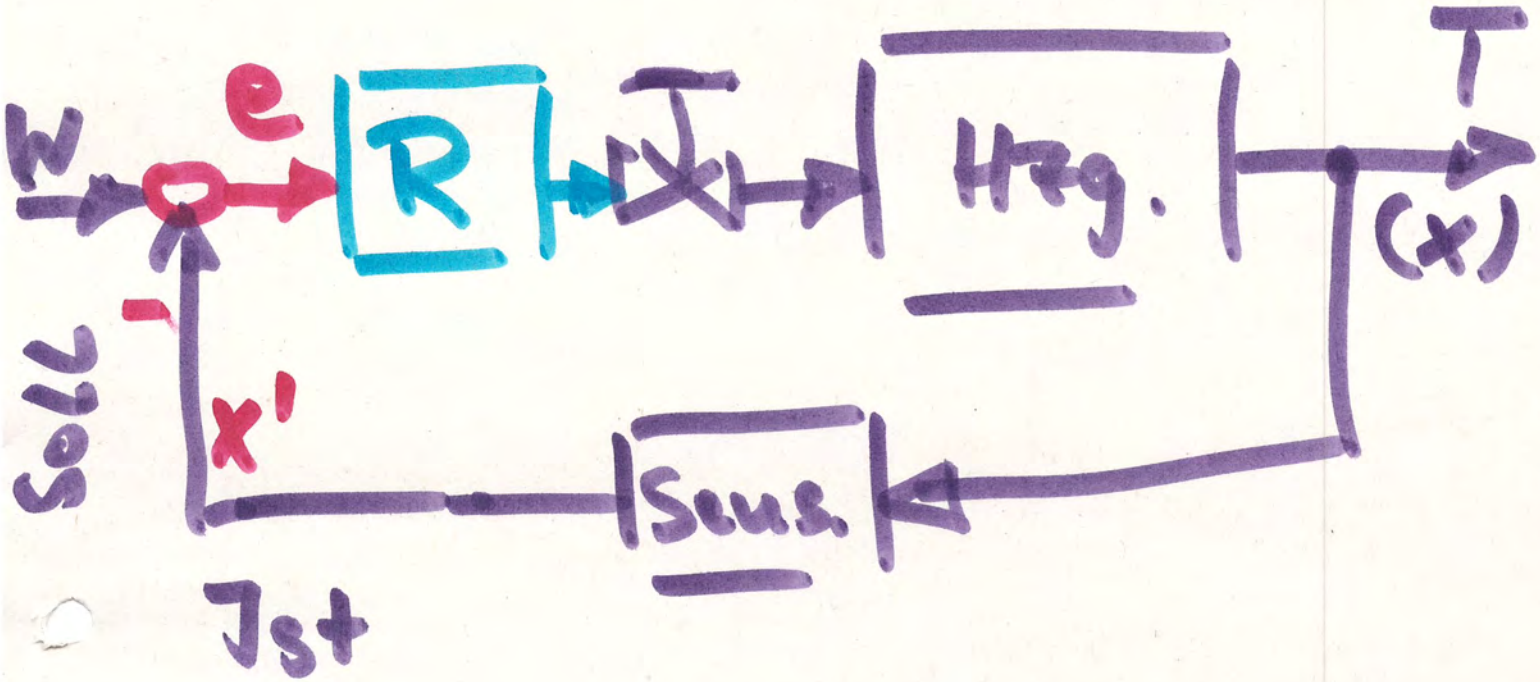
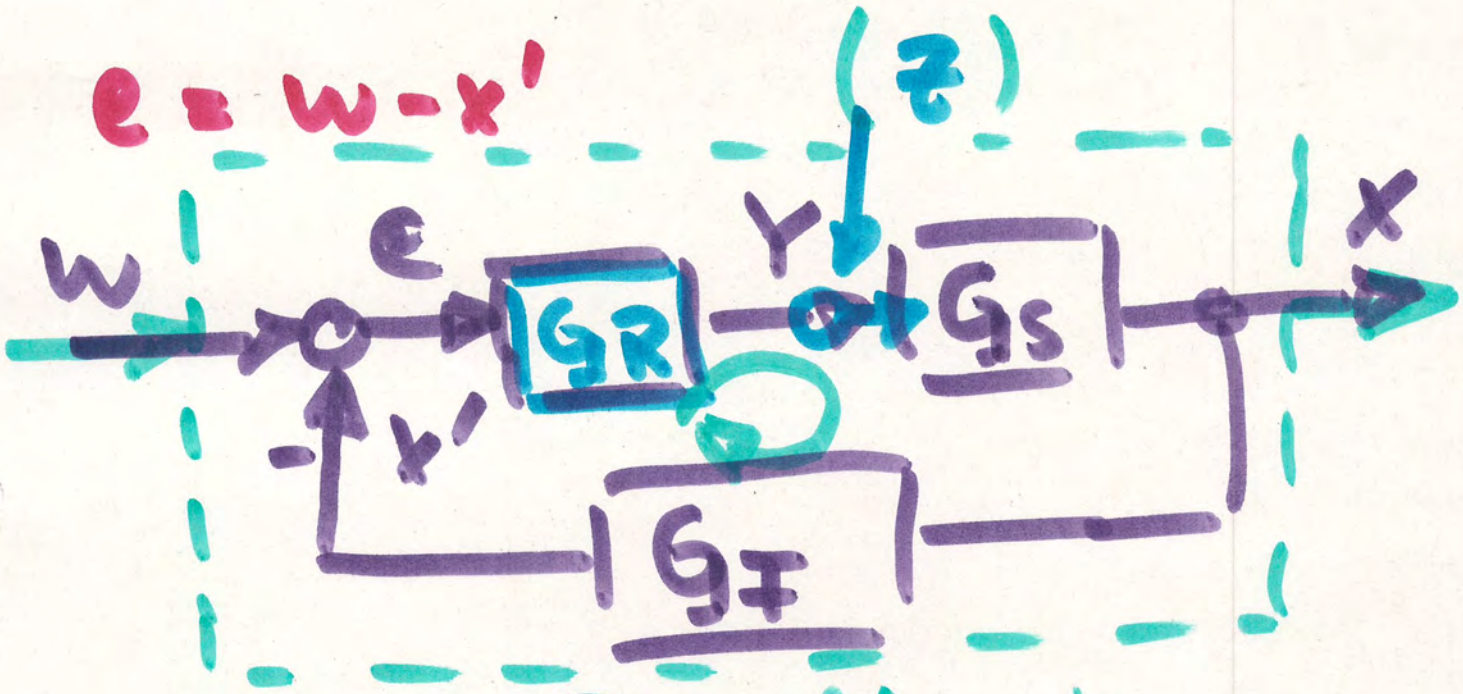
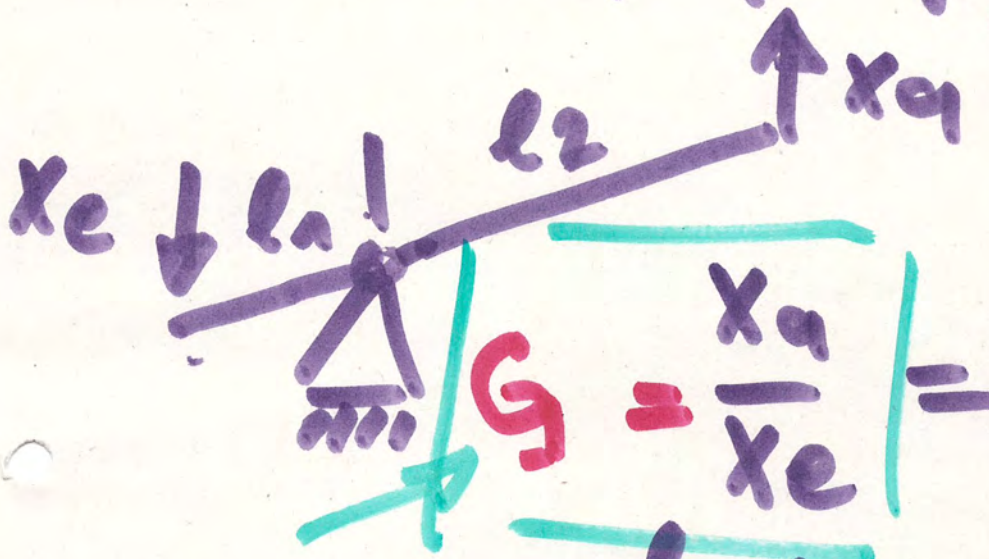
Prozess, Strecke





Regelkreis
(Rückkopplg,
Feedback)

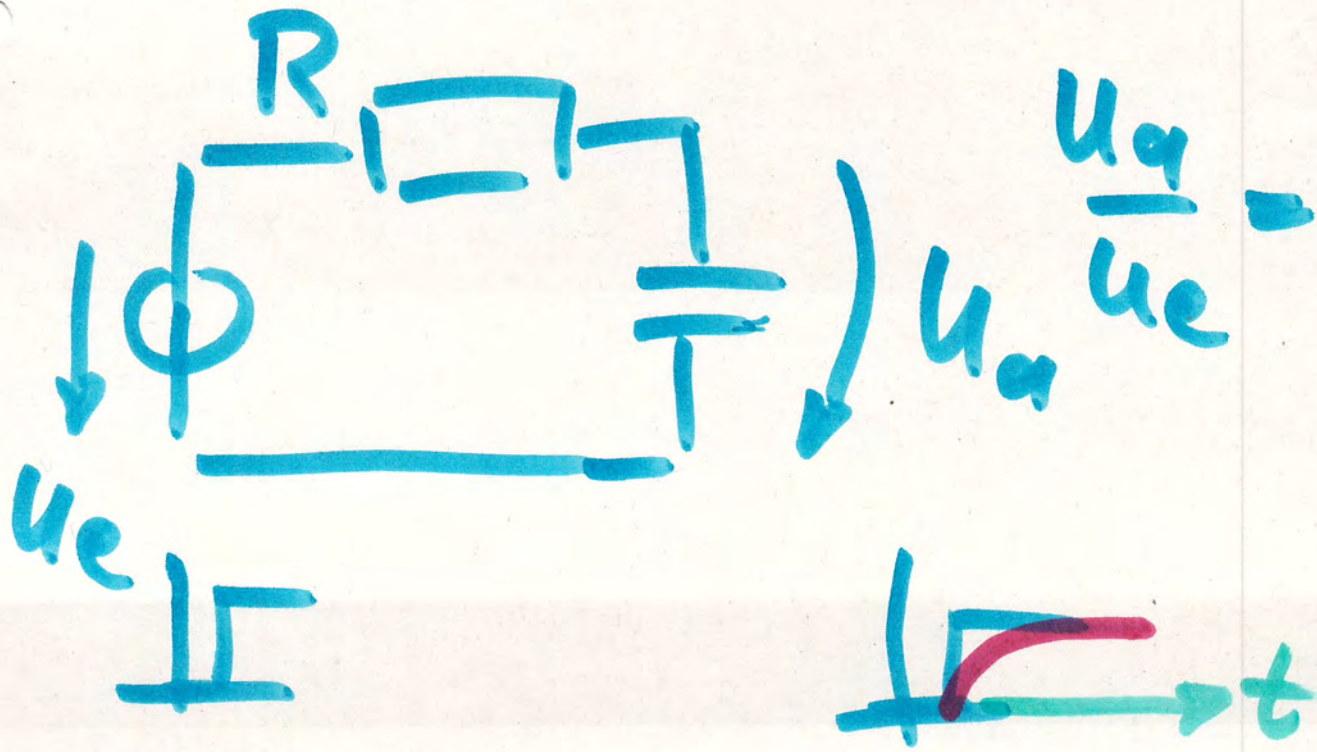
Übertragungseigenschaft / -funktion



$$G = \frac{x_a}{x_e} = \frac{l_2}{l_1} \text{ (weg)}$$

$$\rightarrow \underline{x_a = \frac{l_2}{l_1} x_e = k \cdot x_e}$$

$$\text{auch: } x_a = k' \frac{dx_e}{dt}$$



$G_R = Y/e$; $G_S = X/Y$

$G_F = x'/x$; $e = w - x'$

Ziel: $G_W = X/w$

$$X = Y \cdot G_S = e \cdot G_R \cdot G_S$$

$$= (w - x') \cdot G_R \cdot G_S$$

$$X = (w - x \cdot G_F) \cdot G_R \cdot G_S$$

$$\rightarrow \boxed{G_W = X/w = \frac{G_R G_S}{1 + G_R \cdot G_S \cdot G_F}}$$

$\rightarrow G_Z = X/Z$

$G_0 = G_R \cdot G_S \cdot G_F$

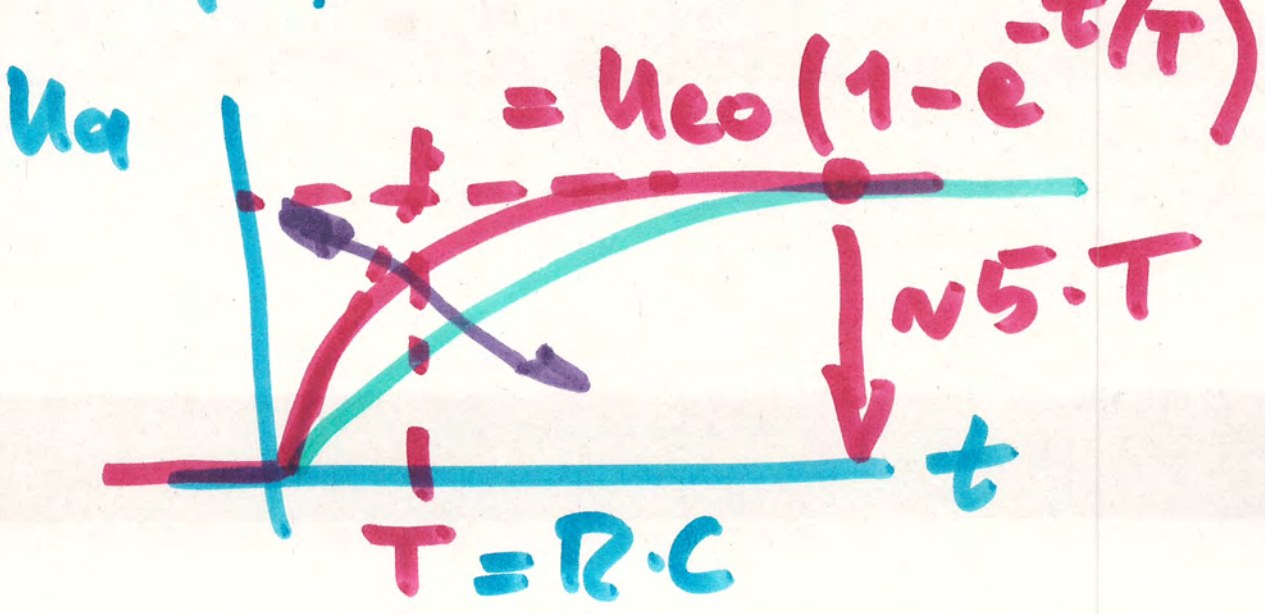
Laplace: $\frac{d}{dt} \circ\!\!-\!\!\bullet\; p$

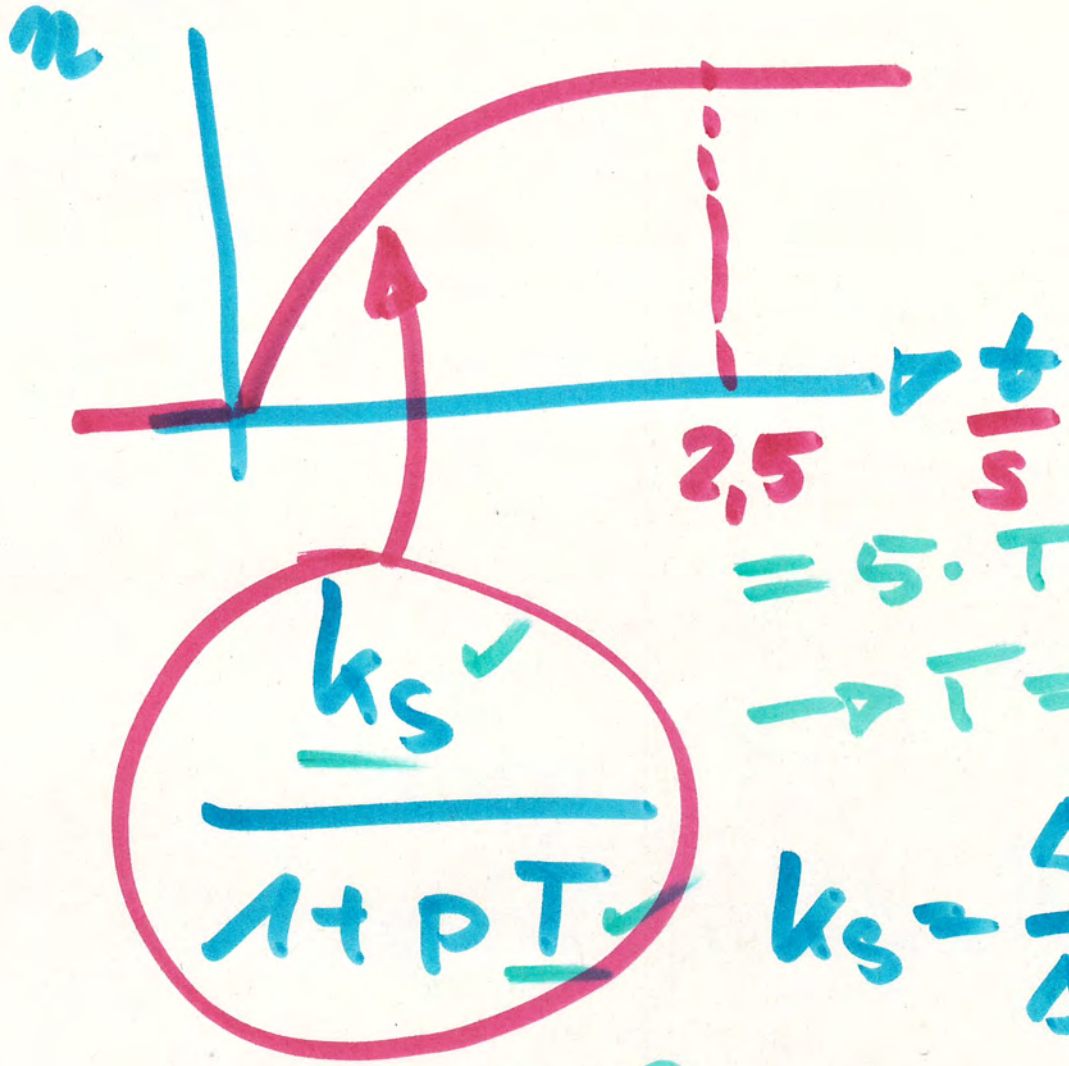
$\int dt \circ\!\!-\!\!\bullet\; 1/p$

$$u_e = u_a + R \cdot C \cdot \frac{du_a}{dt}$$

$$\circ\!\!-\!\!\bullet \quad u_e(p) = u_a(p) + T \cdot p \cdot u_a(p)$$

$$\frac{1}{1 + p \cdot T} = \frac{u_a}{u_e} = G$$





$= 5 \cdot T$

$\rightarrow T = 0{,}5\,s$

$K_S = \frac{\Delta n}{\Delta U_m} = 2$

$\Rightarrow G_S = \frac{2}{1+0{,}5 \cdot p}$

$\rightarrow G_T = 1 \; ; \; G_R = 5$

$$G_W = \frac{5 \cdot 2/(1+0{,}5 \cdot p)}{1 + 5 \cdot 2/(1+0{,}5 \cdot p) \cdot 1}$$

$\rightsquigarrow$ Standard form

1. Teilmenge beseitigen

$$= \frac{5 \cdot 2}{(1 + 0{,}5 \cdot p) + 5 \cdot 2}$$

2. Ausrechnen + Sortieren

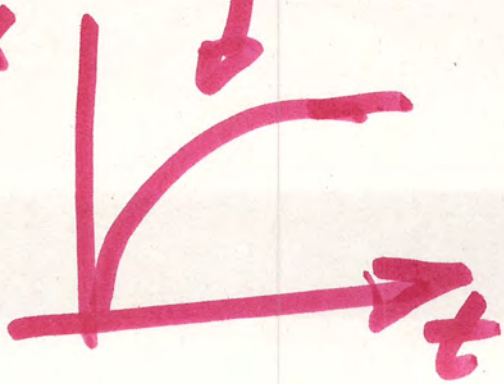
$$= \frac{10}{1 + 10 + 0{,}5 \cdot p} \quad | : 11 \quad | : 11$$

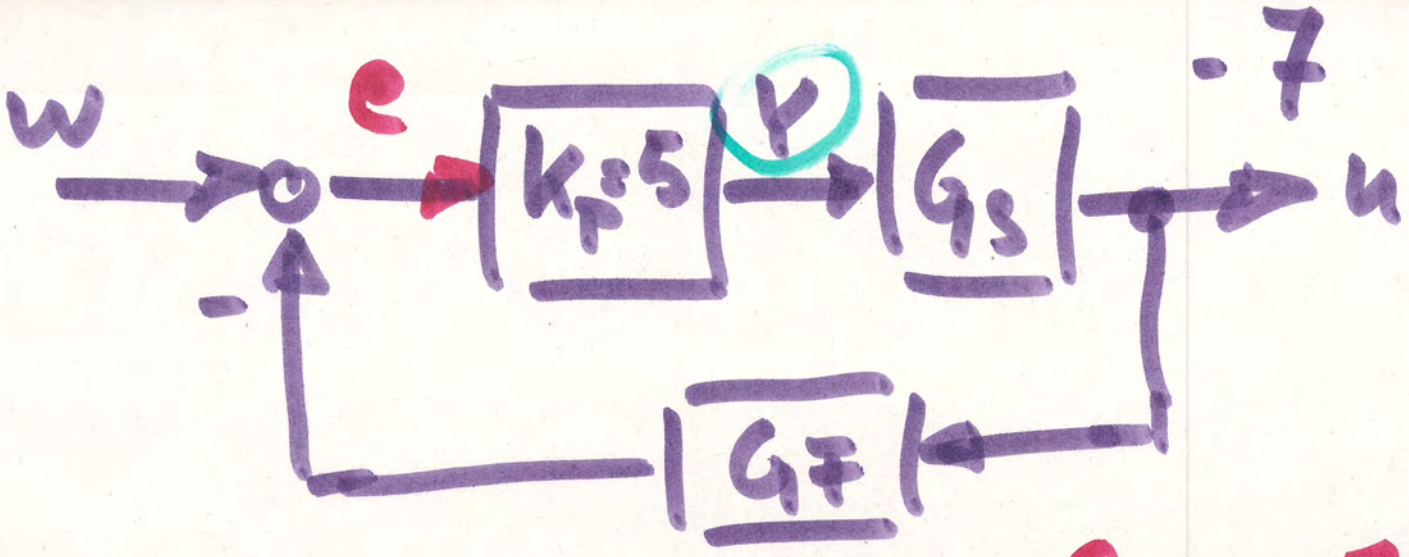
3. Normierg. (konst. im Nenner → 1)

$$G_w = \frac{10/11}{1 + p \cdot 0{,}5/11}$$

PT1

$$\lim_{p \to 0} G_w = 10/11$$





Annahme: $\lim G_w = 1$

$\rightarrow e = 0$

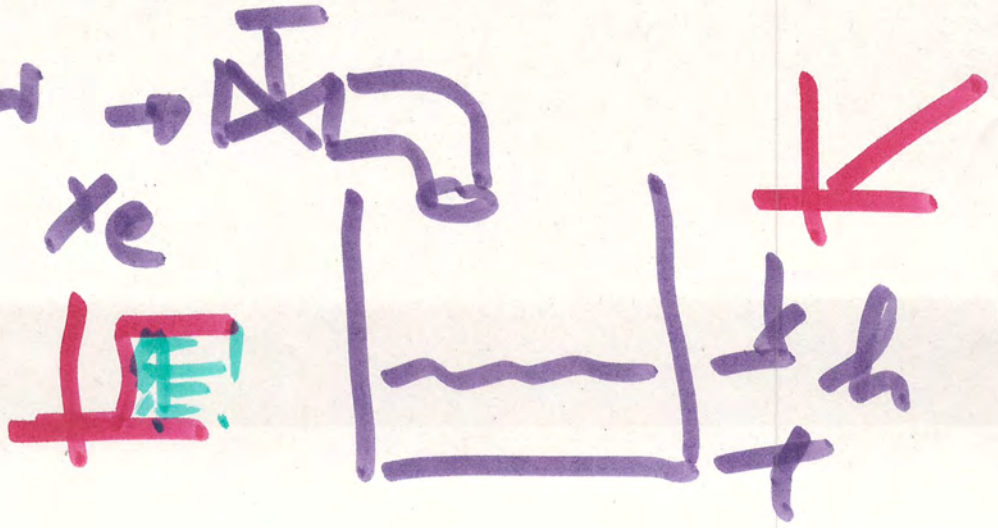
$\rightarrow y = 0\,V$

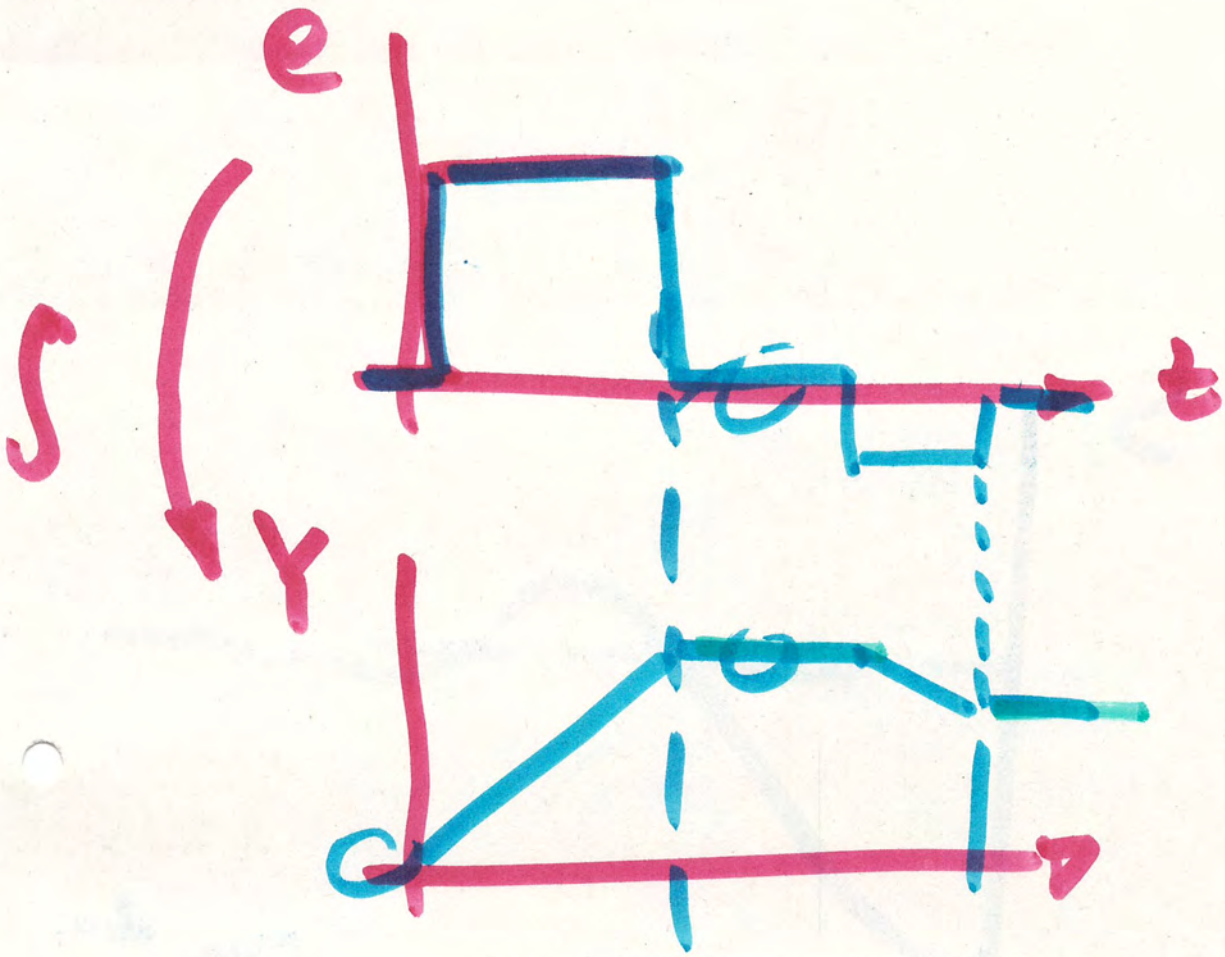
$\Rightarrow$ anderes Verhalten.

„integrierend"

$\rightarrow x_a = k_I \int x_e \, dt \rightarrow G = ?$

Behälter $\rightarrow$





$$\mathcal{L}: x_a = K_I \cdot \frac{1}{p} \cdot x_e$$

$$\rightarrow G = \frac{x_a}{x_e} = \frac{K_I}{p}$$

$$\rightarrow G_w = \frac{K_I/p \cdot 2/1+0{,}5 \cdot p}{1 + K_I/p \cdot 2/1+0{,}5 \cdot p \cdot 1}$$

$$\ldots = \frac{1}{1+2p+p^2}$$

PT_2

• Bsp. Analyse PT_2 - 9

Standard: $\frac{K_P}{1 + 2DT_0 p + T_0^2 p^2}$

$\rightarrow 2DT_0 = 2 \; ; \; T_0^2 = 1$

$2 \cdot D \cdot 1 = 2$ ⟵ $T_0 = 1$

$\rightarrow \boxed{D = 1}$ koeffizvergl.

• $P + I \rightarrow PI$

$G_P = K_P + \frac{K_I}{p}$

$= \frac{1}{p}(p \cdot K_P + K_I)$ T_N

$= \frac{K_I}{p}\left(1 + p\frac{K_P}{K_I}\right)$

$$\text{Jsp.}\quad G_R = \frac{K_P}{pT_N}(pT_N + 1)$$

kump.!

$$G_W = \frac{G_R \cdot G_S}{1 + G_R G_S \cdot G_F}$$

$L = 1$

$$1. \quad \frac{K_R}{pT_N}(1 + pT_N) \cdot \frac{0{,}8}{(1+2p)(1+0{,}5p}$$

$T_N = 2$

$$3/4. \quad G_W = \frac{3{,}5 \cdot 0{,}8/2p(1+0{,}5p}{1 + \text{-''-} \cdot 1}$$

$$= \frac{2{,}8}{2p(1+0{,}5p) + 2{,}8}$$

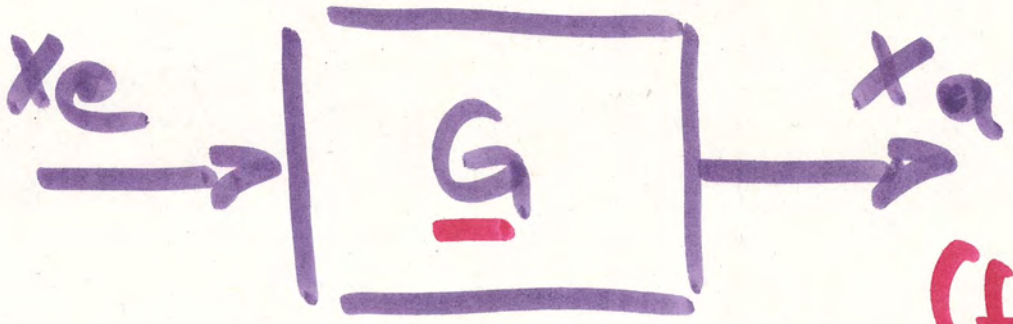
$$= \frac{2{,}8}{2p + 1p^2 + \underline{2{,}8}}$$

$$= \frac{1}{1 + \underbrace{2/2{,}8 \cdot p}_{2DT_0} + \underbrace{1/2{,}8 \cdot p^2}_{T_0^2 = 1/w_0^2}}$$

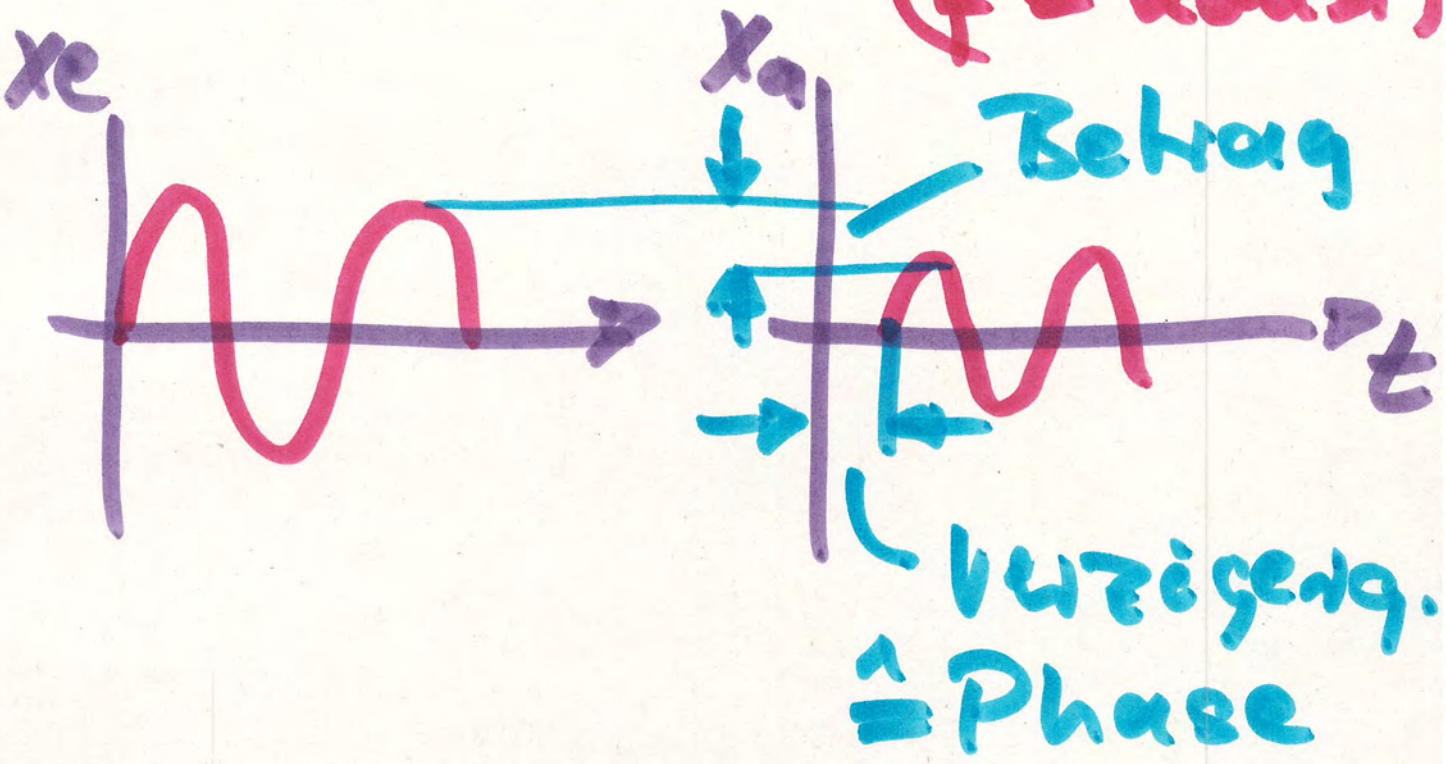
$\rightsquigarrow D = \ldots$

6. $G_w = x/w$

$$x_{stat} = \lim_{p=0} G_w \cdot w_0$$



(f = konst)



$$\mathcal{L} \xrightarrow[p \to jw]{(s)} \underline{G} = \underline{F}(jw)$$

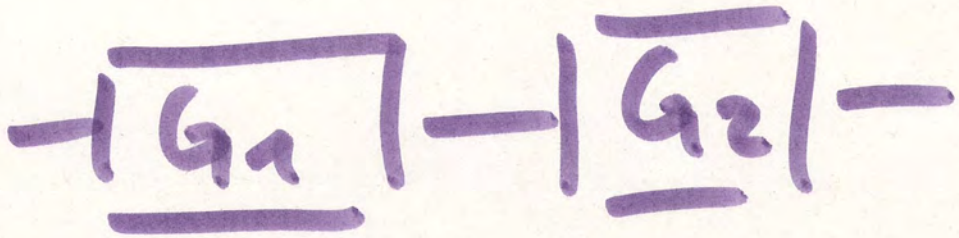
$$PT_1: \quad G = \frac{k_{\#}}{1+pT} = \frac{4}{1+jw} = \underline{G}$$

$$\ldots\ldots |G| e^{j\varphi_G}$$

Bsp

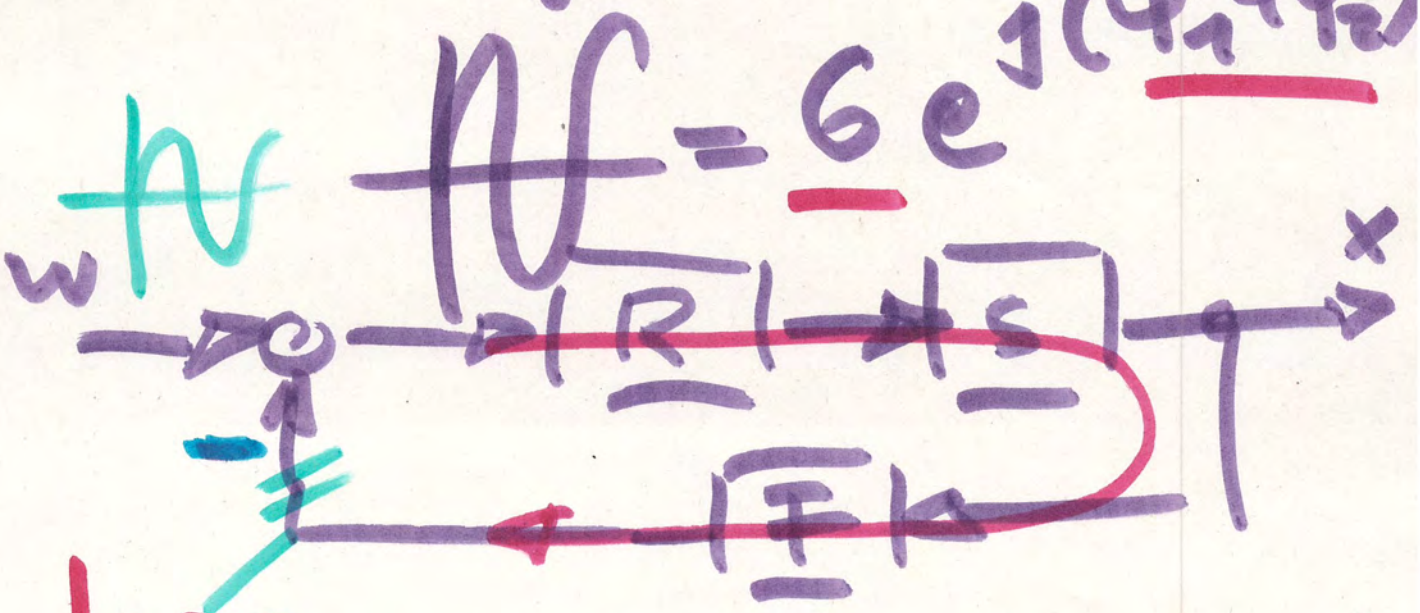
$G_1 = 2e^{j\varphi_1}$

$G_2 = 3e^{j\varphi_2}$



$\rightarrow G_{ges} = G_1 \cdot G_2$

$= 6e^{j(\varphi_1+\varphi_2)}$



$G_0 = G_R \cdot G_S \cdot G_F = -1$

Schwingbedingung