ECE 2300 – CIRCUIT ANALYSIS

HOMEWORK #7

1) The current *iC(t)* through the capacitor in Figure 1 is given by the plot shown in Figure 2. It is given that *vC*(2[ms]) = 6[V]. Find *vC*(8[ms]).



2) In the circuit shown below, the switched closed at *t* = 0. No energy was stored in the capacitor, and no energy was stored in the inductor, at *t* = 0. The expression for *vS(t)* is given below.

Find the power delivered by the voltage source at *t* = 5[s].





3) In the circuit shown below, the two switches were open for a long time before *t* = 0, until all voltages and currents stopped changing. Then, both switches closed at *t* = 0. Then, switch SWA opened again 2[s] later.

a) Find *iQ*(0-).

b) Find *iX*(0-).

c) Find *iQ*(0+).

d) Find *iX*(0+).



4) In the circuit shown below, switches SW1 and SW2 have been closed for a long time before   
*t* = 0, allowing all voltages and currents to stop changing.

At *t* = 0, switch SW1 opens and remains open.

At *t* = 0.5[s], switch SW2 opens and remains open.

a) Find *iL*(0-).

b) Find *iX*(0-).

c) Find *iL*(0+).

d) Find *iX*(0+).

e) Find the energy stored in the inductor just before *t* = 0, *wSTO.BY.L*(0-).

f) Find the energy stored in the inductor just after *t* = 0, *wSTO.BY.L*(0+).



5) In the circuit shown below, the energy stored in inductor *L1* was zero when switch SWA closed and switch SWB opened at *t* = 0. Then, 10[ms] later switch SWA opened.

a) Find *vQ*(0-).

b) Find *vQ*(0+).

c) Find the energy stored in the inductor just before *t* = 0, *wSTO.BY.L1*(0-).

d) Find the energy stored in the inductor just after *t* = 0, *wSTO.BY.L1*(0+).



6) An inductor with an inductance of 6.8[H] is connected in parallel with an ideal voltage source. At *t* = 0, the voltage source has a voltage of zero, and the energy stored in the inductor is zero. Then, 50[s] later, the voltage of the voltage source increases to 5[V]. Then, 10[s] after that, the voltage source decreases to a value of -2[V]. Finally, 20[s] later the voltage source returns to zero, and stays at that value.

a) Find expressions for the energy stored in the inductor, as a function of time, for the time period 0 < *t* < 100[s].

b) Plot the energy stored in the inductor, as a function of time, for the time period   
0 < *t* < 100[s].

7) An capacitor with a capacitance of 4.7[mF] is connected in series with an ideal current source. At *t* = 0, the current source has a current of zero, and the energy stored in the capacitor is zero. The current source has a current given by



a) Find an expression for the energy stored in the capacitor, as a function of time, for two periods of the sinusoid after *t* = 0.

b) Plot the energy stored in the capacitor, as a function of time, for two periods of the sinusoid after *t* = 0.

8) In the circuit shown below, the switches SWA and SWB were closed for a long time before   
*t* = 0, allowing all voltages and currents to stop changing. Then, at *t* = 0, switch SWA opened. After that, 50[ms] later, switch SWB opened.

a) Find *iQ*(0-).

b) Find *iX*(0-).

c) Find *iQ*(0+).

d) Find *iX*(0+).

e) Find the energy stored in the capacitor just before *t* = 0.

f) Find the energy stored in the capacitor just after *t* = 0.



9) In the circuit shown below, switch SWA was closed and switch SWB was open for a long time before *t* = 0, long enough so that all voltages and currents had stopped changing. Then at *t* = 0, switch SWA opened. Ten milliseconds later, switch SWB closed.

a) Find *iX*(10[ms]-).

b) Find *iX*(10[ms]+).

c) Find the energy stored in the capacitor just before *t* = 10[ms].

d) Find the energy stored in the capacitor just after *t* = 10[ms].



10) (Bonus Question) What is the difference between engineering and science? What is the difference between engineering and technology? How can you tell the difference between a physicist and an electrical engineer? How can you tell the difference between an electrical technician and an electrical engineer? Write your answers using clear, complete sentences.

Numerical Solutions:

1. 61.6[V]

2. 86.55[W]

3. a) 0, b) -1.489[mA], c) -3.182[mA], d) -2.55[mA]

4. a) -29[A], b) 30[A], c) -29[A], d) 29[A], e) 84.1[J], f) 84.1[J]

5. a) 0, b) 186.2[mV], c) 0, d) 0

6. a) *wSTO.BY.L* = 0; for 0  t  50[s],

*wSTO.BY.L* = 1.838x106[J/s2]t2 – 183.8[J/s]t + 4.595x10-3[J]; for 50[s]  t  60[s],

*wSTO.BY.L* = 0.294x106[J/s2]t2 – 49.98[J/s]t + 2.125x10-3[J]; for 60[s]  t  80[s],

*wSTO.BY.L* = 7.353x10-6[J]; for 80[s]  t  100[s].

b) Omitted

7. Omitted

8. a) 0, b) 2.358[mA], c) 10.35[mA], d) 4.054[mA], e) 712.9[J], f) 712.9[J]

9. a) 0, b) -10.29[mA], c) 2.094[mJ], d) 2.094[mJ]

10. Answer omitted.