EGR 220  HW 8  Due Nov 1

Note that for HW 9 you will find the complete solutions for these problems.

For problems 1, 2 and 3 set up the problem to be solved without finding constants $A_1$ and $A_2$ until HW 9 (and similar instructions for problem 4)

a) Find the relevant initial and final conditions, $I_0$ and $I_\infty$, or $V_0$ and $V_\infty$. (Do not, for this homework, find $(di/dt)|_{t=0}$ or $(dv/dt)|_{t=0}$ That is coming next.)

b) Identify the circuit as series RLC, parallel RLC or general RLC (which means the 3 elements, R, L and C are not all in series or all in parallel).

c) Calculate $\alpha$ and $\omega_0$ and $s_1$ and $s_2$. (for a general circuit, $\alpha$ and $\omega_0$ are not defined, but you could find $s_1$ and $s_2$)

d) Identify and clearly state if the circuit behavior is overdamped, underdamped or critically damped.

e) Construct the complete mathematical expression for the final response (using either the text book or class notes/slides), putting in the numerical values you do have and identifying the constants still needing to be found.
   
   o This means constructing the natural response, and adding on the forced response term if there is one, which is determined by the independent sources connected to the circuit for $t > 0$.

f) Sketch an approximate graph showing the expected, or anticipated, circuit behavior

   o Either a graph of $v(t)$ vs. $t$ or $i(t)$ vs. $t$
   
   o The graph should show the voltage or current starting at its initial condition, ending at its final condition, and show the form of the “damping” as it moves from one to the other – under-, over- or critically damped.

Problem 1:
In the circuit below, the switch moves from $A$ to $B$ at time $t = 0$. Set up the solution, as outlined above, to find $v(t)$ (constants $A_1$ and $A_2$ will be determined in HW 9)
**Problem 2:**
In the circuit below, the switch moves from $A$ to $B$ at time $t = 0$.
- As outlined above, set up the problem to find $i(t)$ for all $t \geq 0$.

![Circuit diagram](image1)

**Problem 3:**
- As outlined above, set up the problem to find $i(t)$ for all $t \geq 0$.
- (Note that this is the only circuit in this homework with non-zero forcing function at $t = \infty$)

![Circuit diagram](image2)
Problem 4:
Design a parallel RLC circuit that has the characteristic equation below.

\[ s^2 + 100s + 10^6 = 0 \]

- Assume R = 2kΩ. Find values for L and C (this is what it means to ‘design’ this circuit).
- Identify the type of response described by this equation:
  - Is it source-free (natural) response or step (complete) response.
- Identify the type of damping: over-damped, critically damped, under-damped
- Sketch the circuit diagram, labeling the elements.
  - Assume there is a current source of 2A for time t<0 that charges the capacitor and inductor (include this in your diagram).
- Write the expression for \( i(t) \) or \( v(t) \) (your choice) for this circuit and identify the constants that will need to be found (next week)
- Graph and label the response of this circuit as for the problems above.