SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Summer 2007
ENSC 320: ELECTRIC CIRCUITS II

Midterm Examination No. 1
June 15, 2007

Duration: 110 minutes. Attempt all five problems. Questions are **not** *equally weighted. Closed book and closed notes. Calculators, PDAs, laptops, and wireless phones are not permitted.*

1. **(20 points)**

   Find the response $v_{out}(t)$ for the ideal op amp circuit shown in Fig. 1 in terms of $v_{in}(t)$, R, and C. Based on your response, state the function that this circuit realizes. Suppose that $v_{in}(t) = cos(250t)$, $R = 4k\Omega$, and $C = 1\mu F$. The circuit is initially relaxed. Find $v_{out}(t)$.

2. **(30 points)**

   The switch in the circuit shown in Fig. 2 has been closed for a long time when it opens at $t = 0$. Circuit parameters are: $V_0 = 10V$, $R_1 = 20\Omega$, $R_2 = 0.5\Omega$, $L = 1H$, and $C = 0.25F$.

   - Specify the $t = 0+$ values of v and i (shown on the diagram).
   - Write two state equations describing the circuit.
   - Write the state equations in the matrix form.
   - Convert the two first order equations into a second order equation in terms of i.
   - Find the natural frequencies (characteristic values) of the circuit.
   - Find the solution $i(t)$.

3. **(10 points)**

   Find Laplace transform of the signals sketched in Fig. 3 and the following functions of t:

   - $f(t) = te^{-at}$
   - $f(t) = e^{-at}sin(\omega t)$.

4. **(10 points)**

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

   - $F(s) = \frac{3s+1}{(s+2)(s^2+4s+8)}$
   - $F(s) = \frac{s(s+2)e^{-3s}}{(s+1)^2(s+4)}$

5. **(30 points)**

A series RLC circuit is shown in Fig. 4. Circuit parameters are: $R = 4\Omega$, $L = 1H$, and $C = 0.2F$. Use Laplace transform to find the circuit's:

- impulse response
- step response.

Figure 1:

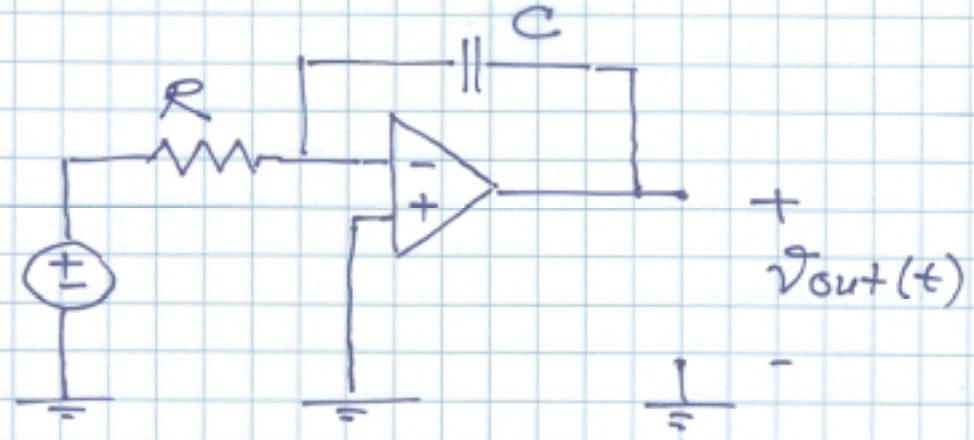

Figure 2:

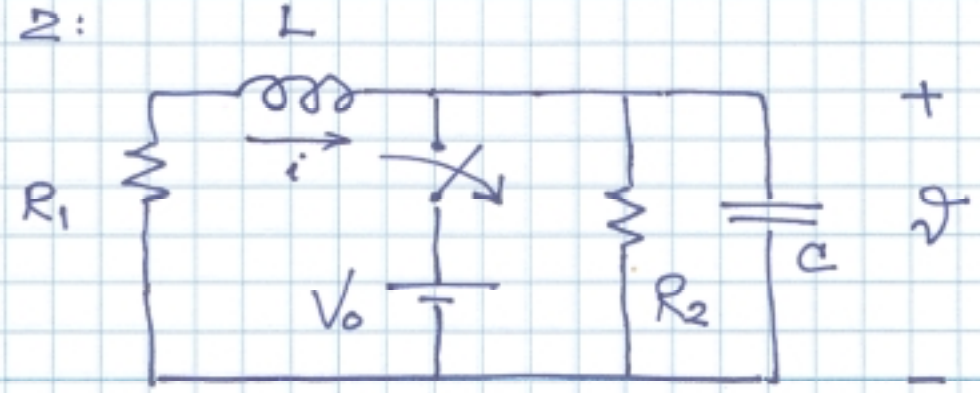

Figure 3:

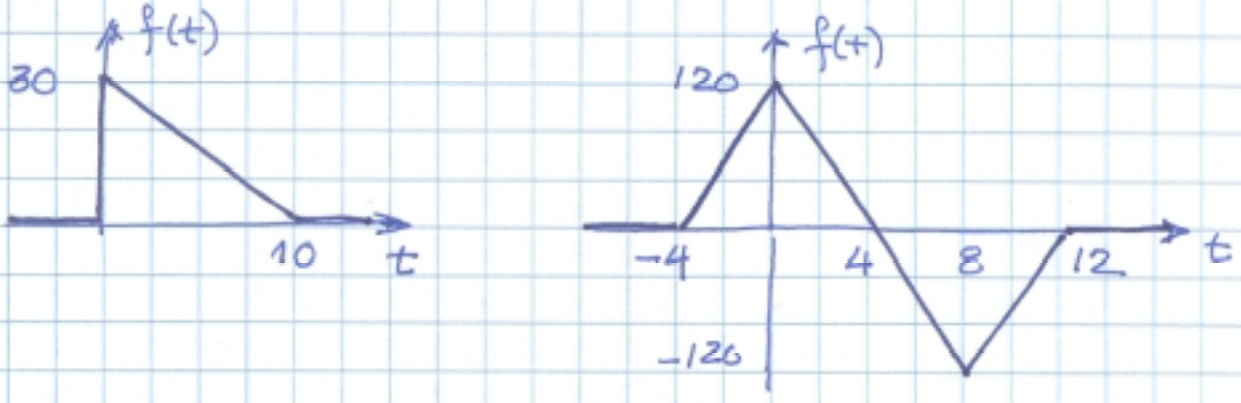

Figure 4: