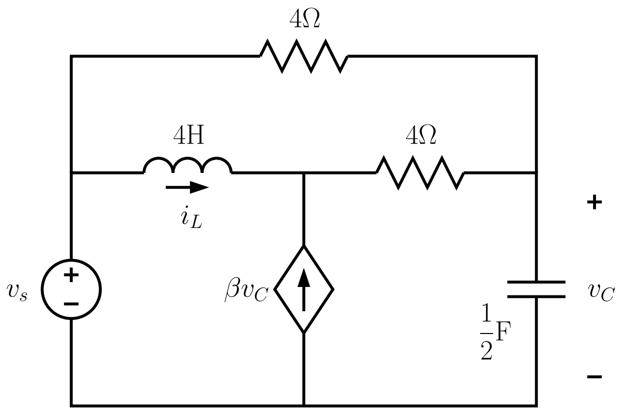
EE 201 Section 1, Take Home Exam 1, Due March 16, 2016

March 9, 2016

1. Consider the following circuit.



(a) Obtain the state equation.

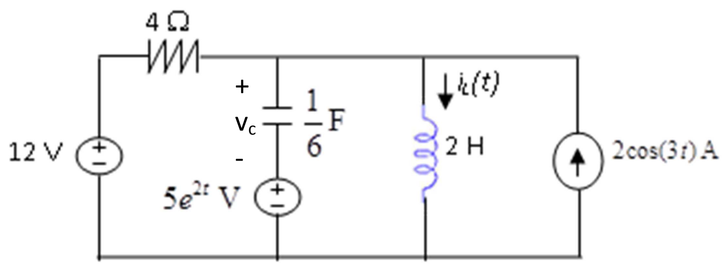
(b) Find the natural frequencies of the circuit in terms of β.

For parts (c) and (d) take $v_s(t) = 0$.

(c) Let $\beta = 2$ and $v_C(0) = 4$ V. Find a possible initial inductor current $i_L(0)$ so that only a single mode is excited.

(d) Given $v_C(t) = \cos(\omega t)$ V, determine β and ω.

2. Consider the following circuit.



(a) Obtain the state equation.

(b) Find the natural frequencies of the circuit.

(c) Convert the state equation of part (a) into Laplace domain. Find the zero input solution of $i_L(t)$ for $i_L(0^-)$ = 2A and $v_C(0^-)$ = -2V.

(d) Find the particular solution of $i_L(t)$.

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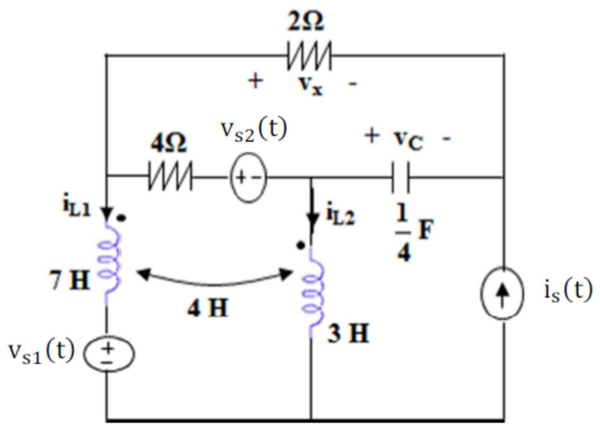
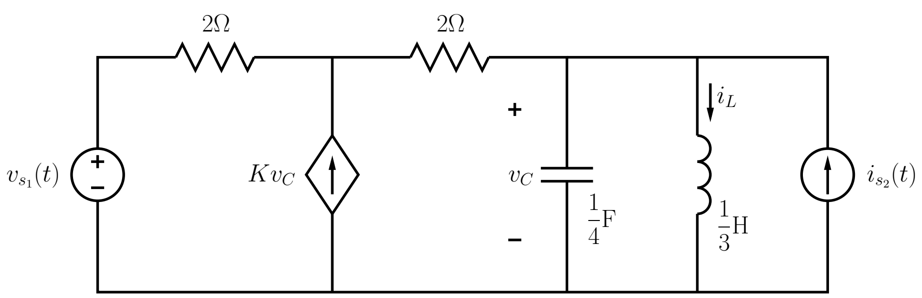
3. Consider the following circuit.



$v_C(0) = V_0,\quad i_{L1}(0) = I_{01},\quad i_{L2}(0) = I_{02}$

a) Obtain the node/ modified node/ mesh equation in matrix form.
b) Determine the natural frequencies from the mesh equation.
c) Write the form of the homogeneous solution for $v_x(t)$.
d) For $v_{s1}(t) = 3e^{-4t}$ V, $v_{s2}(t) = 10$ V, $i_s(t) = 0$, find the particular solution for $v_x(t)$.

4. Consider the circuit below.



$K > 0$

$v_C(0) = 7\text{V},\ i_L(0) = 4\text{A}$

$v_{s_1}(t) = 10\cos(6t + 20°)$ V

$i_{s_2}(t) = 3e^{6t}$ A

a) Obtain the node equation in matrix form.
b) Express the natural frequencies in terms of K.
c) Determine the value of K so that the natural frequencies are purely imaginary. For this value of K, write the form of the homogeneous solution for $v_C(t)$.
d) For $K = 4$ find the natural frequencies; write the form of the homogeneous solution for $v_C(t)$; and find the particular solution for $v_C(t)$.