MAE140 - Linear Circuits - Fall 20
Midterm #1, October 29

Instructions

(i) Prior to the exam, you must have completed the Academic Integrity Pledge at `https://academicintegrity.ucsd.edu/forms/form-pledge.html`

(ii) The exam is open book. You may use your class notes and textbook.

(iii) Collaboration is not permitted. Your answers must be the result only of your own work.

(iv) The exam has 2 questions for a total of 20 points.

(v) You have from 2:00pm to 3:20pm. Please allow sufficient time to post your answers in Canvas.

(vi) If there is any clarification needed for a statement, post your question in the "Discussions" tab of the class Canvas webpage ("Clarifications on question statements of midterm1")

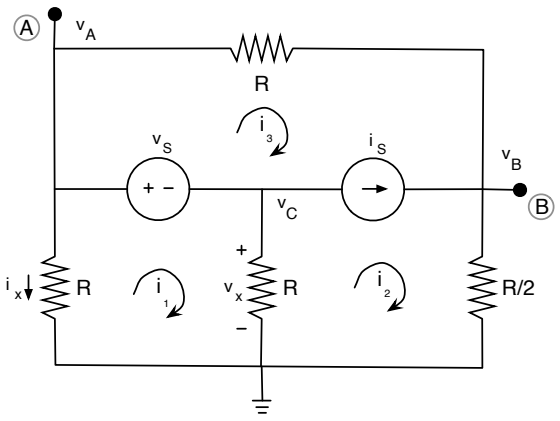

Figure 1: Circuit for all questions.

Good luck!

1. **Circuit analysis**

   Part I: [5 points] Formulate node-voltage or mesh-current equations for the circuit in Figure 1. Use the node labels provided in the figure. Clearly indicate the final equations and circuit variable unknowns. The final equations in matrix form must depend only on unknown node-voltages or mesh-currents. **Do not modify the circuit or the labels**. No need to solve any equations!

   Part II: [3 points] Provide expressions for the mesh currents i_1, i_2, and i_3 in terms of the node voltages.

   Part III: [2 points] Provide expressions for the voltage v_x and the current i_x in terms of node voltages.

2. **Linearity and Equivalent circuits**

   Part I: [2 points] Turn off all the sources in the circuit of Figure 1 and find the equivalent resistance as seen from terminals Ⓐ and Ⓑ.

   Part II: [3 points] Turn off the voltage source and compute the open-circuit voltage as seen from terminals Ⓐ and Ⓑ using association of resistors and current division.

   Part III: [3 points] Turn off the current source and compute the open-circuit voltage as seen from terminals Ⓐ and Ⓑ using association of resistors, source transformations, and voltage division.

   Part IV: [2 points] Use your answers to Parts I-III to determine the Thévenin equivalent of the circuit as seen from terminals Ⓐ and Ⓑ.