SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Summer 2012
ENSC 320: ELECTRIC CIRCUITS II

Midterm Examination
Monday, July 16, 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. **Laplace Transform Analysis: Circuit Applications (20 points)**

   Consider the switched RLC circuit shown in Figure 1. Suppose the switch has been in position A for a long time and moves to point B at $t = 0$. Suppose $v_{in}(t) = 50$ V.

   - Find $i_L(t)$ and $v_C(t)$ at $t = 0^-$.
   - Find $v_C(t)$ for $t > 0$.
   - Sketch $v_C(t)$ for $t \geq 0$.

2. **Laplace Transform Analysis: Transfer Function Applications (30 points)**

   Consider the circuit shown in Figure 2, where $R_1 = 50\ \Omega$, $R_2 = 200\ \Omega$, and $C = 2.5\ mF$.

   - Find the circuit's transfer function.
   - Let $v_{in}(t) = 10e^{-2t}u(t)\ V$ and $v_c(0_-) = 4\ V$.
     - Use Laplace transform to find the complete response of the circuit by first finding the zero-state response and the zero-input response.
     - Identify the circuit's forced response and natural response.
     - Identify the circuit's steady-state response and transient response.
   - Let $v_{in}(t) = 10e^{-10t}u(t)\ V$ and $v_c(0_-) = 0\ V$. Is the forced response well defined? Justify your answer.

3. **The Convolution Method (20 points)**

   Consider the circuit shown in Figure 3. Suppose that the input excitation is $v_{in}(t) = e^{-a|t|}$ V, where $a \neq 1$ and $a > 0$.

   - Find the circuit's impulse response.
   - Determine the response $v_{out}(t)$ for all t.

4. **Resonant and Bandpass Circuits (30 points)**

   For the bandpass circuit shown in Figure 4:

   - Find the transfer function $H(s) = I_L(s)/V_{in}(s)$.
   - Find ω_m, H_m, and B_ω.

Figure 1:

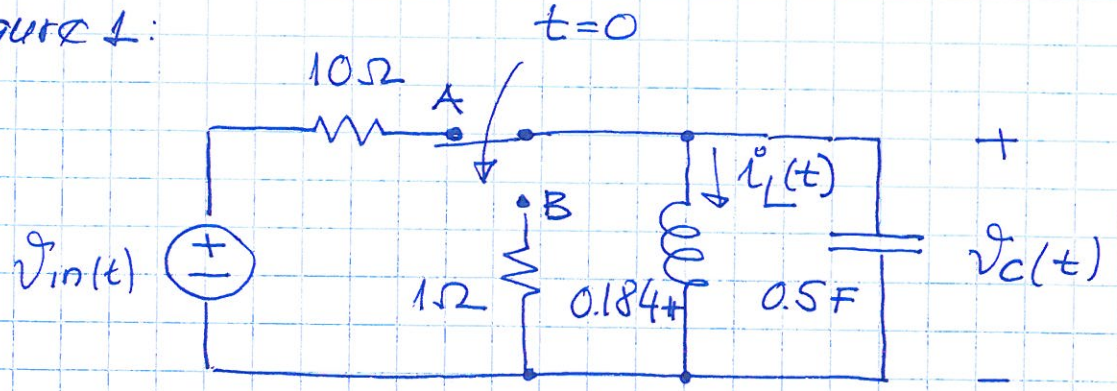

Figure 2:

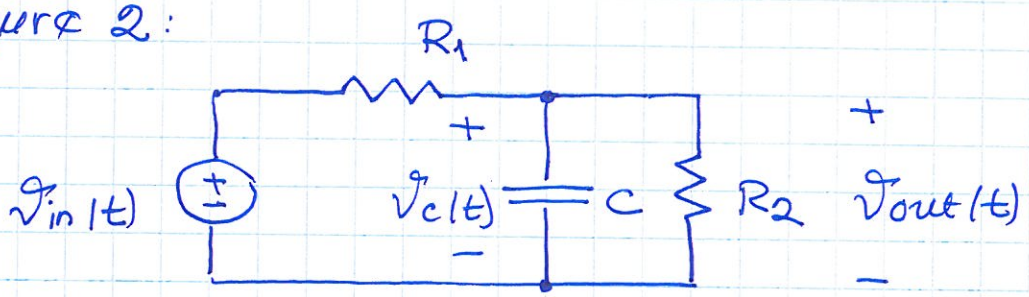

Figure 3:

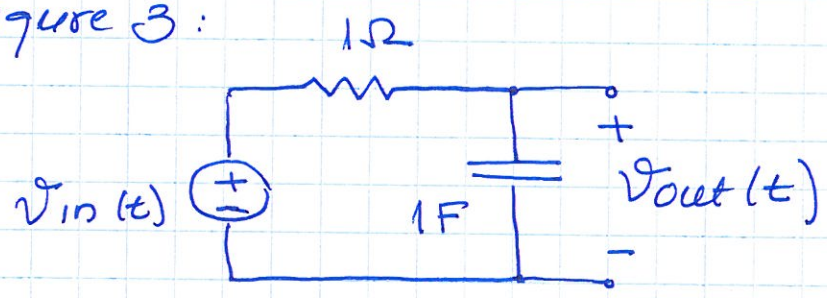

Figure 4: