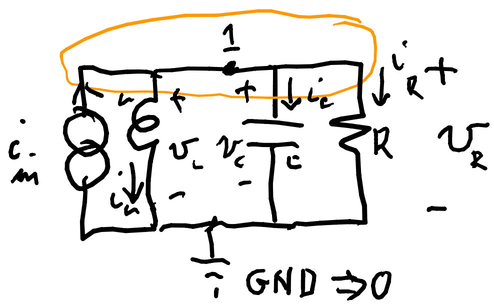
Note Title 8/30/2012

08/30/12
EE610



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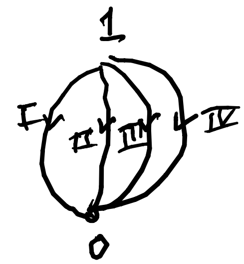


has connections

need laws of components

KCL, KVL

1) KCL: $0 = +i_{in} - i_L - i_C - i_R$

choose $\downarrow i$ $+$ v $-$ vi = power into branch

KVL: $0 = v_L - v_R = v_C - v_R$

$\Rightarrow v = v_R = v_L = v_C$

L: $i_L = \frac{1}{L}\int_0^t v(\tau)\,d\tau + i(0)$, C: $i_C = C\frac{dv}{dt}$, R: $i_R = Gv$; $G = 1/R$

$$i_{in} = \frac{1}{L}\int_0^t v(\tau)\,d\tau + i(0) + C\frac{dv}{dt} + Gv$$

$$\frac{di_{in}}{dt} = \frac{1}{L}v + C\frac{d^2v}{dt^2} + G\frac{dv}{dt}$$

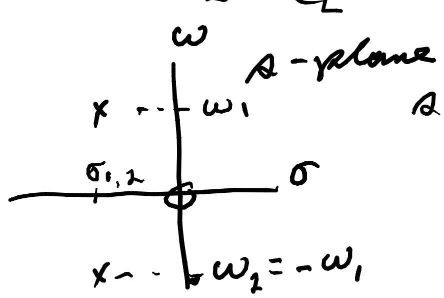
Note if $i = Ie^{st} \Rightarrow i_{in} = I_{in}e^{st} = Ie^{st}$ also then $v(t) = Ve^{st}$

$$sIe^{st} = \frac{1}{L}Ve^{st} + Cs^2Ve^{st} + GsVe^{st}$$

e^{st} is an entire function $\neq 0$

$$sI = \left(\frac{1}{L} + Cs^2 + Gs\right)V \Rightarrow \frac{V}{I} = \frac{s}{\frac{1}{L} + Cs^2 + Gs} = \frac{Ls}{CLs^2 + LGs + 1}$$

$$= Z(s)$$



$s = \sigma + j\omega$

poles where $s^2 + \frac{G}{C}s + \frac{1}{LC} = 0$

$$s_{1,2} = -\frac{G}{2C} \pm \frac{1}{2}\sqrt{\left(\frac{G}{C}\right)^2 - \frac{4}{LC}}$$

give natural responses

if $I = 0 = (1 + LCs^2 + LGs)V$ $\Rightarrow$ can have $V = 0$ or

$$P(s) = s^2 + \frac{G}{s} + \frac{1}{LC} = 0$$

$\Rightarrow$ $v(t) = V_1 e^{s_1 t} + V_2 e^{s_2 t}$ where $s_{1,2}$ solve $P(s) = 0$