EECS 40, Fall 2007  
Prof. Chang-Hasnain

Homework #3

Due at 5:00 pm in 240 Cory on THURSDAY, 9/27/07
Total Points: 100

- Put (1) your name and (2) discussion section number on your homework.
- You need to put down all the derivation steps to obtain full credits of the problems. Numerical answers alone will at best receive low percentage partial credits.
- No late submission will be accepted except those with prior approval from Prof. Chang-Hasnain.
- Problems of this HW are from Hambley 4th Edition

1. (Inductance and Capacitance) Read the «practical application » on p. 143-144. Answer the question on p. 144: «Identify the features in Figure PA3.2 that are analogous to each of the circuit elements in Figure PA3.1». (8 points)

2. (Inductance and Capacitance) (16 points)
   \[ x(t) = \begin{cases} 
   0 & \text{on} \ (-\infty, 1], \\
   4t-4 & \text{on} \ (1,2), \\
   -4t+12 & \text{on} \ [2,3) \\
   0 & \text{on} \ [3, \infty) 
   \end{cases} \]
   a. The voltage \( v(t) \) and current \( i(t) \) across a .5F capacitor adhere to passive convention. Also, \( V(0) = 0V \), and \( i(0) = 0A \). Determine \( i(t) \), power, and stored energy when \( v(t) = x(t) \) as given above, and sketch. (8 points)
   b. Find an expression for \( v(t) \) when \( i(t) = x(t) \), and sketch. (4 points)
   c. Suppose instead that we are measuring current and voltage across a 4H inductor. Find an expression for \( i(t) \) when \( v(t) = x(t) \), and sketch. (4 points)

3. P3.33 (Physical Characteristics of Capacitors) (5 points)

4. P3.65 (Inductances in Series and Parallel) (10 points)

5. P4.6 (First-Order RC Circuits) (10 points)

6. P4.17 (First-Order RC Circuits). (16 points)
   f) Also find an expression for the energy stored in capacitor 2, as a function of time. (3 points)
   g) Find an expression for the power dissipated as a function of time by the resistor. (3 points)
7. (First order RL circuits). The circuit is at steady state at $t<0$. The output $V_0$ of the circuit is given by $V_0(t) = 6 - 3e^{-0.35t}$ V when $t>0$. (15 points)
   
   a. Write the initial voltage (at $t=0$) as a function of $R1$ and $R2$. (3 points)
   
   b. Write the steady state voltage (at $t=\infty$) in terms of $R1$ and $R2$. (3 points)
   
   c. Write the time constant for $t>0$. (3 points)
   
   d. Determine the values $L$, $R1$, and $R2$. (6 points)

![Circuit Diagram]

8. P4.27 (DC Steady State) (5 points)

9. (RL and RC Circuits with General Sources). Consider a voltage source $V_s$ across an inductor $L$ and a resistor $R$. Write the differential equation for $i(t)$, and find the complete solution if $V_s=15\cos(150t)$. (15 points)