SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Summer 2012
ENSC 320: ELECTRIC CIRCUITS II

Midterm Examination
Monday, June 25, 2012

Duration: 110 minutes. Attempt all four problems. Questions are not equally weighted. Closed book and closed notes. Calculators, PDAs, laptops, and wireless phones are not permitted. Use a ball-point pen for writing the exam (no pencils, please).

1. **Second-Order Linear Circuits (30 points)**

   The switch in the circuits shown in Figure 1 is closed at $t = 0$. The dependent source gain k is a positive constant.

   - Find the voltage response $v_c(t)$.
   - Find the range of k such that the voltage response $v_c(t)$ is over-damped.
   - Find the response $v_c(t)$ for the value of k that makes the circuit critically damped.

2. **Laplace Transform: Basics (15 points)**

   - Find Laplace transform of the signal sketched in Figure 2.
   - Find the inverse Laplace transform of the following function of s:

   $$F(s) = \frac{4s^2 + 7s + 1}{s(s+1)^2}.$$

   (Use simplifications and the transform properties to simplify calculations.)
   - Apply the initial-value and final-value theorems to the transform pair.

3. **Laplace Transform Analysis: Circuit Applications (20 points)**

   A series RLC circuit is shown in Figure 3. Circuit parameters are: $R = 4\Omega$, $L = 1H$, and $C = 0.2F$. Use Laplace transform to find the circuit's:

   - impulse response
   - step response.

4. **Laplace Transform Analysis: Transfer Function Applications (35 points)**

   Consider the circuit shown in Figure 4. Assume that the op-amp is ideal.

   - Find transfer function $H(s) = V_{out}/V_{in}$.
   - Find zeros and poles of $H(s)$.
   - Find the magnitude and the phase of the frequency response.
   - Plot the magnitude and the phase as functions of ω and identify the type of the circuit.

Figure 1:

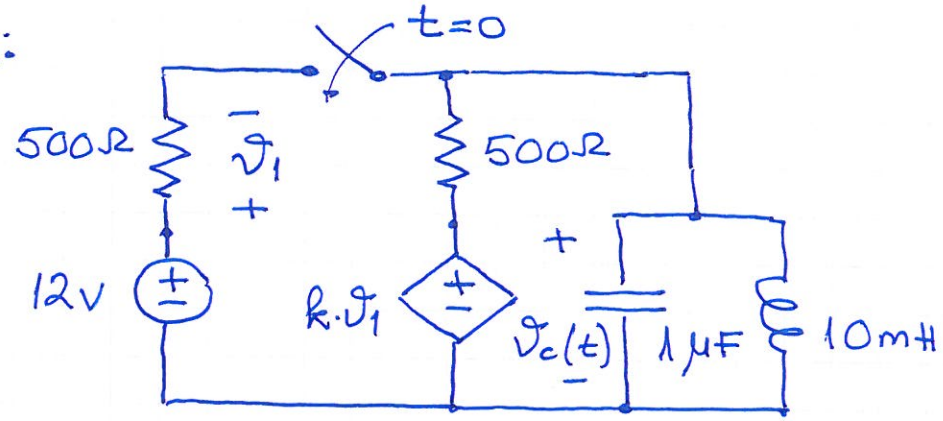

Figure 2:

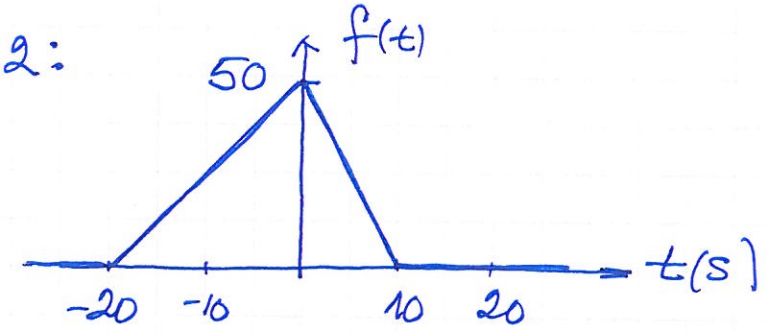

Figure 3:

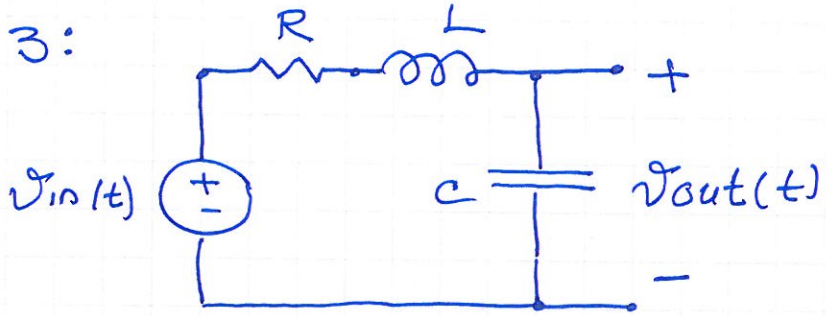

Figure 4: