Gabriel Emersen gte0002 HW10 Due 3/22

3.42) $h(t) = \delta(t) + 4e^{-3t}\cos(2t)u(t)$

a.) $H(s) = \mathcal{L}\{h(t)\} = 1 + \frac{4(s+3)}{(s+3)^2+2^2} \Rightarrow 1 + \frac{4s+12}{(s+3)^2+4}$

b.) zero's $= s = -3$

poles $= s = -3$

c.) $\frac{(s+3)^2+4}{(s+3)^2+4} + \frac{4s+12}{(s+3)^2+4} = \frac{4s+12+(s+3)(s+3)+4}{(s+3)(s+3)+4}$

$\Rightarrow \frac{s^2+10s+25}{(s+3)(s+3)+4} = \frac{Y(s)}{X(s)} = \frac{s^2+10s+25}{s^2+6s+13}$

$\Rightarrow \frac{d y^2(t)}{dt^2} + 6\frac{dy(t)}{dt} + 13y(t) = \frac{dx^2(t)}{dt^2} + 10\frac{dx(t)}{dt} + 25x(t)$

d.) $x(t) = 2te^{-5t}u(t)$ $\quad Y(s) = X(s) \cdot H(s)$

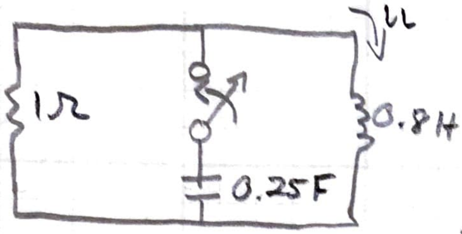
$X(s) = \frac{2}{(s+5)^2}$ $\quad H(s) = \frac{s^2+10s+25}{s^2+6s+13}$

$Y(s) = \frac{2}{(s+5)^2} \cdot \frac{s^2+10s+25}{s^2+6s+13} = \frac{2(s^2+10s+25)}{(s^2+10s+25)(s^2+6s+13)}$

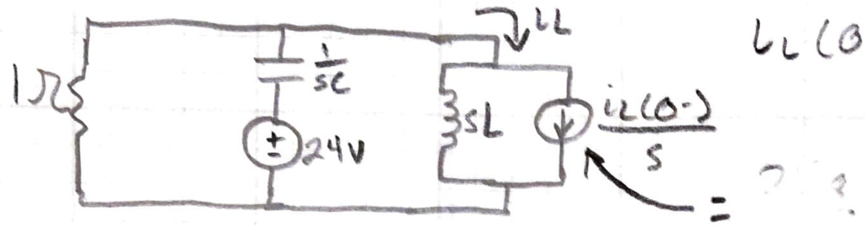
$\Rightarrow \frac{2(s^2+10s+25)}{(s+5)^2(s+3)^2+4} = \frac{2s^2+20s+50}{(s+5)^2(s+3)^2+4}$

$y(t) = \mathcal{L}^{-1}\{Y(s)\}$

4.8)



$V_c(0^-) = 24V$



$i_L(0^-) = \frac{0}{s} = 0$

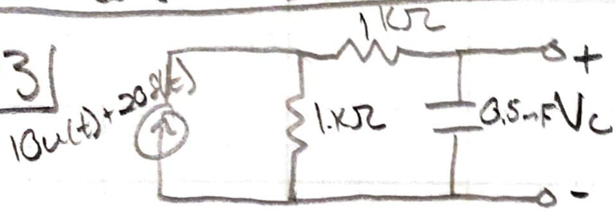
$\frac{1}{sC} = \frac{1}{0.25s} = \frac{4}{s}$ $\quad sL = 0.8s$

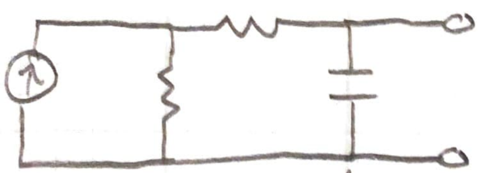
$\frac{24}{s} + \left[I(s)\left(1 + \frac{4}{s} + 0.8s\right)\right] = 0$

$I(s) = -\frac{24}{s} - \frac{1}{\frac{0.8s^2+s+4}{s}} \Rightarrow -\frac{24}{s} - \frac{s}{0.8s^2+s+4}$

$i(t) = \mathcal{L}^{-1}\{I(s)\}$

4.13





$V_c(t) = i_c(t) \cdot \frac{1}{sC}$

$i_c(t) = I_s \cdot \frac{1k\Omega}{1k\Omega + \frac{1}{sC}}$

$i_c(t) = 10u(t) + \frac{20}{s}(u(t)) \cdot \frac{1}{1+\frac{1}{0.5s}}$

$10 + \frac{20}{s} \cdot \frac{1k}{1k + \frac{1}{0.5s}}$

$i_c(s) = \frac{10 + \frac{20}{s}}{1k + \frac{1}{0.5s}} = \frac{(10+20)0.5s}{(1+1)s} = \frac{5s+10s}{2s} = \frac{15\cancel{s}}{2\cancel{s}} = 7.5A$

$V_c(s) = \frac{7.5}{0.5s}$ *Multiply by 2 $\Rightarrow \frac{15}{s} = 15 \cdot \frac{1}{s}$

$V_c(t) = \boxed{15u(t)}$