**University of Toronto**
**Faculty of Applied Science and Engineering**

# Final Exam

April 24, 2015
Duration: 150 minutes

ECE159 - Electric Circuit Fundamentals
Examiners: Ali Sheikholeslami and Li Qian

ANSWER QUESTIONS ON THESE SHEETS, USING THE BACKS IF NECESSARY.

1. Calculator type is restricted (no programmable calculators).
2. Weight for each question is indicated in []. Attempt all questions, since a blank sheet will certainly get a zero.

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maximum grade = 80

**Last Name:** _____

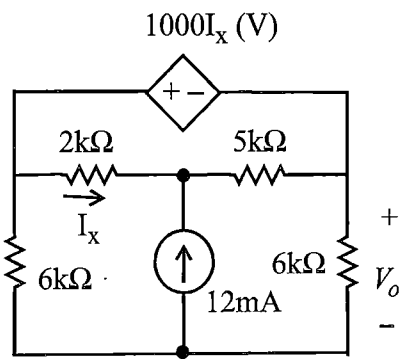
**First Name:** _____

**Student Number:** _____

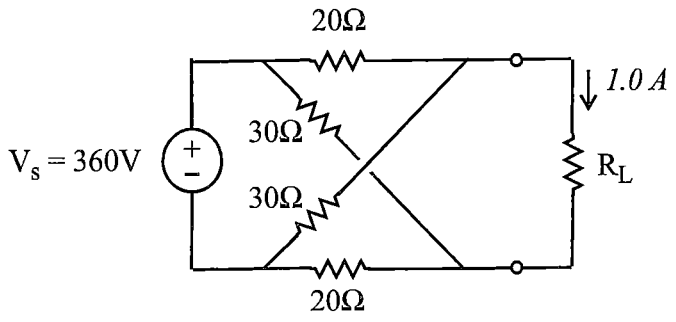
| Question | Mark |
|---|---|
| 1 | ...../10 |
| 2 | ...../10 |
| 3 | ...../10 |
| 4 | ...../10 |
| 5 | ...../20 |
| 6 | ...../20 |
| Total | ...../80 |

Q1. [10 marks] For the circuit shown below, $I_x$ is expressed in Amperes.

Use nodal or mesh analysis to find $V_o$.

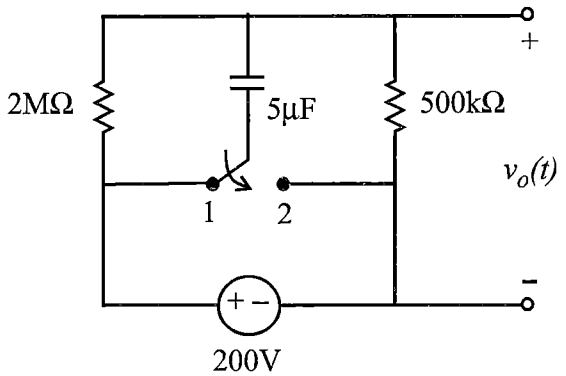


Q2. [10 marks] For the circuit shown below,




Use Thevenin theorem to calculate the load resistance ($R_L$) that draws 1.0A from the output terminals.

Q3. [10 marks] In the circuit shown below,



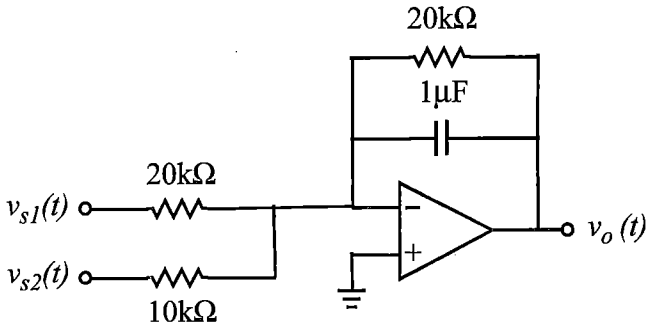

the switch has been in position 1 for a long time. At t = 0, the switch is moved to position 2. Find $v_o(t)$ for t > 0.

Q4. [10 marks] In the circuit shown below, the op-am is ideal. Assume $v_{s1}(t)$ and $v_{s2}(t)$, as well as the voltage across the capacitor, are all 0 before time 0. At time 0, we apply the following voltage waveforms to the circuit:

$v_{s1}(t) = 8\cos(377t)$ *for* $t>0$

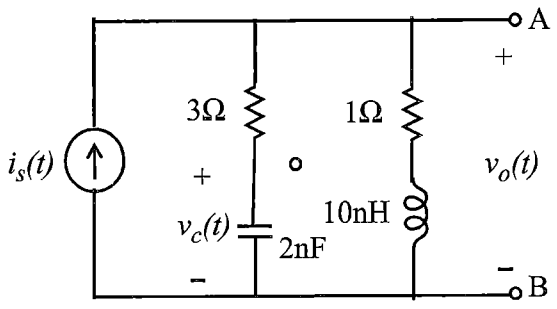
$v_{s2}(t) = 4\cos(377t + \pi/4)$ *for* $t>0$

Find $v_o(t)$ *for* $t>0$. Your answer must include both transient and steady-state response.



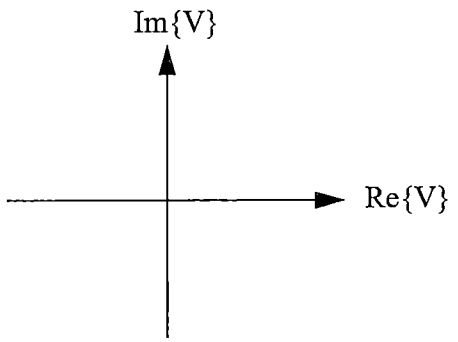
Q5. [20 marks] The circuit shown below is operating in the sinusoidal steady state with $i_s(t) = 4\cos(10^8 t - \pi/4)$ A.

(a) [4 marks] Calculate the phasor associated with the output voltage $v_o(t)$. The phasor should be expressed in rectangular form.




(b) [4 marks] Calculate the phasor associated with the voltage across the 2nF capacitor, $v_c(t)$. The phasor should be expressed in rectangular form.

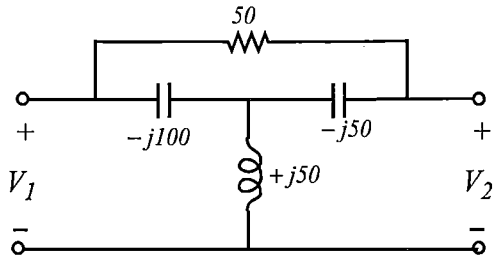
(c) [2 marks] Draw a sketch of the phasor diagram that includes the two phasors found in part (a) and (b). Clearly identify the magnitude and phase of each phasor on your diagram.




(d) [5 marks] Calculate the average power dissipated by the 3Ω resistor.

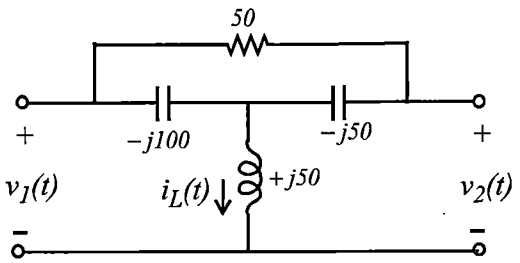
(e) [5 marks] Find the load impedance (to be connected to terminals A and B) that results in maximum power transfer to the load.

Q6. [20 marks] In the two-port network shown below, all the impedances shown are in Ohms.

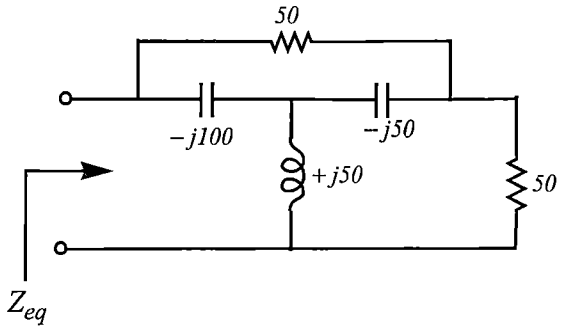



(a) [10 marks] Find the z-parameters of the two-port network. All the z-parameters (complex numbers) must be expressed in rectangular form.

(b) [5 marks] If $v_1(t) = v_2(t) = 10\cos(1000t)$, find the steady-state current, $i_L(t)$, that flows through the inductor. The circuit is repeated here for your convenience.



(c) [5 marks] Find the input impedance of the circuit shown below:



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