Ryerson University
Department of Electrical and Computer Engineering
ELE202-Electric Circuits Analysis
Final Examination
April 27, 2021 - Duration: 3 hours
Examiners: Dr. Mohammadi, Dr. Hossain and Dr. Jassar

I solemnly declare that I will complete this examination independently, with full compliance to the Senate Policy 60 Academic Integrity, and meeting the requirements stated in the examination.

Student Last Name: ..... **Student First Name: .....**

Student Number: ..... **Signature: ..... (Required)**

NOTES:

1. The test is Open book.
2. There are 6 questions, each with subsections. Answer all questions. Please show all working steps.
3. NO QUESTIONS to be asked during the test. If doubt exists as to the interpretation of any question, you are urged to submit with the answer, a clear statement of any logical assumptions made.
4. All the instructions are posted on d2l.

Question No.	***Mark of each question***	***Mark obtained***
Q1	20	
Q2	20	
Q3	20	
Q4	20	
Q5	20	
Q6	20	
Total (120)		

Q 1: [20 marks]

Q 1: Part a) For the circuit given below, switch stays in closed position for long enough time before it opens at time t = 0 sec. Determine an expression for $i_L(t), and\ v_L(t)$ for t>0. Also, draw and label the graph for $i_L(t)$ as a function of time (t). **[10 marks]**

V_1 = (2 times the last digit of your student number) in V. If your student # is 123456789, then V_1=18 V

If your student # is 987654321, then V_1 = 2 V

But, if last digit of your student number is 0, V_1 = (2*10) Volts. If your student # is 123456780, then V1 = 20 V

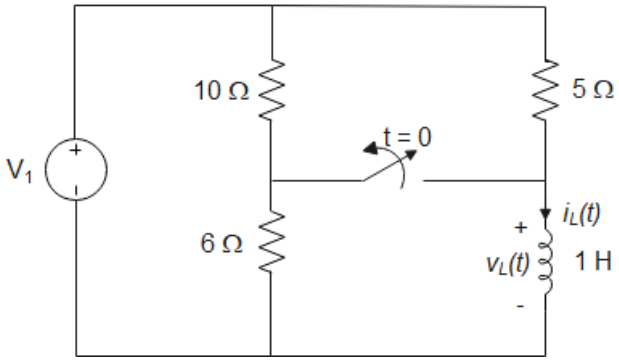

Figure 1 a: RL circuit with DC input

Q 1: Part b) For the circuit given below, the switch stays in position "1" for long enough time before it moves to position "2" at time t = 0 sec. Determine an expression for $v_C(t), and\ i(t)$ for t>0. Also, draw and label the graph for $v_C(t)$ as a function of time (t). **[10 marks]**

V_1 = (2 times the last digit of your student number) in V and I_1 = the last digit of your student number in A.

If your student # is 123456789, then V_1=18 V and I_1 = 9 A

If your student # is 987654321, then V_1 = 2 V and I_1 = 1 A

But, if last digit of your student number is 0, V_1 = (2*10) Volts and I_1 = 10 A. If your student # is 123456780, then V_1 = 20 V and I_1 = 10 A.

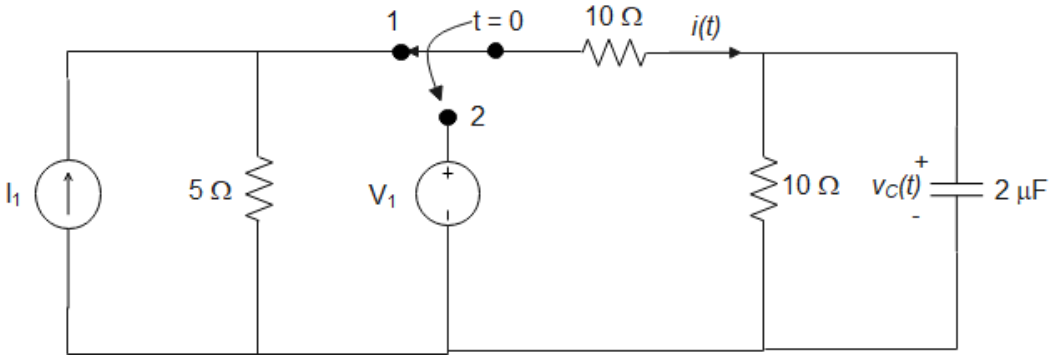

Figure 1 b: RC circuit with DC input

Q 2: [20 marks] Solve the circuit given below using Nodal Analysis. The value of, the voltage sources is in Volts, the current sources is in Amperes, the inductive and capacitive reactance and the resistance is in Ohms.

1. Write the nodal equations at all the non-reference nodes **[6 marks]**
2. Simplify the equations **[4 marks]**
3. Rearrange the equations in Matrix form **[2 marks]**
4. Show all the steps of Cramer's rule to find the Node voltage **[2 marks]**
5. Using a calculator, calculate the numerical values of the Node voltages at all the non reference nodes **[2 marks]**
6. Calculate the values of I_0 and V_0 **[4 marks]**

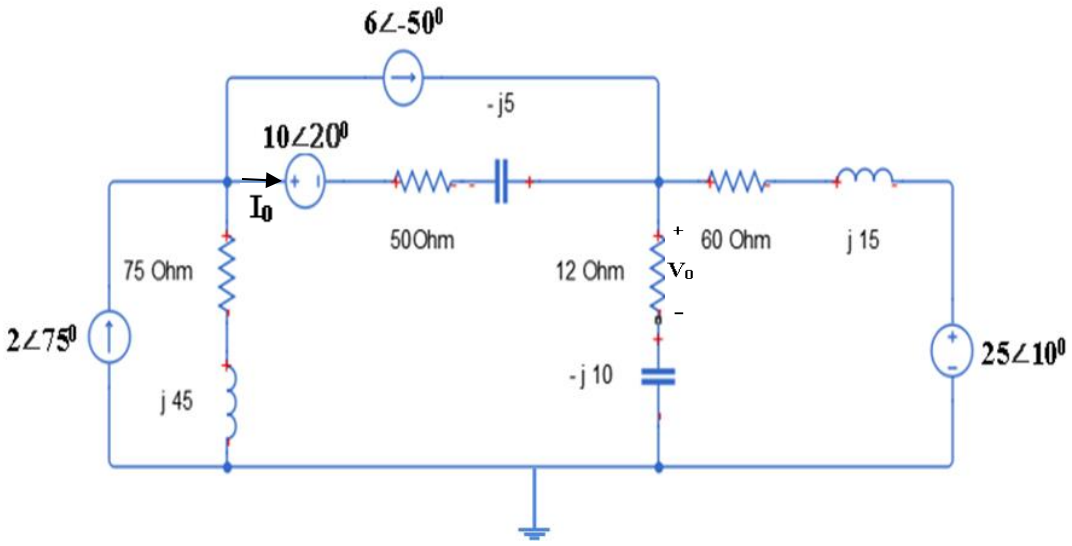

Figure 2: Circuit for Q 2

Q 3: **[20 marks]** Solve the circuit given below using Mesh Analysis. The values of, the voltage source is in Volts, the current source is in Amperes, the inductance is in mH (milli Henry), the capacitance is in µF (micro Farads) and the resistance is in Ohms. The given circuit is in time domain. Convert the circuit into phasor (frequency) domain.

1. Write all the mesh equations **[6 marks]**
2. Simplify the equations **[4 marks]**
3. Rearrange the equations in Matrix form **[2 marks]**
4. Show all the steps of Cramer's rule to find the mesh currents **[2 marks]**
5. Using a calculator, calculate the numerical value for the mesh currents **[2 marks]**
6. Calculate the values of $i_0(t)$ and $v_0(t)$ in time domain **[4 marks]**

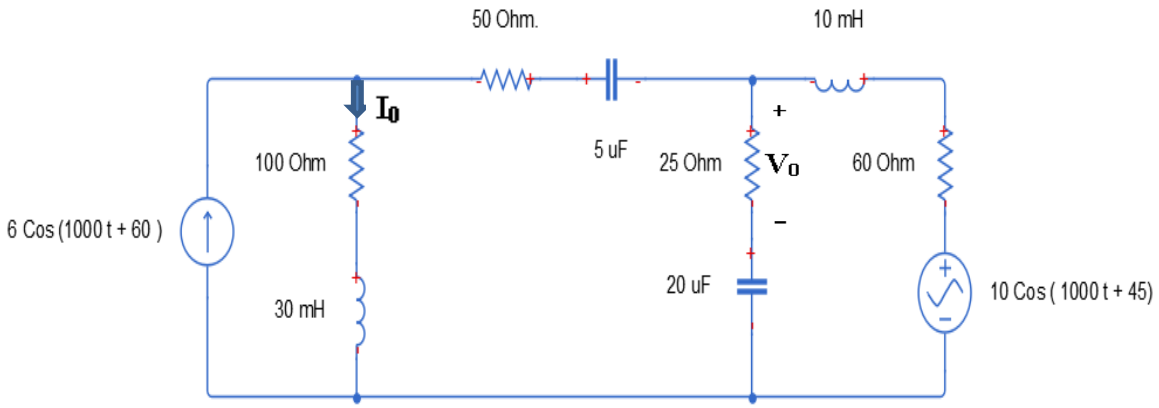

Figure 3: Circuit for Q 3

Q 4: [20 marks] Determine the Thevenin equivalent at terminals $a - b$ of the circuit shown in Figure 4.

1. Calculate the Thevenin equivalent voltage, V_{th}. Use the source transformation technique as an analysis tool. If you use any other methods, marks will not be assigned even the value calculated is correct. **[8 marks]**
2. Calculate R_{th}. **[8 marks]**
3. The variable resistor R_L is adjusted until it absorbs the maximum power from the circuit. Calculate the value of R_L for maximum power **[2 marks]**
4. Determine the maximum power absorbed by R_L **[2 marks]**

Note: The value of the current amplification factor "K" of the dependent source is the largest digit of your student number, e.g., K=6 for a student number "15203465".

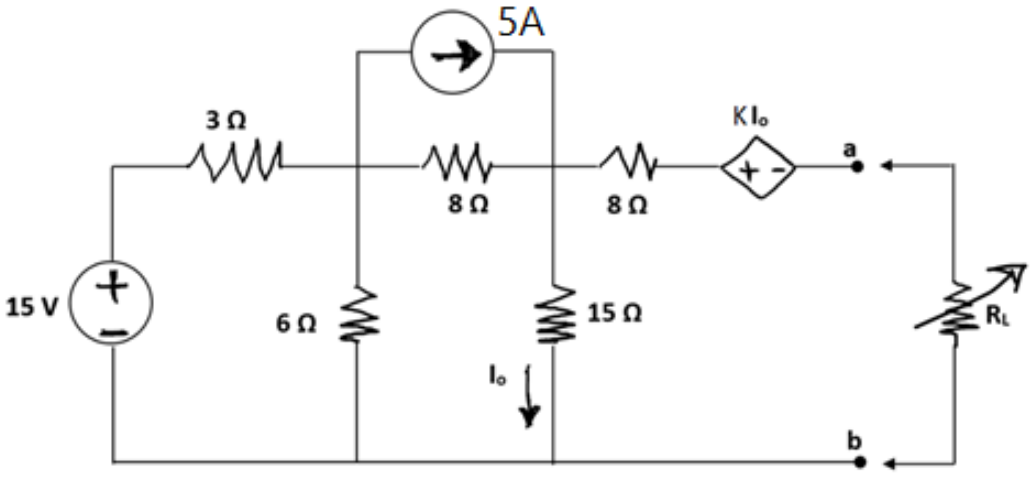

Figure 4: Circuit for Q 4 – Thevenin Theorem

Q 5: [20 marks] Using superposition principle, calculate the current ***i*** in the circuit shown in Figure 5.

1. We have two independent sources. Draw the two circuit configurations required for superposition. The given circuit is in time domain. Each of the two circuits must be converted to Phasor (frequency) domain **[8 marks]**
2. Calculate I (in phasor form) due to current source only. **[4 marks]**
3. Calculate I (in phasor form) due to voltage source only. **[4 marks]**
4. Calculate the total *i(t)* (in time-domain form) due to both sources. **[4 marks]**

Note: The value of "K" in the voltage source at right is the largest digit of your student number, e.g., K=9 for a student number "15203495".

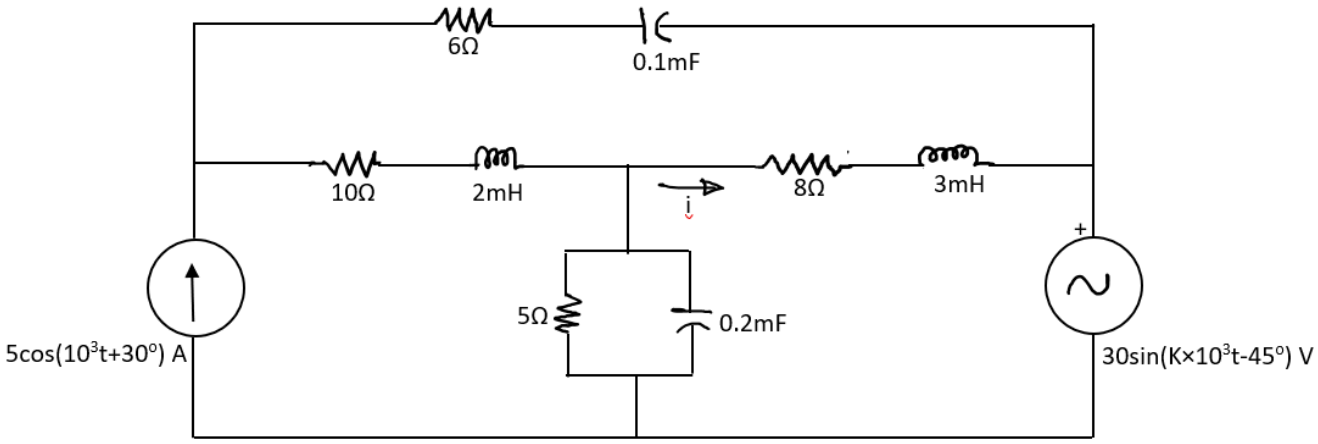

Figure 5: Circuit for Q 5 - Superposition Principle

Q 6: [20 marks] The apparent power entering a certain load Z is 250 VA at a power factor of 0.8 leading. If the RMS phasor voltage of the source is 125 V at 1 MHz:

1. Calculate the complex power consumed by the load **[5 marks]**
2. Calculate the rms value of the current (I_{rms}) going into the load **[5 marks]**
3. Determine Z (both real and imaginary parts) **[5 marks]**
4. The load impedance Z should be of the form $Z = R+j\omega L$ or $Z = R - j(1/\omega C)$. Calculate the value of L or C whichever is applicable. **[5 marks]**

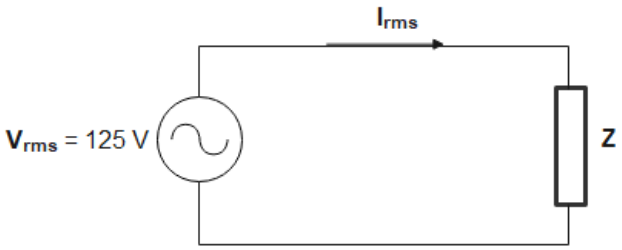

Figure 6: Circuit for Q 6