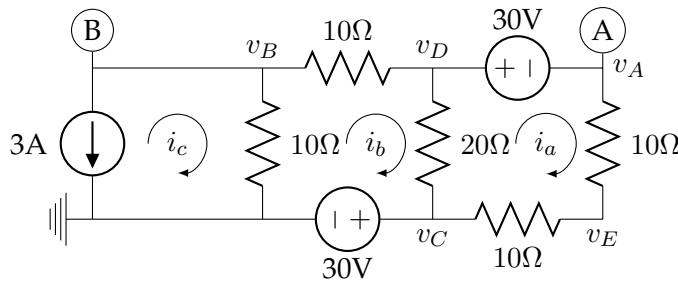


MAE140 - Linear Circuits - Fall 2018
Midterm, October 23rd

Instructions

1. This exam is open book. You may use whatever written materials you choose, including your class notes and textbook. You may use a hand calculator with no communication capabilities.
2. You have 70 minutes.
3. Write your answers on your "Blue Book".
4. Do not forget to write your name, student number, and instructor.
5. This exam has 3 questions, for a total of 30 points.



Hint:

$$\begin{bmatrix} 40 & -20 \\ -20 & 40 \end{bmatrix}^{-1} = \frac{1}{30} \begin{bmatrix} 1 & 1/2 \\ 1/2 & 1 \end{bmatrix}$$

1. Node Voltage Analysis

- (a) (6 points) Apply a source transformation to eliminate v_A and formulate node-voltage equations for the circuit above. Use the node-voltages and labels provided in the figure and clearly indicate the final equations and circuit variable unknowns. Make sure your final equations involve only node-voltages. You do not need to solve any equations.
- (b) (1 point) Explain how you could solve for the node voltage v_A .
- (c) (3 points) Explain how you could solve for the mesh-currents i_a , i_b , and i_c after having calculated the node-voltages.

2. Mesh Current Analysis

- (a) (4 points) Apply a source transformation to eliminate i_c and formulate mesh-current equations for the circuit above. Use the mesh-currents and labels provided in the figure and clearly indicate the final equations and circuit variable unknowns. Make sure your final equations involve only mesh-currents. You do not need to solve any equations.
- (b) (1 point) Explain how you could solve for the mesh current i_c .
- (c) (5 points) Explain how you could solve for the node voltages v_A through v_E after having calculated the mesh-currents.

3. Equivalent Circuits

Answer the following questions to calculate the equivalent as seen from terminals (A) and (B).

- (a) (4 points) Solve the mesh-current equations from Question 2 to show that $v_A = -10V$ and $v_B = -5V$. *Hint: use the hint!*
- (b) (3 points) Set all sources to zero and calculate the equivalent resistance as seen from terminals (A) and (B).
- (c) (3 points) Use the answers to Parts (a) and (b) to calculate the Thevenin and Norton equivalent circuits as seen from terminals (A) and (B).