SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Summer 2006
ENSC 320: ELECTRIC CIRCUITS II

Midterm Examination No. 1

June 23, 2006

Duration: 60 minutes. Attempt all four problems. Questions are **not** *equally weighted. Closed book and closed notes. Calculators, PDAs, laptops, and wireless phones are not permitted.*

1. **(40 points)**

   The switch in the circuit shown in Figure 1 has been closed for a very long time and the capacitor voltage has reached a steady-state value. The switch opens at $t = 0$ and remains open for 100 μs, at which instant it closes again and remains closed.

   - Write the differential equation describing the circuit with switch open.
   - Find the time constant of the circuit with switch open.
   - Find capacitor voltage $v(t)$ for $0 < t \leq 100$ μs.
   - Write differential equation describing the circuit with switch closed.
   - Find the time constant of the circuit with switch closed.
   - Find capacitor voltage $v(t)$ for $t \geq 100$ μs
   - Sketch the waveform for $v(t)$.

2. **(20 points)**

   A series RLC circuit is shown in Figure 2.

   - Write the state equation in matrix form.
   - Find the natural frequencies of the circuit.
   - State three possible cases of the voltage/current waveforms depending on the values of circuit parameters.

3. **(20 points)**

   Find Laplace transform of the signals sketched in Figure 3.

4. **(20 points)**

   Find the inverse Laplace transform of the following functions of s: (Use simplifications and the transform properties to simplify calculations.)

   - $F(s) = \frac{s^2 + 2s + 2}{s(s+2)^2}$
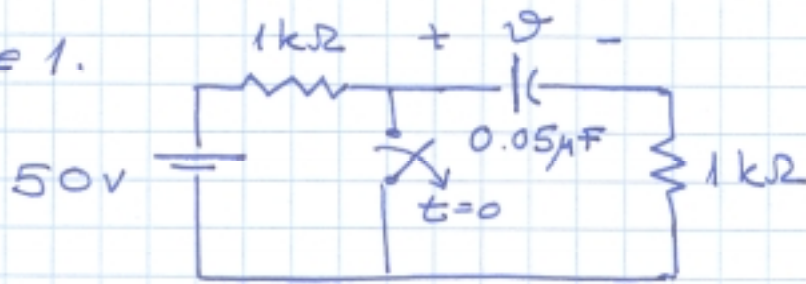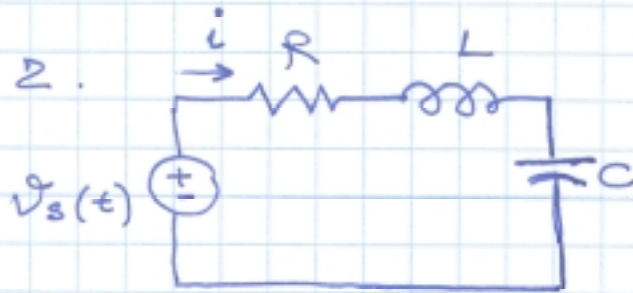   - $F(s) = \frac{2se^{-2s}}{(s+1)(s+3)}$

Figure 1.

$1k\Omega$, $0.05\mu F$, $1k\Omega$, $50V$, $t=0$, $+\ v\ -$

Figure 2.

i, R, L, C, $v_s(t)$

Figure 3.

A, T

1, T

T, T, $2T$

1, T, $2T$, -1