SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Fall 2014
ENSC 220: ELECTRIC CIRCUITS I

Final Examination
Friday, December 12, 2014

Duration: 180 minutes. Attempt all problems. Questions are **not** *equally weighted. Closed book and closed notes. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted.* **Please show details of your work and derive all equations and expressions.** *Please write legibly. Illegible text will not be graded. Use a ball-point pen for writing the examination (no pencils, please).*

1. **(10 points)**

   For the circuit shown in Figure 1:

   (a) Find the Thévenin voltage.
   (b) Find the Thévenin resistance.

2. **(35 points)**

   The circuit shown in Figure 2 is a leaky integrator, which contains an deal op-amp. The input for all time is $v_s(t) = -5u(t)$. R_2 represents the leakage resistance of the capacitor.

   (a) Given C and R_2, choose the resistance R_1 to achieve the overall gain of 10.
   (b) Find response $v_{out}(t)$ assuming $v_c(0^-) = 0$.
   (c) Find the response of the ideal (non-leaky) integrator.
   (d) Sketch and compare the responses of the leaky and ideal integrators.

3. **(35 points)**

   Consider the circuit shown in Figure 3:

   (a) Write the state equations.
   (b) Write a second-order differential equation with v_c as the unknown.
   (c) Find the roots of the characteristic equation.
   (d) Specify the response of the circuit for the given values of circuit parameters.
   (e) If $v_{in}(t) = u(t)\ V$, find $v_C(t)$ for $t > 0$.

4. **(20 points)**

   In the circuit shown in Figure 4, $v_s(t) = \sqrt{2}\ 100\ cos(300t + 30°)\ V$.

   (a) Find $i_L(t)$.
   (b) Find the complex and average power absorbed by the laod.

Figure 1.

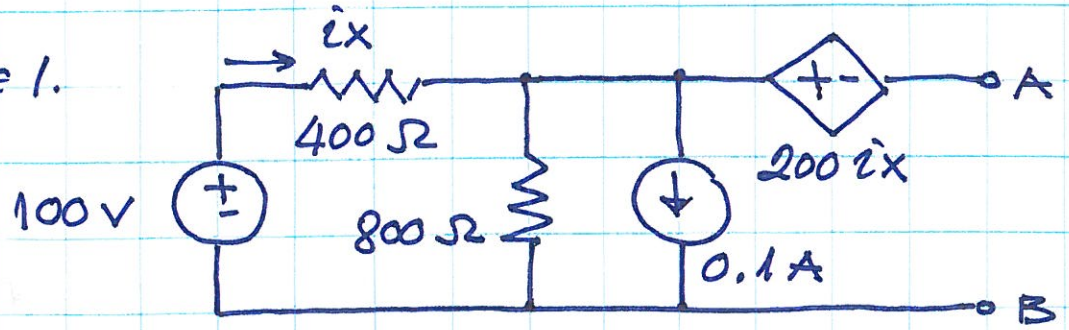
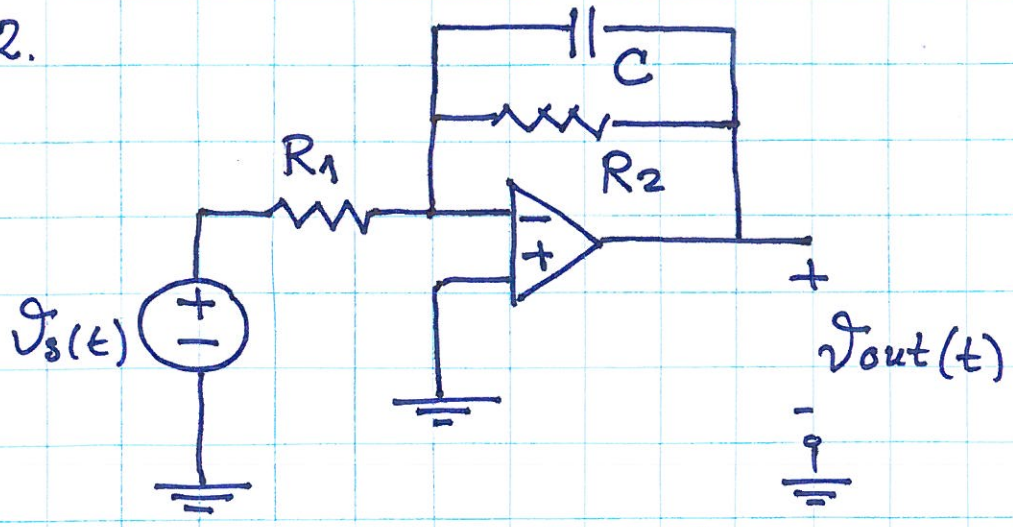
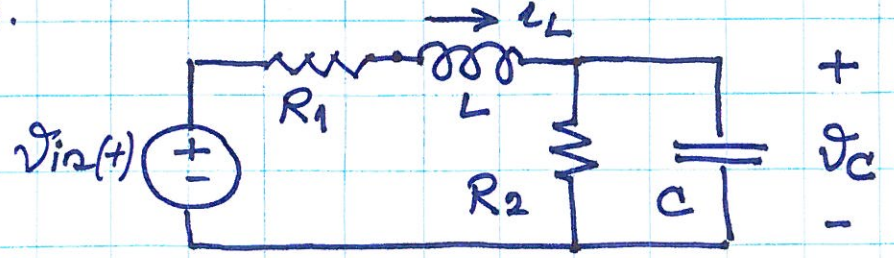


Figure 2.



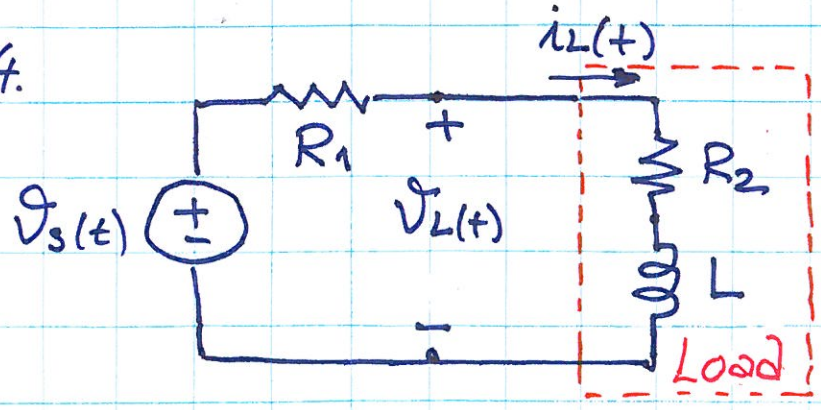
$C = 1\,\mu F$; $R_2 = 10\,M\Omega$

Figure 3.



$R_1 = 1\Omega$; $R_2 = 1\Omega$; $L = \sqrt{2}\,H$; $C = \sqrt{2}\,F$

Figure 4.



$R_1 = 50\Omega$; $R_2 = 350\Omega$; $L = 1H$