SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Fall 2017
ENSC 220: ELECTRIC CIRCUITS I

Final Examination
Saturday, December 16, 2017

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. **(25 points)** Find the Thévenin and Norton equivalent circuits of the op-amp configuration shown in Figure 1:
   (a) Seen between terminals A and B.
   (b) Seen between terminals C and B with source V_s removed.
2. **(20 points)** For the circuit shown in Figure 2:
   (a) Find current $i(t)$ when the switch is in position A.
   (b) Assume that the switch has been in position A for a long time. Find the value of $i(t)$.
   (c) At time $t = 0$ the switch moves from position A to position B. Find current $i(t)$ when the switch is in position B.
3. **(30 points)** The circuits shown in Figure 3 is a two-stage first order cascade circuit.
   (a) Use symbolic values to write the first-order differential equations for $v_1(t)$ and for $v_2(t)$.
   (b) Write the characteristic equation and find natural frequencies of the circuit.
   (c) Find the output $v_2(t)$ when the input $v_s(t) = 5\ u(t)$, $R = 10k\ \Omega$, and $C = 0.1\ \mu F$.
4. **(25 points)** In the circuit shown in Figure 4, $v_s(t) = V_s\ cos(\omega t + \theta)\ V$, $V_s = \sqrt{2}\ 100\ V$, $\omega = 300\ rad/s$, $\theta = 30°$, $R_1 = 50\ \Omega$, $R_2 = 350\ \Omega$, and $L = 1\ H$. The circuit operates in steady-state.
   (a) Find the phasor I_L.
   (b) Find $i_L(t)$.
   (c) Find the complex and average power absorbed by the load.

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Figure 1:

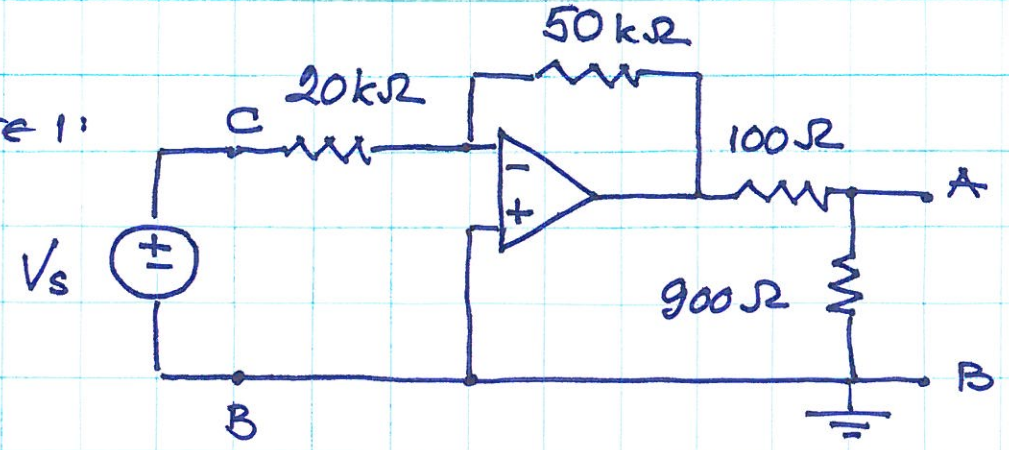

Figure 2:

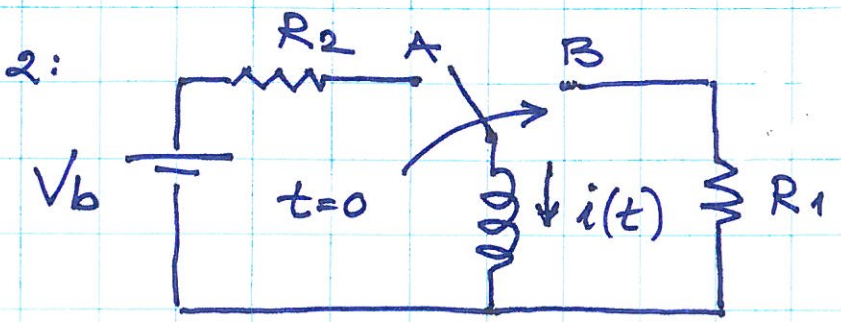

Figure 3:

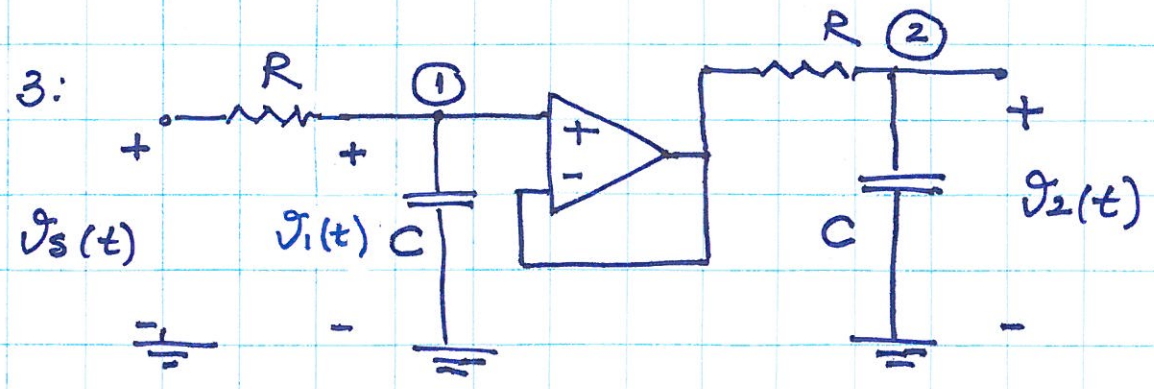

Figure 4: