EE 202

Homework #1

(Due: March 2, 2006)

1) The natural response of a **2nd order circuit** for two sets of initial conditions at time **t = 0** is given as follows :

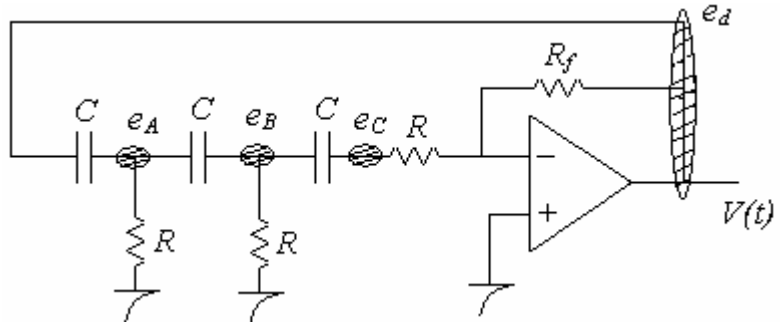
Set 1	Set 2
$V_c(t) = 2e^{-2t}\,u(t)$ $i_L(t) = 1e^{-2t}\,u(t)$	$V_c(t) = 4e^{-3t}\,u(t)$ $i_L(t) = 8e^{-3t}\,u(t)$

a) Find the form of the solution for $\begin{bmatrix} Vc(t) \\ i_L(t) \end{bmatrix}$

b) Tell how the order of the circuit relates to number of dynamic components. What are the natural frequencies of the circuit?

c) Find a circuit such that it has all passive elements and independent sources and its natural frequencies are on the imaginary axis.

2)

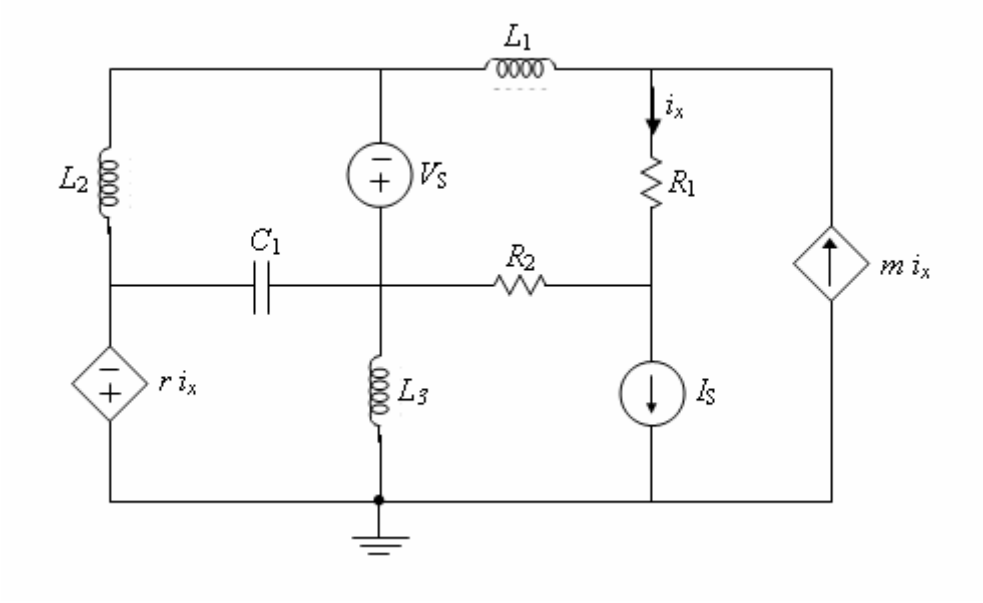


Op-Amp is assumed to be in linear region.

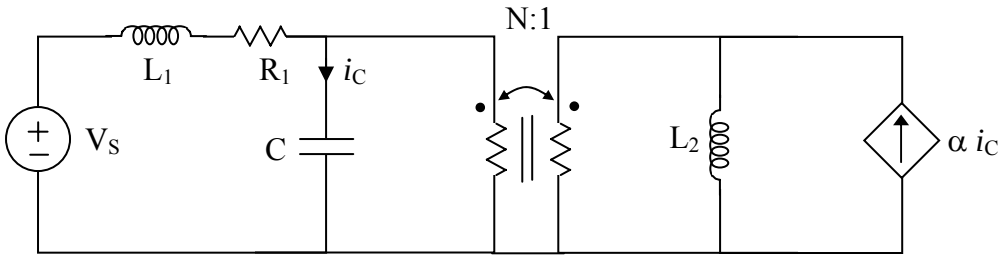
i) First express $\mathbf{e_d}$ in terms of $\mathbf{e_a}$, $\mathbf{e_b}$ and $\mathbf{e_c}$ then write node equations in terms of $\mathbf{e_A}$, $\mathbf{e_B}$, $\mathbf{e_C}$. (You should have a 3x3 matrix differential equation.)

ii) For R = 1Ω ; C = 1F , find $\mathbf{R_f}$ so that circuit has a natural frequency at $s = -\frac{1}{6}$.
What are the other natural frequencies? Is this circuit stable?

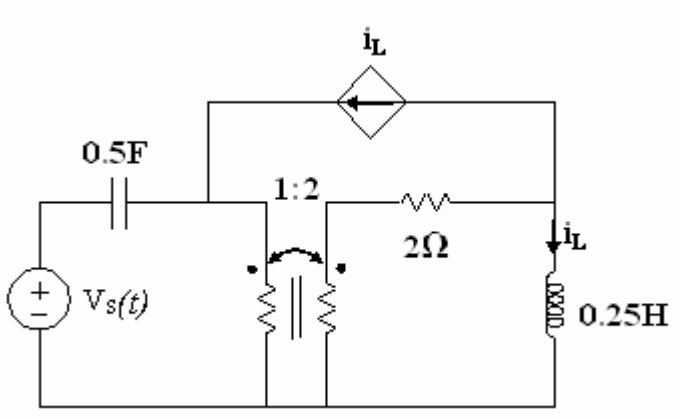
3) Write **Node, Mesh equations** for the circuit.



4) Obtain the state equations for the circuit.



5)



i) Find the natural freguencies using MNA.
ii) Find the natural freguencies using state equations.

Note : For part i) you may use symbolic processing capabilities of MATLAB. Type the following to see an example for symbolic evaluation of determinants.

matrix M →

```
>> syms D
>> M = [ D+1  5*D ; 2*D  D ];
>> det (M)
>> solve (det(M))
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