$\ddot{x}(\tau) + 3\dot{x}(\tau) + 2x(\tau) = 0$

$\lambda^2 + 3\lambda + 2 = (\lambda+1)(\lambda+2)$

$\left(\frac{d}{d\tau}+1\right)\left(\frac{d}{d\tau}+2\right)x(\tau) = 0$

$\left(\frac{d}{d\tau}\cdot\frac{d}{d\tau} + 2\frac{d}{d\tau} + \frac{d}{d\tau} + 2\right)x(\tau) = 0$

$\frac{d^2}{d\tau^2}x(\tau) + 3\frac{d}{d\tau}x(\tau) + 2x(\tau) = 0$

bruk

Hjelpevariabel

$y(\tau) = \left(\frac{d}{d\tau}+2\right)x(\tau) = \dot{x}(\tau) + 2x(\tau)$

$\left(\frac{d}{d\tau}+1\right)y(\tau) = 0$

$\dot{y}(\tau) + y(\tau) = 0$

$y(\tau) = c_1 e^{-\tau}$

$\dot{x}(\tau) + 2x(\tau) = c_1 e^{-\tau}$

$\dot{x} = -2x + c_1 e^{-\tau} \quad | \circ$

$x = c_2 e^{-2\tau} + c_1 \int_0^\tau e^{2(s-\tau)} e^{-s}\, ds$? ?

$= c_2 e^{-2\tau} + c_1 \int_0^\tau e^{s-2\tau}\, ds$

$= c_2 e^{-2\tau} - c_1 e^{-\tau}$

$x = c_2 e^{-2\tau} - c_1 e^{-\tau}$

$a_2\ddot{x}(\tau) + a_1\dot{x}(\tau) + a_0(\tau) = 0$

$x(\tau) = c_1 e^{\lambda_1 \tau} + c_2 e^{\lambda_2 \tau}$

$\dot{x}(\tau) + \lambda x(\tau) = f(\tau) \qquad x(0) = x_0$

gjett på $\quad x(\tau) = c(\tau) e^{-\lambda \tau} \qquad\qquad (c(\tau) e^{-\lambda\tau})' = \dot{c}(\tau) e^{-\lambda\tau} - \lambda c(\tau) e^{-\lambda\tau}$

$$\underbrace{\dot{c}(\tau) e^{-\lambda\tau} - \lambda c(\tau) e^{-\lambda\tau}}_{\dot{x}(\tau)} + \lambda \underbrace{c(\tau) e^{-\lambda\tau}}_{x(\tau)} = f(\tau)$$

$$\dot{c}(\tau) e^{-\lambda\tau} = f(\tau) \quad \Big| \cdot e^{\lambda\tau}$$

$$\dot{c}(\tau) = f(\tau) e^{\lambda\tau} \quad \Big| \cdot \int$$

$$c(\tau) = \int_0^\tau f(s) e^{\lambda s} \, ds$$

$$x(\tau) = c(\tau) e^{-\lambda\tau} = e^{-\lambda\tau} \int_0^\tau f(s) e^{\lambda s}$$

$\dot{x}(\tau) + \lambda x(\tau) = f(\tau) \qquad x(0) = 0 \Rightarrow x(0) = x_0 \qquad\qquad (x_0 e^{-\lambda\tau})' = -\lambda x_0 e^{-\lambda\tau}$

$$-\lambda x_0 e^{\lambda\tau} + \lambda x_0 e^{\lambda\tau} = f(0)$$

$$f(0) = 0$$

$$x(\tau) = x_0 e^{-\lambda\tau} + e^{-\lambda\tau} \int_0^\tau f(s) e^{\lambda s} \, ds$$

$$x(\tau) = x_0 e^{-\lambda\tau} + \int_0^\tau f(s) e^{\lambda(\tau - s)} \, ds$$

$x_0 e^{-\lambda\tau} = x_h \quad$ homogen løsning

$\int_0^\tau f(s) e^{\lambda(\tau - s)} ds = x_p \quad$ partikulær løsning

$$x(\tau) = x_h(\tau) + x_p(\tau)$$

$$\ddot{x}(\tau) + 3\dot{x}(\tau) + 2x(\tau) = 0$$

$$\lambda^2 + 3\lambda + 2 = (\lambda+1)(\lambda+2)$$

$$\left(\frac{d}{d\tau}+1\right)\left(\frac{d}{d\tau}+2\right)x(\tau) = 0$$

$$y(\tau) = \left(\frac{d}{d\tau}+2\right)x(\tau) = \dot{x}(\tau) + 2x(\tau)$$

$$0 = \left(\frac{d}{d\tau}+1\right)y(\tau) = \dot{y}(\tau) + y(\tau)$$

$$y(\tau) = c_1 e^{-\tau}$$

$$\dot{x}(\tau) + 2x(\tau) = c_1 e^{-\tau}$$

$$c_1 e^{-\tau} = f(\tau) \qquad x(0) = c_2 e^{-2\tau}$$

$$c_1 e^{-s}$$

$$x(\tau) = c_2 e^{-2\tau} + c_1 \int_0^\tau e^{-2(\tau-s)} e^{-s}\, ds$$

$$= c_2 e^{-2\tau} + c_1 \int_0^\tau e^{2(s-\tau)} e^{-s}\, ds$$

$$= c_2 e^{-2\tau} + c_1 \int_0^\tau e^{s-2\tau}\, ds$$

$$= c_2 e^{-2\tau} - c_1 e^{-\tau}\, ds$$

c_1 & c_2 er vilkårlige konstanter

$$x(\tau) = c_1 e^{-\tau} + c_2 e^{-2\tau}$$

$$a_2\ddot{x} + a_1\dot{x} + a_0 x = 0$$

$$x(\tau) = c_1 e^{\lambda_1 \tau} + c_2 e^{\lambda_2 \tau}$$

λ_1 & λ_2 rødder til karakteristisk polynom

$$a_2\lambda^2 + a_1\lambda + a_0 = a_2(\lambda-\lambda_1)(\lambda-\lambda_2)$$

$\ddot{x} + a_1 \dot{x} + a_0 x = 0$

$\delta = -\frac{a_1}{2} \qquad \omega_0 = \left| \frac{\sqrt{a_1^2 - 4a_0}}{2} \right|$

Tilfeller

1. $a_1^2 - 4a_0 > 0 \Rightarrow$ 2 reelle røtter

$\lambda = \delta \pm \omega_0$

$x(t) = c_1 e^{(\delta + \omega)t} + c_2 e^{(\delta - \omega)t}$

$= e^{\delta t}(c_1 e^{\omega t} + c_2 e^{-\omega t})$

2. $a_1^2 - 4a_0 = 0 \Rightarrow$ dobbel rot $\lambda = \delta$

$x(t) = c_1 e^{\delta t} + c_2 t e^{\delta t}$

3. $a_1^2 - 4a_0 < 0$

$\lambda = \frac{-a_1 \pm \sqrt{a_1^2 - 4a_0}}{2} = -\frac{a_1}{2} \pm i \frac{\sqrt{4a_0 - a_1^2}}{2} = \delta \pm i\omega_0$

$x(t) = c_1 e^{(\delta + i\omega_0)t} + c_2 e^{(\delta - i\omega_0)t}$

$= e^{\delta t}(c_1 e^{i\omega_0 t} + c_2 e^{-i\omega_0 t}) \qquad d_1 = c_1 + c_2, \quad d_2 = i(c_1 - c_2)$

$= e^{\delta t}(d_1 \cos(\omega_0 t) + d_2 \sin(\omega_0 t))$

2) $a_1 = a_0 = 1$

$\delta = -\frac{a_1}{2} = -\frac{1}{2} \quad \omega_0 = \left| \frac{\sqrt{a_1^2 - 4a_0}}{2} \right| = \left| \frac{\sqrt{1 - 4}}{2} \right| = \frac{\sqrt{3}}{2} \quad i$

$x(t) = e^{-\frac{1}{2}t}\left(d_1 \cos\left(\frac{\sqrt{3}}{2} t\right) + d_2 \sin\left(\frac{\sqrt{3}}{2} t\right)\right)$

3) $a_1 = 2 \quad a_0 = 1$

$\delta = -\frac{2}{2} = -1$

$\omega_0 = \left| \frac{\sqrt{2^2 - 4}}{2} \right| = 0$

$x(\tau) = C_1 e^{-\tau} + C_2 \tau e^{-\tau}$

4) $a_1 = 0 \quad a_0 = 1$

$\delta = -\frac{0}{2} = 0$

$\omega = \left| \frac{\sqrt{0^2 - 4a_0}}{2} \right| \Rightarrow i\omega_0 = \left| \frac{\sqrt{4}}{2} \cdot i \right| = i$

$x = d_1 \cos(\tau) + d_2 \sin(\tau)$

5) $a_1 = 3, \quad a_0 = 1$

$\delta = -\frac{3}{2} \qquad \omega_0 = \left| \frac{\sqrt{9 - 4}}{2} \right| = \frac{\sqrt{5}}{2}$

$x = e^{-\frac{3}{2}\tau} \left(C_1 e^{\frac{\sqrt{5}}{2}\tau} + C_2 e^{-\frac{\sqrt{5}}{2}\tau} \right)$

$$\ddot{x} + \frac{k}{m}x = 0$$

$$x(t) = c_1 \cos\left(\sqrt{\frac{k}{m}}\,t\right) + c_2 \sin\left(\sqrt{\frac{k}{m}}\,t\right)$$

b) $x(0) = 1$, $\dot{x}(0) = 0$

$$\dot{x}(t) = -\sqrt{\frac{k}{m}}\,c_1 \sin\left(\sqrt{\frac{k}{m}}\,t\right) + \sqrt{\frac{k}{m}} \cos\left(\sqrt{\frac{k}{m}}\,t\right) c_2$$

$$\dot{x}(0) = c_2\sqrt{\frac{k}{m}} = 0$$

$$c_2 = 0$$

$$x(0) = 1$$

$$c_1 = 1$$

$$\underline{\underline{x(t) = \cos\left(\sqrt{\frac{k}{m}}\,t\right)}}$$

$$\dot{x}(t) + \lambda x = \underset{=0}{f(t)} \qquad x(t) = c(t)e^{-\lambda t}$$

$$\dot{x}(t) = \dot{c}(t)e^{\lambda t} - c(t)\cdot\lambda e^{\lambda t}$$

$$\dot{c}(t)e^{-\lambda t} - \lambda c(t)e^{-\lambda t} + \lambda c(t)e^{-\lambda t} = f(t)$$

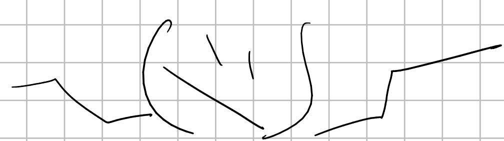
$$\dot{c}(t)e^{-\lambda t} = f(t) \quad \Big|\cdot e^{\lambda t}$$

$$\dot{c}(t) = f(t)e^{\lambda t} \qquad (f(t)\cdot g(t))' = f'(t)\cdot g(t) + f(t)\cdot g'(t)$$

$$x(t) = c(t)e^{-t}$$

$$= c_1 e^{-\lambda t}\int_0^t f(s)e^{\lambda s}\,ds$$

$$= c_1\int_0^t f(s)e^{\lambda(s-t)}\,ds$$



$= \text{partikular}$

$= x_h + x_p$

$= c_1 e^{\lambda t} + c_2 e^{-\lambda t}$

$\dot{x}(t) + 2x(t) = c_1 e^{-t}$ $\quad\quad c_1 e^{-t} = f(t)$

$\dot{x}(t) + 2x(t) = f(t)$

$x(t) = c_1 \int_0^t f(s) e^{-\lambda s} \, ds$

$\ddot{x} + \frac{k}{m} x = 0$

$x(t) = c_1 \cos\left(\sqrt{\frac{k}{m}}\, t\right) + c_2 \sin\left(\sqrt{\frac{k}{m}}\, t\right)$

$\dot{x}(t) = -c_1 \sqrt{\frac{k}{m}} \sin\left(\sqrt{\frac{k}{m}}\, t\right) + c_2 \sqrt{\frac{k}{m}} \cos\left(\sqrt{\frac{k}{m}}\, t\right)$

7) $x(0) = 0$, $\dot{x}(0) = 1$

$x(0) = 0$

$c_1 = 0$

$\dot{x}(0) = 1$

$c_2 \sqrt{\frac{k}{m}} = 1$

$c_2 = \frac{1}{\sqrt{k/m}}$

$x(t) = \frac{1}{\sqrt{\frac{k}{m}}} \sin\left(\sqrt{\frac{k}{m}}\, t\right)$

$$\dot{x}(t) + 2x(t) = c_1 e^{-t}$$
$$= 0$$

$$f(t) = c_1 e^{-t}$$
$$f(s) = c_1 e^{-s}$$

~~formel~~

$$x_h(t) = \int_0^t f(s) e^{-2(t-s)} ds$$

$$x(t) = \int_0^t c_1 e^{-s} \cdot e^{-2(t-s)} ds$$
$$= \int_0^t c_1 e^{-s} \cdot e^{-2t+2s} = \int_0^t c_1 e^{s-2t}$$

8) $$\ddot{x} + \frac{k}{m} x = 0$$

$$x(t) = c_1 \cos\left(\sqrt{\frac{k}{m}}\, t\right) + c_2 \sin\left(\sqrt{\frac{k}{m}}\, t\right)$$
$$\dot{x}(t) = -c_1 \sqrt{\frac{k}{m}} \sin\left(\sqrt{\frac{k}{m}}\, t\right) + c_2 \sqrt{\frac{k}{m}} \cos\left(\sqrt{\frac{k}{m}}\, t\right)$$

$$x(0) = x_0 \qquad \dot{x}(0) = v_0$$

$$x(0) = x_0$$
$$c_1 = x_0$$

$$\dot{x}(0) = v_0$$
$$c_2 \sqrt{\frac{k}{m}} = v_0$$
$$c_2 = \frac{v_0}{\sqrt{\frac{k}{m}}}$$

$$x(t) = x_0 \cos\left(\sqrt{\frac{k}{m}}\, t\right) + \frac{v_0}{\sqrt{\frac{k}{m}}} \sin\left(\sqrt{\frac{k}{m}}\, t\right)$$

$$\dot{x}(\tau) + \alpha x(\tau) = 0 \qquad \Big| \cdot e^{\alpha\tau}$$

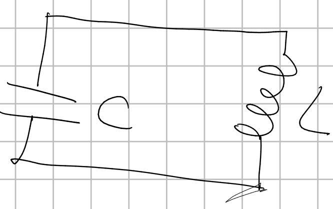
$$\dot{x} e^{\alpha\tau} + \alpha x e^{\alpha\tau} = 0$$

$$\int \frac{d}{d\tau}\left(e^{\alpha\tau} x(\tau)\right) d\tau = \int 0 \; d\tau$$

$$e^{\alpha\tau} x(\tau) = C \qquad \Big| \cdot e^{-\alpha\tau}$$

$$x(\tau) = Ce^{-\alpha\tau}$$

$$L\dot{i}(\tau) + \frac{1}{C}\int_0^\tau i(s)\, ds = 0$$



$$L\ddot{i}(\tau) + \frac{1}{C} i(\tau) = 0$$

$$i(\tau) = c_1 \cos\left(\frac{1}{\sqrt{LC}}\tau\right) + c_2 \sin\left(\frac{1}{\sqrt{LC}}\tau\right)$$

$$\dot{i}(\tau) = -c_1 \frac{1}{\sqrt{LC}} \sin\left(\frac{1}{\sqrt{LC}}\tau\right) + c_2 \frac{1}{\sqrt{LC}} \cos\left(\frac{1}{\sqrt{LC}}\tau\right)$$

$$v(\tau) = v(0) + \frac{1}{C}\int_0^\tau i(s)\, ds$$

a) $i(0) = 1 \qquad \dot{i}(0) = 0$

$i(0) = 1$

$c_1 = 1$

$\dot{i}(0) = 0$

$c_2 \frac{1}{\sqrt{LC}} = 0$

$c_2 = 0$

$$\underline{i(\tau) = -\frac{1}{\sqrt{LC}} \cos\left(\frac{1}{\sqrt{LC}}\tau\right)}$$

10)
$$i(\tau) = c_1 \cos\left(\frac{1}{\sqrt{LC}}\tau\right) + c_2 \,\mathrm{sen}\left(\frac{1}{\sqrt{LC}}\tau\right)$$

$$\dot{i}(\tau) = -c_1 \frac{1}{\sqrt{LC}} \,\mathrm{sen}\left(\frac{1}{\sqrt{LC}}\tau\right) + c_2 \frac{1}{\sqrt{LC}} \cos\left(\frac{1}{\sqrt{LC}}\tau\right)$$

$i(0) = 0$ $\qquad$ $\dot{i}(0) = 1$

$i(0) = 0$ $\qquad$ $c_2 \frac{1}{\sqrt{LC}} = 1$

$c_1 = 0$ $\qquad$ $c_2 = \sqrt{LC}$

$$\underline{\underline{i(\tau) = \cos\left(\frac{1}{\sqrt{LC}}\tau\right)}}$$

11)

$i(0) = i_0$ $\qquad$ $\dot{i}(0) = v_0$

$i(0) = i_0$

$c_1 = i_0$

$\dot{i}(0) = v_0$

$c_2 \frac{1}{\sqrt{LC}} = v_0$

$c_2 = v_0 \sqrt{LC}$

$$i(\tau) = i_0 \cos\left(\frac{1}{\sqrt{LC}}\tau\right) + v_0 \sqrt{LC} \,\mathrm{sen}\left(\frac{1}{\sqrt{LC}}\tau\right)$$

$\ddot{x} + a_1 \dot{x}(\tau) + a_0 x(\tau) = f(\tau)$ $\quad x(0) = x_0 \quad \dot{x}(0) = v_0$

Begrenser oss til $f(t) = e^{i\omega\tau}$

$\dot{x} + \delta x + f(\tau) \qquad x(0) = x_0$

$$x = x_0 e^{-\delta\tau} + \int_0^\tau f(s) e^{-\lambda(\tau - s)} ds$$

$$= x_h(\tau) + x_p(\tau)$$

Homogen løsning

$$\ddot{x}_h(\tau) + a_1 \dot{x}_h(\tau) + a_0 x_h(\tau) = 0$$

Dersom $f(\tau) = e^{i\omega\tau}$

$$x_p = H(\omega) e^{i\omega\tau}$$

H = frekvensrespons til likningen

1 2)

$$\ddot{x} + \dot{x} + x = e^{i\omega\tau} \qquad x(0) = \dot{x}(0) = 0$$

homogen løsning

$$\delta = -\frac{1}{2} \qquad \omega_0 = \sqrt{\frac{1^2 - 4}{2}} \Rightarrow i\,\omega_0 = \sqrt{\frac{3}{2}} \cdot i$$

$$x_h = e^{-\frac{1}{2}\tau}\left(d_1 \cos\left(\frac{\sqrt{3}}{2}\tau\right) + d_2 \sin\left(\frac{\sqrt{3}}{2}\tau\right)\right)$$

$f(t) = e^{i\omega\tau}$

$$x_p = H(\omega) e^{i\omega\tau}$$

$$\dot{x}_p = i\omega H(\omega) e^{\omega i\tau}$$

$$\ddot{x}_h = -\omega^2 H(\omega) e^{i\omega\tau}$$

$$-\omega^2 H(\omega) e^{i\omega\tau} + i\omega H(\omega) e^{i\omega\tau} + H(\omega) e^{i\omega\tau} = e^{i\omega\tau}$$

$$-\omega^2 H(\omega) + i\omega H(\omega) + H(\omega) = 1$$

$$H(\omega)(-\omega^2 + i\omega + 1) = 1$$

$$H(\omega) = \frac{1}{-\omega^2 + i\omega + 1}$$

$$x(\tau) = e^{-\frac{1}{2}\tau}\left(d_1 \cos\left(\frac{\sqrt{3}}{2}\tau\right) + d_2 \sin\left(\frac{\sqrt{3}}{2}\tau\right)\right) + \frac{e^{i\omega\tau}}{(-\omega^2 + i\omega + 1)}$$

$$x(0) = 0$$

$$d_1 + \frac{1}{-\omega^2 + i\omega + 1} = 0$$

$$d_1 = -\frac{1}{-\omega^2 + i\omega + 1} = \frac{1}{\omega^2 - i\omega - 1}$$

$$\dot{x}(\tau) = -\frac{1}{2} e^{-\frac{1}{2}\tau}\left(d_1 \cos\left(\frac{\sqrt{3}}{2}\tau\right) + d_2 \sin\left(\frac{\sqrt{3}}{2}\tau\right)\right)$$

$$+\left(-\frac{\sqrt{3}}{2} d_1 \sin\left(\frac{\sqrt{3}}{2}\tau\right) + \frac{\sqrt{3}}{2} d_2 \cos\left(\frac{\sqrt{3}}{2}\tau\right)\right)$$

$$+\frac{e^{i\omega\tau}}{-\omega^2 + i\omega + 1}$$

$$\dot{x}(0) = 0$$

$$d_1 + \frac{\sqrt{3}}{2} d_2 + \frac{1}{-\omega^2 + i\omega + 1} = 0$$

$$\frac{\sqrt{3}}{2} d_2 = 0$$

$$d_2 = 0$$

$$\underline{\underline{x(\tau) = e^{-\frac{1}{2}\tau}\left(\frac{1}{\omega^2 - i\omega - 1} \cdot \cos\left(\frac{\sqrt{3}}{2}\tau\right)\right) + \frac{e^{i\omega\tau}}{-\omega^2 - i\omega + 1}}}$$

$\ddot{x}(t) + \dot{x}(t) + x(t) = \cos(\omega t)$

Homogen løsning

$a_1 = 1 \qquad a_0 = 1$

$\delta = \frac{-1}{2} \qquad \omega = \left|\frac{\sqrt{1-4}}{2}\right| \Rightarrow i\,\omega = \frac{\sqrt{3}}{2} \cdot i$

$x_h(t) = e^{-\frac{1}{2}t}\left(d_1 \cos\left(\frac{\sqrt{3}}{2}t\right) + d_2 \sin\left(\frac{\sqrt{3}}{2}t\right)\right)$

$f(t) = \cos(\omega t)$

$x_p(t) = At\cos(\omega t) + Bt\sin(\omega t)$

$\dot{x}_p(t) = -A\omega t\sin(\omega t) + B\omega t\cos(\omega t)$

$\ddot{x}_p(t) = -A\omega^2 t\cos(\omega t) - B\omega^2 t\sin(\omega t)$

$x_p(t) = -A\omega^2 t\cos(\omega t) - B\omega^2 t\sin(\omega t)$

$\quad - A\omega t\sin(\omega t) + B\omega t\cos(\omega t)$

$\quad + At\cos(\omega t) + Bt\sin(\omega t)$

$\quad = (-A\omega^2 t + B\omega t + At)\cos(\omega t)$

$\quad + (-B\omega^2 t - A\omega t + Bt)\sin(\omega t)$

$x(t) = e^{-\frac{1}{2}t}\left(d_1 \cos\left(\frac{\sqrt{3}}{2}t\right) + d_2 \sin\left(\frac{\sqrt{3}}{2}t\right)\right) \qquad x(0) = \dot{x}(0) = 0$

$\quad + (-A\omega^2 + B\omega + A)t\cos(\omega t)$

$\quad + (-B\omega^2 - A\omega + B)t\sin(\omega t)$

$x(0) = 0$

$d_1 = 0$

$x(t) = d_2 e^{-\frac{1}{2}t}\sin\left(\frac{\sqrt{3}}{2}t\right)$

$\quad + (-A\omega^2 + B\omega + A)t\cos(\omega t)$

$\quad + (-B\omega^2 - A\omega + B)t\sin(\omega t)$

$$\dot{x}(\tau) = -\frac{1}{2} d_2 e^{-\frac{1}{2}\tau} \cdot \sin\left(\frac{\sqrt{3}}{2}\tau\right) + \frac{\sqrt{3}}{2} d_2 e^{-\frac{1}{2}} \cos\left(\frac{\sqrt{3}}{2}\tau\right)$$

$$+(-A\omega^2 + B\omega + A)\cos(\omega\tau) \quad -(A\omega^2 + B\omega + A)\tau \sin(\omega\tau)$$

$$+(-B\omega^2 - A\omega + B)\sin(\omega\tau) \quad +(-B\omega^2 - A\omega + B)\tau\cos(\omega\tau)$$

1 3) $m\ddot{x} + \mu\dot{x} + kx = mg$

$$\ddot{x} + \frac{\mu}{m}\dot{x} + \frac{k}{m}x = g \qquad f(\tau) = g \qquad x_p = H(\omega)e^{i\omega\tau} \qquad \omega = 0$$

$$= H(0)$$

$$= H$$

$x_p = H$

$\dot{x}_p = 0$

$\ddot{x}_p = 0$

$$0 + 0 + \frac{k}{m}H = g$$

$$H = \frac{mg}{k}$$

$$\underline{x_p = \frac{mg}{k}}$$

1 4)

$\ddot{x} + \mu\dot{x} + x = g \qquad x(0) = \dot{x}(0) = 0$

x_h:

$$\delta = -\frac{\mu}{2} \qquad \omega = \left|\frac{\sqrt{\mu^2 - 4}}{2}\right|$$

$$x_h = e^{-\frac{\mu}{2}\tau}\left(c_1 e^{\omega\tau} + c_2 e^{-\omega\tau}\right)$$

$x_p = H(\omega) \quad \omega = 0$

$x_p = g$

$$\underline{\underline{x(\tau) = e^{-\frac{\mu}{2}\tau}\left(c_1 e^{\omega\tau} + c_2 e^{-\omega\tau}\right)}}$$

1 5) $\underline{\mu = 2}$

Ukens nøtter & PID-Regulator

Proporsjonal: $u_p(t) = K_p(r - x)$

Integral: $u_I(t) = K_I \int_0^t r - x$

Derivat: $u_D(t) = K_D(\dot{r} - \dot{x})$

$u(t) = u_p(t) + u_I(t) + u_D(t)$

$r = 1$

1) $\dot{x} + b x = u_p$

$\dot{x} + b x = K(1 - x)$

$\dot{x} + b x = K - K x$

$\dot{x} + b x + K x = K$

$\dot{x} + (b + K) x = K$ $\qquad \cancel{f(t)} = K \qquad a = (b + k)$

$x = x_0 e^{-(b+k)t} + \int_0^t K e^{-(b+K)(t-s)} ds$

$= x_0 e^{-(b+K)t} - \frac{K}{b + K}$