Reg.-tek 23. feb. 2016

1a) $u_A = 15$, $y_A = 45$

Kan bare ses i fig 1.

Fig 2 inneholder bare info om dynamikken i selve arb.pkt, ikke noe om arb.pkt.

1b) Åpen sløyfe, juster u til $u_A = 15$.

Gir et sprang i u på 1, avleser respons.

1c) åpen sløyfe, juster u til $u_A = 15$. Legger på en sinus med liten amplitude, f.eks 0.5 eller 1.0

$u_{w=0.2} = 15 + 1.0 \sin(0.2t)$, $10\,dB = 3.16$

$y_{w=0.2} = 45 + 3.16 \cdot 1.0 \sin(0.2t - 80^\circ)$

$u_{w=0.5} = 15 + 1.0 \sin(0.5t)$, $17\,dB = 4.4$

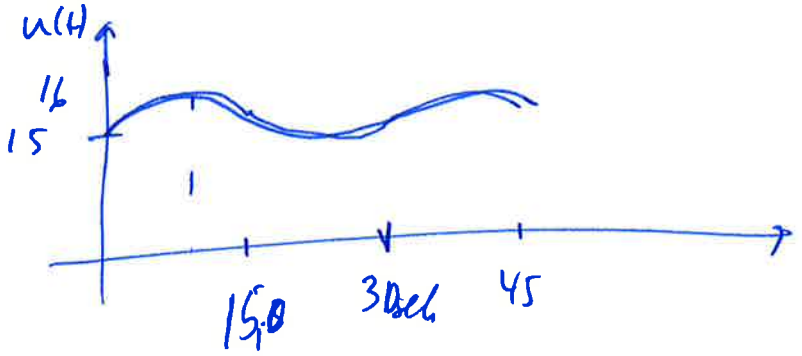
$y_{w=0.5} = 45 + 4.4 \cdot 1.0 \sin(0.5t - 190^\circ)$

1d) Det betyr at amplituden i sinus signalet må være små, f.eks 0.1, 0.5 eller 1.0

1.0 av totalt område på 20 er 5% av u

1e)

1e)

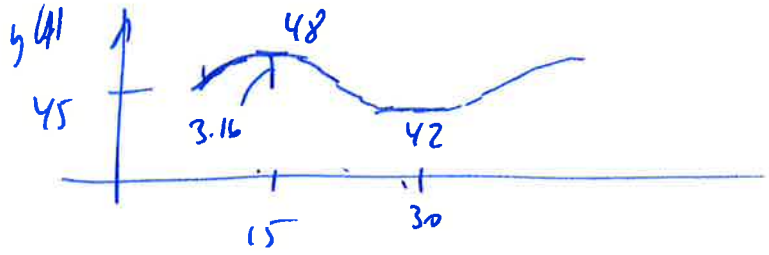


$\omega = 0.2$

$T_p = 6.28 \times 5$

$= \underline{31 \text{ sek}}$

~~$u(t) = 15$~~



1f) Ser ut som andre orden underdempet med ledd

1g) Overslingsfaktor: $\delta = \dfrac{y_{max} - y_s}{y_s}$ (omkring y_t)

$= \dfrac{(50-45) - (48.5-45)}{48.5-45}$

$= \dfrac{5 - 3.5}{3.5} = 0.42$

$\delta = 0.42 \Rightarrow \underline{\zeta = 0.26}$

Resonnstopp i $\omega_0 = 1$

$\tau = 6$ sek

Responstid: $48.5 - 45 = 3.5$

$0.63 \times 3.5 = 2.2$

$45 + 2.2 = \underline{47.2}$

Tiden for $y = 47.2$ er ca 11.5 sek

$T_r \approx 1.5$ sek

$T_r \approx \dfrac{1.5}{\omega_0} = \dfrac{1.5}{1}$ ok

(g) fint K avlæses ved stasjonær K.

$$K = 10\ dB = 3.16$$

$$H(s) = \frac{3.16}{\frac{s^2}{\omega_0^2} + 2\frac{\zeta}{\omega_0}s + 1} \cdot e^{-\tau s}$$

$$= \frac{3.16}{s^2 + 0.52s + 1} e^{-6s}$$

(h) anta $\omega_0 = 1 \Rightarrow$ fase $= -90°$

Avlest $= -440$

Differanse $= -350°$ som stemmer bedre

Fase: $\tau\omega$ [rad]

$= 6 \cdot 1.0 = 6.0$ rad. $= 6.0 \frac{360}{2\pi}$

$= 343°$

Se at det stemmer bra

2)

a) poler i: $(10s+1)(s+10) = 0$

$p = -0.1$

$p = -10$ ⇒ bra utan impuls på ingången.

asymp. stabilt.

b) $H(s) = \frac{6}{(10s+1)(s+10)}$

$$|H(j\omega)| = \frac{6}{\sqrt{10^2\omega^2+1}\sqrt{\omega^2+10^2}}$$

$$\angle H(j\omega) = -\operatorname{atan}\left(\frac{10\omega}{1}\right) - \operatorname{atan}\left(\frac{\omega}{10}\right)$$

c) $u(t) = 0.2\sin(0.5t)$

$$|H(j\omega)| = |H(j0.5)| = \frac{6}{\sqrt{10^2 \cdot 0.5^2+1}\sqrt{0.5^2+10}}$$

$$= \frac{6}{\sqrt{26}\cdot\sqrt{11.25}} = 0.36$$

$$\angle H(j0.5) = -\operatorname{atan}(10\cdot 0.5) - \operatorname{atan}\left(\frac{0.5}{10}\right)$$

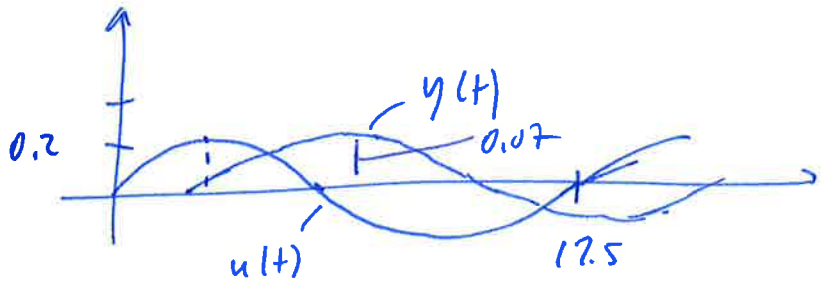
$$= -\operatorname{atan}(5) - \operatorname{atan}(0.05)$$

$$= -81^\circ$$

$$y(t) = 0.2 \cdot 0.36 \cdot \sin(0.5t - 81^\circ)$$

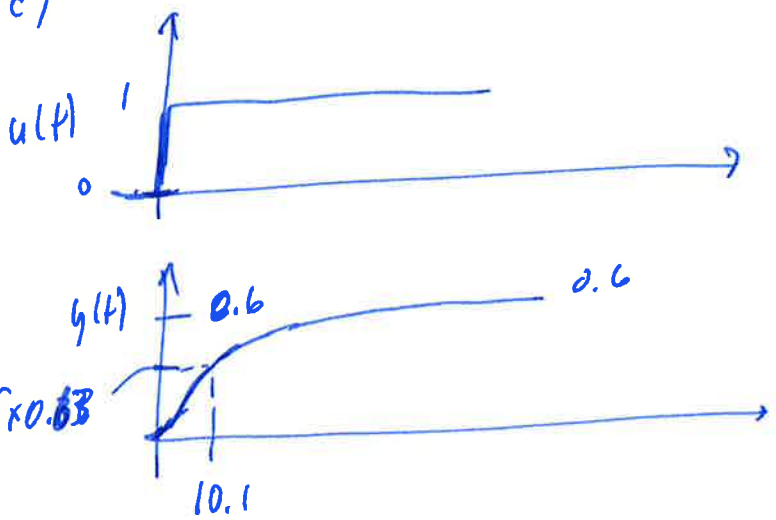
$$= 0.07\sin(0.5t - 81^\circ)$$

c)



$$T_p = \frac{2\pi}{\omega} = \frac{6.2\pi}{0.5} \approx 12.5$$

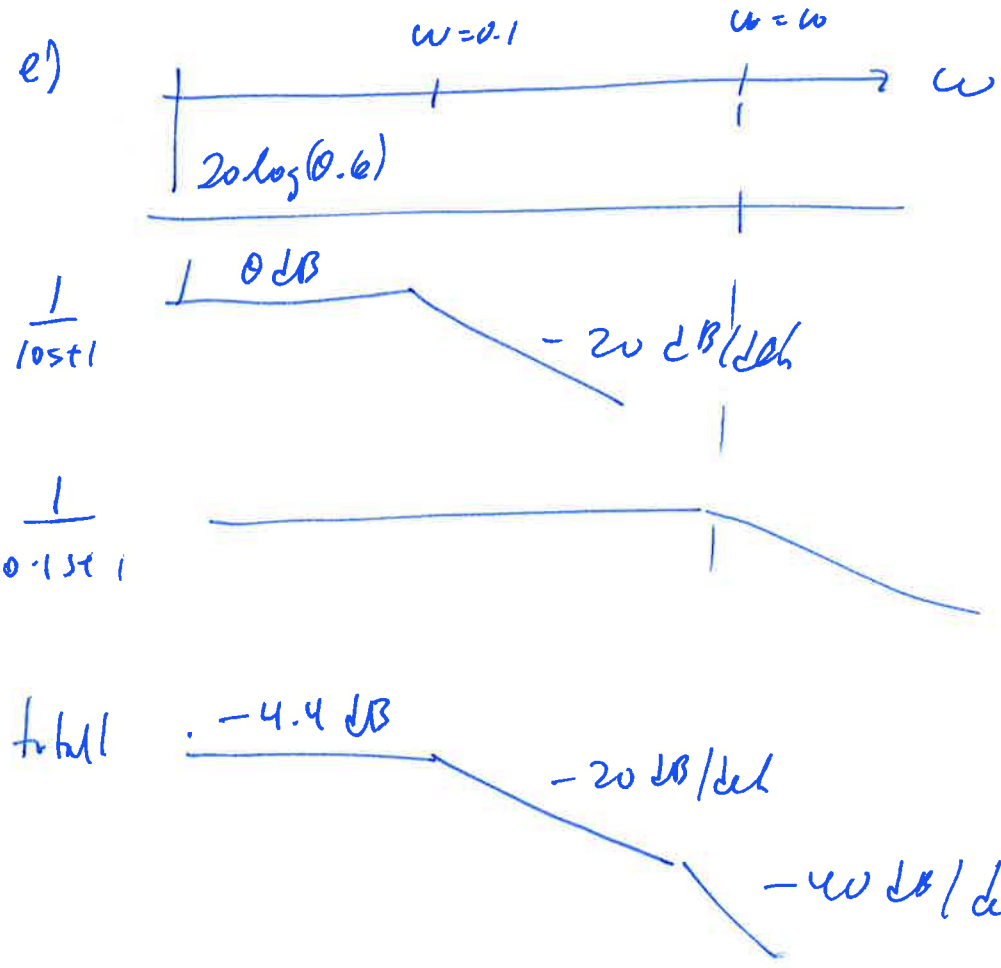
d)



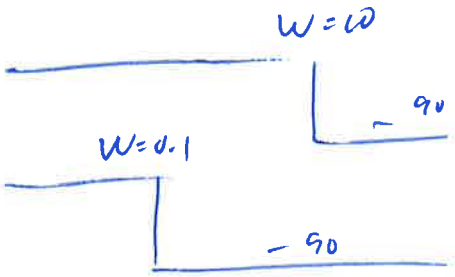
$$H(s) = \frac{6}{(10s+1)(s+10)} \cdot \frac{\frac{1}{10}}{\frac{1}{10}} = \frac{0.6}{(10s+1)(0.1s+1)}$$

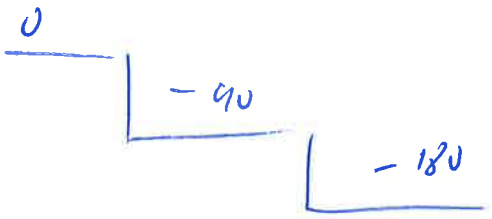
Kan forenkles til $H_p(s) = \frac{0.6}{10s+1}$ vask dynamikk neglisjeres.

e)



e)





f) $T_i = T = 10$ $\quad K_p = \frac{T}{T_n \cdot K}$, velger T_n minste enn T, f.eks. 2sek

Dette for å få raskeste reg.

$$K_p = \frac{10}{2 \cdot 0.6} = \frac{10}{1.2}$$

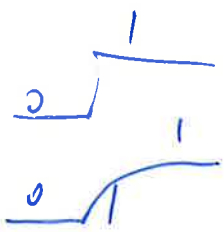
g) $$H_0(s) = \frac{K_p(T_i s + 1)}{T_i s} \cdot \frac{0.6}{10s+1} = \frac{K_p \cdot 0.6}{T_i \cdot s} = \frac{\frac{10}{1.2} \cdot 0.6}{10s} = \frac{0.5}{s}$$

↑ dersom finner t

h) $$W(s) = \frac{H_0(s)}{1 + H_0(s)} = \frac{\frac{0.5}{s}}{1 + \frac{0.5}{s}} = \frac{1}{2s+1}$$

↑ T_n

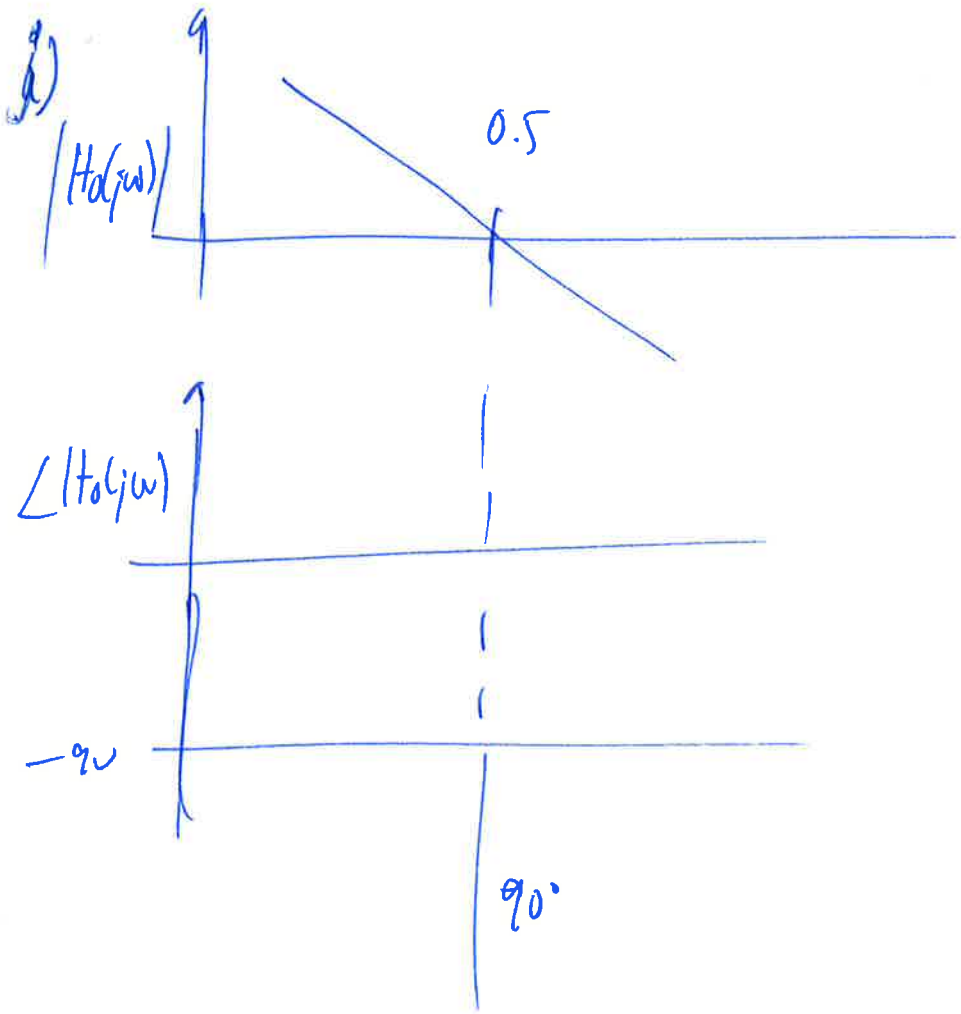
i)



som forventet

$T_n = T = 2$ sek

d)



Lösung handelt

$\varphi = 90°$, $\Delta K = \infty$