$$G(s) = \frac{\frac{5s}{s + 10}}{\frac{s + 10 + 5s}{s + 10}} = \frac{5s \cdot (s + 10)}{(s + 10)(6s + 10)} = \frac{5s}{6s + 10}$$

c)
$$U_a(s) = G(s) \cdot U_e(s)$$

für *Einheitssprung* $U_e(s) = \frac{1}{s}$

$$U_a(s) = \frac{5s}{6s + 10} \cdot \frac{1}{s} = \frac{5}{6s + 10}$$

Polstellen von $G(s)$:

$$\begin{aligned} s_1: \quad 0 &= 6s + 10 \\ s &= -\frac{10}{6} = -\frac{5}{3} \qquad \Rightarrow \textit{System ist stabil.} \end{aligned}$$

d)
$$E(s) = U_e(s) - U_a(s) = U_e(s) - G(s) \cdot U_e(s) = U_e(s) \cdot (1 - G(s)) = U_e(s) \cdot \left(\frac{6s + 10 - 5}{6s + 10} \right) = U_e(s) \cdot \left(\frac{6s + 5}{6s + 10} \right)$$

für *Einheitssprung*: $U_e(s) = \frac{1}{s}$

$$\lim_{t \rightarrow \infty} e(t) = \lim_{s \rightarrow 0} (s \cdot E(s)) = \lim_{s \rightarrow 0} \left(s \cdot \frac{1}{s} \cdot \frac{6s + 5}{6s + 10} \right) = \frac{5}{10} = \frac{1}{2}$$

$$E(s) = \frac{1}{s} \cdot \frac{6s + 5}{6s + 10} = \frac{1}{s} \cdot \frac{6s}{6s + 10} + \frac{1}{s} \cdot \frac{5}{6s + 10} = \frac{6}{6\left(s + \frac{5}{3}\right)} + \frac{5}{s(6s + 10)}$$

$$\frac{5}{s(6s + 10)} = \frac{A}{s} + \frac{B}{6s + 10}$$

$$5 = A(6s + 10) + Bs$$

Koeffizientenvergleich

$$s^1: \quad 0 = 6A + B \qquad \rightarrow B = -3$$

$$s^0: \quad 5 = 10A \qquad \rightarrow A = \frac{1}{2}$$

$$e(t) = e^{-\frac{5}{3}t} + \frac{1}{2} - \frac{1}{2}e^{-\frac{5}{3}t} = \frac{1}{2} \left(1 + e^{-\frac{5}{3}t} \right)$$