1) 1.1) $m\dot{v} = F_U + F_f - C v(t)^2$, $m = 1000\,kg$, $C = 3\,Ns/m$, $V_a = 30\,m/s$

$F_{f_a} = 0$

$$\left.\frac{\partial f}{\partial F_U}\right|_a = 1$$

$$\left.\frac{\partial f}{\partial F_f}\right|_a = 1$$

$$\frac{\partial f}{\partial v(t)} = -2CV_a$$

$$m\Delta\dot{v}(t) = \left.\frac{\partial f}{\partial F_U}\right|_a \cdot \Delta F_U + \left.\frac{\partial f}{\partial F_f}\right|_a \Delta F_f + \left.\frac{\partial f}{\partial V}\right|_a \cdot \Delta V$$

$$= \underline{\underline{\Delta F_U(t) + \Delta F_f(t) - 2CV_a\Delta V(t)}}$$

1.2)

$$m\Delta\dot{v}(t) = \Delta F_U(t) + \Delta F_f(t) - 2CV_a\Delta V(t)$$

$$m\dot{y} = U(t) + V(t) - D_a y(t)$$

pådrag (motorkr.) Forrstyrrelse måling (Chastighet)

$D_a = \underline{\underline{180}}$

8)

2.1) $V = 700\,N$

$m\Delta\dot{y} = \Delta U + \Delta V - 180\Delta y$

$\Delta y = y - y_a$

$y = \Delta y - y_a$

$$m\,s\,\Delta y(s) = \Delta U(s) + \Delta V(s) - 180\,\Delta y(s)$$

$$\Rightarrow (ms + 180)\Delta y(s) = \Delta V + \Delta U$$

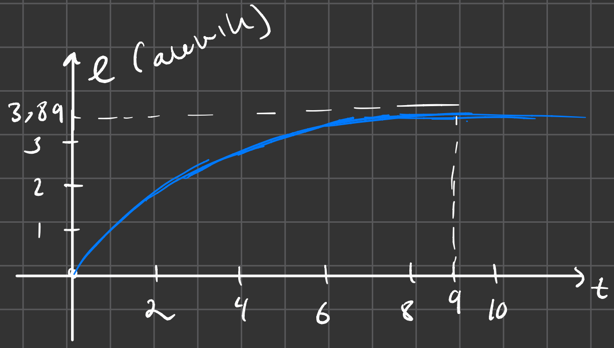
$$\Rightarrow \Delta y(s) = \frac{\overset{\frac{700}{s}}{\Delta V} + \overset{=0}{\Delta U}}{ms+180} = \frac{700}{s(ms+180)} = \frac{700}{s(1000s+180)}$$

$$= \frac{700}{s\left(s + \frac{180}{1000}\right)1000} = \frac{0{,}7}{s(s+0{,}18)} = \frac{3{,}89 \cdot 0{,}18}{s(s+0{,}18)}$$

$\mathcal{L}^{-1}$:

$$\underline{\underline{3{,}89\left(1 - e^{-0{,}18t}\right)}}$$

2.2)



2.3) $\Delta y(s) = \dfrac{\Delta V(s) + \Delta U(s)}{ms + D_a}$ ← ser fra hvert bidrag.

y:

$\Rightarrow h(s) = \dfrac{\Delta y(s)}{\Delta V(s)} = \dfrac{1}{ms + D_a} = \underline{\underline{\dfrac{1}{1000s + 180}}}$

2:

$\Rightarrow h(s) = \dfrac{\Delta y(s)}{\Delta U(s)} = \dfrac{1}{ms + D_a} = \underline{\underline{\dfrac{1}{1000s + 180}}}$

$\Delta y = y - y_a$

3.1) $u(t) = K_p(r(t) - y(t))$

ønsket hastighet, $y = \underline{30\ m/s} \Rightarrow \underline{r = 0\ \frac{m}{s}}$, $K_p = \underline{\underline{2000}}\ Ns/m$

Vi har: $m\dot{y} = -D_a y(t) + U(t) + V(t)$

$\Rightarrow m\dot{y} = -D_a y(t) + K_p(r(t) - y(t)) + V(t)$
$= -D_a y(t) + K_p r(t) - K_p y(t) + V(t)$

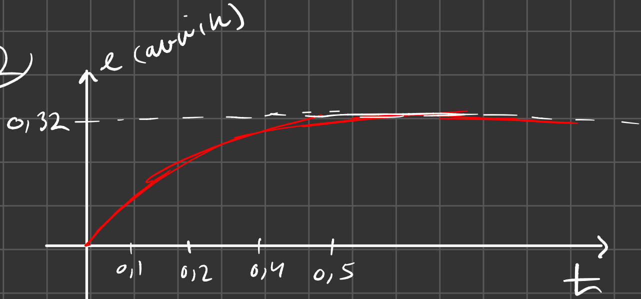
L:
$\Rightarrow (ms + D_a + K_p) y(s) = K_p r(s) + V(s)$

$y(s) = \dfrac{\cancel{K_p r(s)} + V(s)^{=\frac{V}{s}}}{ms + D_a + K_p} = \dfrac{\frac{V}{s}}{ms + D_a + K_p}$

$$= \frac{\frac{V}{sm}}{s + \frac{Da+kp}{m}} = \frac{\frac{V}{m}}{s\left(s+\frac{Da+kp}{m}\right)}$$

$$= \frac{\frac{V}{kp+Da}\cdot\frac{kp+Da}{m}}{s\left(s+\frac{kp+Da}{m}\right)} \Rightarrow \mathcal{L}^{-1}: \; y(t) = \frac{V}{kp+Da}\left(1-e^{-\frac{kp+Da}{m}t}\right)$$

3.2)



4.)

1) $h_{ry}(s) = \frac{y(s)}{r(s)} = \frac{kp}{ms+Da+kp} = \frac{\frac{kp}{kp+Da}}{1+\frac{m}{kp+Da}s}$

2) $h_{ry}(s) = \frac{K}{1+Ts}$, $k=0{,}92$, $T=0{,}46$

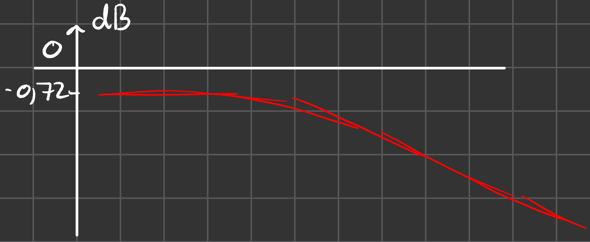
$\Rightarrow h(j\omega) = \frac{k}{1+j\omega T}$; $|h(j\omega)| = \frac{k}{1+j\omega T}$, $\angle h(j\omega) = -\tan^{-1}(\omega T)$

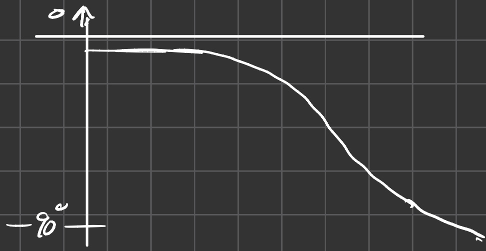
$dB = 20\log(X)$ $\quad |h(j\omega)| \xrightarrow[\omega\to 0]{} K = 20\log(0{,}92) = -0{,}72dB$

$|h(j\omega)| \xrightarrow[\omega\to\infty]{} \frac{k}{\omega T} = \frac{2}{j\omega}$

$\angle h(j\omega) \xrightarrow[\omega\to 0]{} 0$

$\angle h(j\omega) \xrightarrow[\omega\infty]{} -90°$


dB
0
-0,72


0
-90°