

Lösningss förlopp tentamen Stry-och Reglerth.  
09/202 för U3

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1-8. Se kursbok

9.  $t_{1/3} = 7$ ,  $t_{2/3} = 14$   $Q = \frac{t_{2/3}}{t_{1/3}} = 2$

Avläsning w F.S. diagram ger:  $\begin{cases} z = -0.4 \\ P = 1.122 \end{cases}$   
med ordn. tvl  $n=2$ .

$$T = \frac{t_{2/3}}{P \cdot (1+z)} \approx 8.9 \text{ sek}$$

$$K = \frac{\Delta y}{\Delta u} = \frac{12}{2} = 6$$

2)  $G(s) = \frac{K}{(1+sT)(1+s\alpha T)} = \frac{6}{(1+8.9s)(1+3.6s)} \quad \left( = \frac{Y(s)}{U(s)} \right)$

b)  $6 u(t) = 21.72 y''(t) + 12.5 y'(t) + y(t)$

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10. 2)  $G(s) = \frac{K}{s(1+sT)} = \frac{K}{s(1+\frac{s}{\omega_b})} = \frac{50}{(1+100s)s} \quad \left( \frac{Y(s)}{U(s)} \right)$

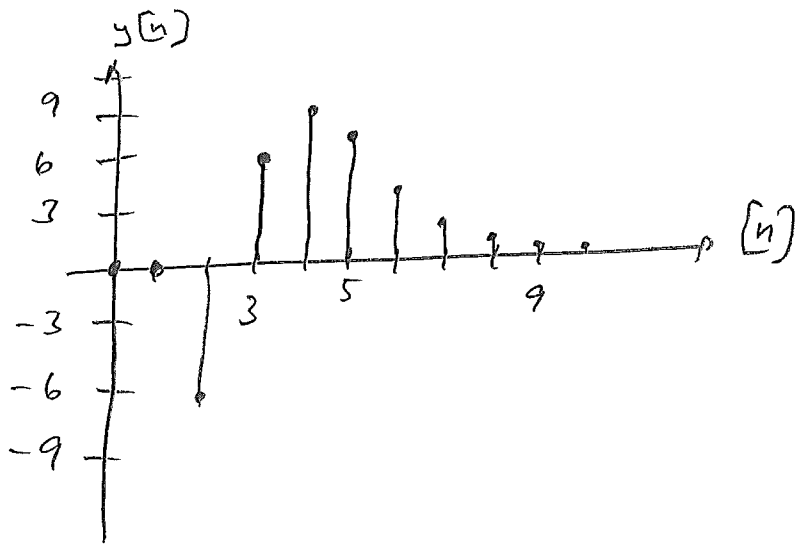
LF-asymptot

$$\left| \frac{K}{\omega} \right| = 100000$$

vid  $\omega = 0.0005$

b)  $50 \cdot u(t) = 100 y''(t) + y'(t)$

11.



$n$	$y[n] = 0.5y[n-1] + 3x[n-1]$		
0	0	0	0
1	0	0	0
2	-6	0	-6
3	6	-3	9
4	9	3	6
5	7.5	4.5	3
6	15/4	15/4	0
7	15/8	15/8	0
8	15/16	15/16	0

12.

a) se nästa sida!

b) Antag att vi har en P-pol  $p = 1$   
 i Bodediagrammet på nästa sida.

Di är det motsvarande som syns där.

Använd måttstockar:  $A_m \approx 0 \text{ dB}$  (199r)  $\Rightarrow \begin{cases} K_0 = 1 \\ \omega_T = \frac{2\sigma}{T_0} \\ \downarrow \\ T_0 = \frac{2\sigma}{3} \approx 2,15 \text{ s} \end{cases}$

$\gamma_m = 0^\circ$

Ziegler-Nichols självreglermetod:

$$\begin{cases} K = 0.45 \cdot K_0 = 0.45 \\ T_i = \frac{T_0}{1.2} = 1.75 \text{ sek} \end{cases}$$

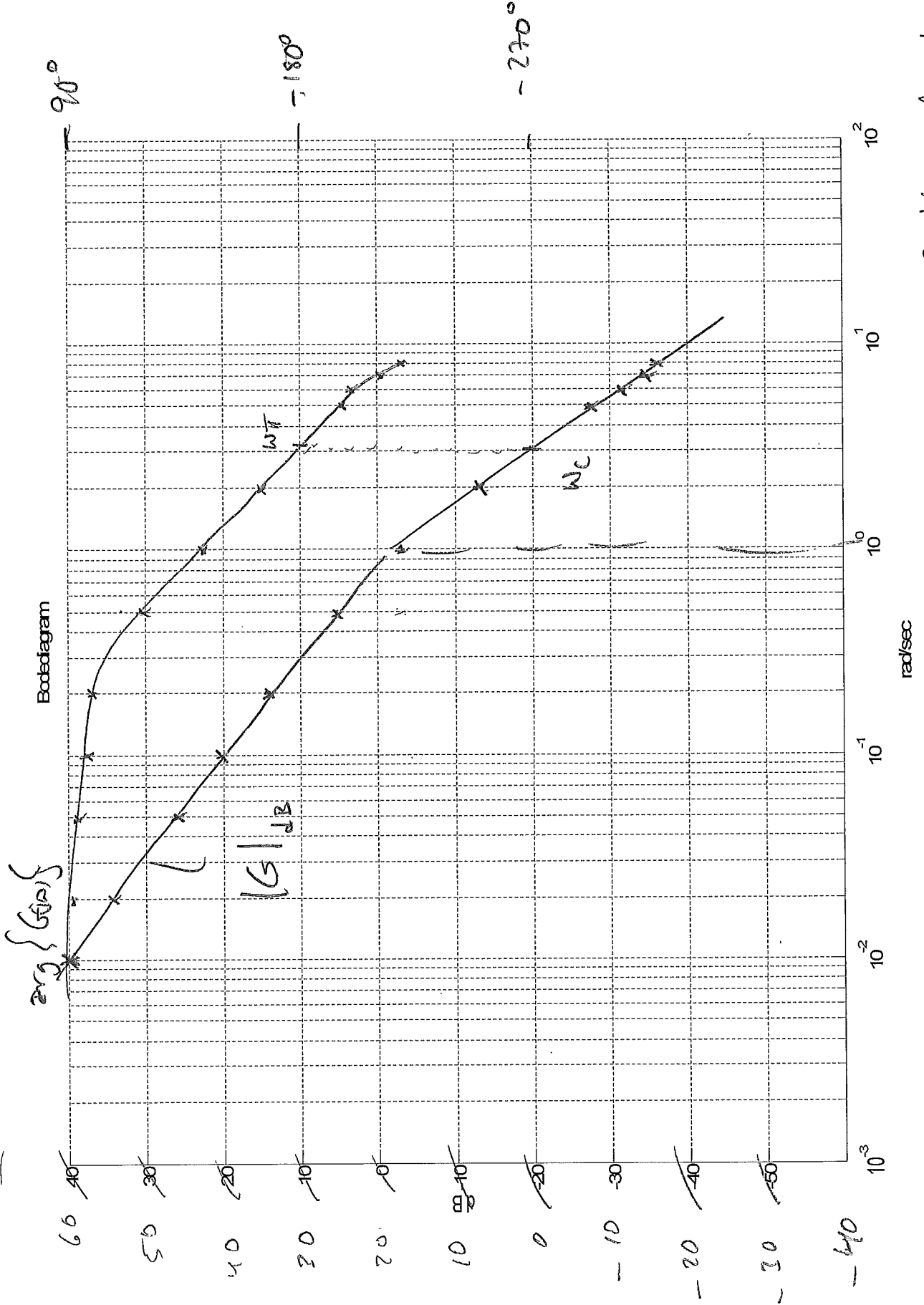
c)

$$G(s) = \frac{K e^{-sL}}{s(1+sT)}$$

processen m. integrering + död-tid + 1 tidskonstant.

12.

2)



$$\omega_c = \omega_n = 3 \text{ rad/sec} \quad A_n = 1 \Rightarrow K_0$$

13.

a)

$$M\ddot{x} + b\dot{x} + 2kx = ky$$

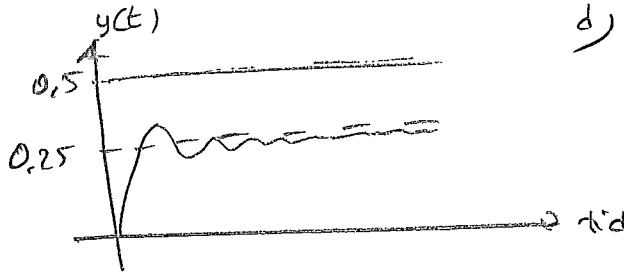
$$G(s) = \frac{Y(s)}{X(s)} = \frac{k}{Ms^2 + bs + 2k} = \frac{2}{100s^2 + 3s + 4}$$

b)

$$G(0) = \frac{1}{2}$$

$$y(\infty) = u(\infty) \cdot G(0) = \frac{1}{4} \text{ m}$$

c)



d) polerne  $\bar{z}$  komplex konj. polpe

$$s = -\frac{3}{100} \pm i \frac{\sqrt{1591}}{200}$$

14.

a)

$$1 + G_p G_R = 0$$

$$1 + \frac{10k}{10s^2 + 2s + 1} = 0$$

$$10s^2 + 2s + 1 + 10k = 0$$

R-H tabelk:

$s^2$	10	1+10k
$s^1$	2	0
$s^0$	1+10k	

$\hookrightarrow k > -\frac{1}{10}$

b)

$$e_{ss} = \frac{1}{1+K_0} \cdot 2 = \frac{1}{1+10} \cdot 2 = \frac{2}{11}$$

c)

$$1 + G_p \cdot G_R = 0$$

$$1 + \left(\frac{T_i s + 1}{T_i s}\right) \cdot \frac{10}{10s^2 + 2s + 1} = 0$$

$$10T_i s^3 + 2T_i s^2 + T_i s + 10T_i s + 10 = 0$$

$s^3$	$10T_i$	$11T_i$
$s^2$	$2T_i$	10
$s^1$	$\frac{22T_i^2 - 100T_i}{2T_i}$	0
$s^0$	10	

Krav:

$$T_i > 0$$

$$T_i > \frac{100}{22}$$

d)

$$e_{ss} = 0$$

e)

$$e_{ss} = 0$$

f)

$$e_{ss} = \frac{1}{K_1} = 1 \text{ enhet.}$$