Circuit Analysis Homework 3

Professor: Brian Frost

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1. Using the principle of source transformation, briefly describe why Norton's and Thevenin's Theorems are logically equivalent. Include the relationship between V_{TH} and I_N, as well as that between R_{TH} and R_N.
2. For the circuit in Figure 1, we cannot use either of mesh or nodal analysis to solve the circuit. Apply a source transformation, and use one of mesh or nodal analysis to solve the circuit (only one of these methods is possible).
3. For the circuit in Figure 1, define the output as the voltage across R_L (or equivalently R_0 or the dependent source). Solve for V_{TH} and R_{TH}. Really solve for them, as in don't just make matrices and tell me how to find them – the circuit is simple enough.
4. What is the maximum power that this circuit can transfer to a load? To what load is this power transferred?
5. Using the method of superposition, write out two matrix equations that can be used to solve for the current through resistor R_1 in Figure 2. Explain how, if these equations were solved, one could solve for this current.
6. Let the output of the circuit in Figure 2 be the voltage across resistor R_3. Using matrix methods to generate expressions that could determine the Thevenin voltage and resistance. Explain how, if one were to solve these equations, one would find these values.
7. On your exam, we discussed output impedance. Z_{out} is defined as the equivalent resistance across the output when all independent sources are turned off. In fact, for circuits with only resistors and sources, Z_{out} is the same as R_{TH}! Find the output impedance of the amplifier in Figure 3 – represent the circuit in its Thevenin equivalent and Norton equivalent forms. For this problem, consider the input to be an independent voltage source with voltage V_{IN}.
8. Consider a simple circuit in which a single capacitor of value C is hooked up to a current source with current $I(t) = H(t)A\sin(\omega t)$. What is the voltage across the capacitor $v(t)$? What is the phase difference between the current and voltage across the capacitor?
9. Consider a simple circuit in which a single inductor of value L is hooked up to a voltage source with current $v(t) = H(t)A\sin(\omega t)$. What is the current through the inductor $i(t)$? What is the phase difference between the current and voltage across the inductor?
10. Fill in the blanks:
    At DC, an inductor acts like a _____
    At DC, a capacitor acts like a _____
    The _____ a capacitor cannot change abruptly
    The _____ an inductor cannot change abruptly

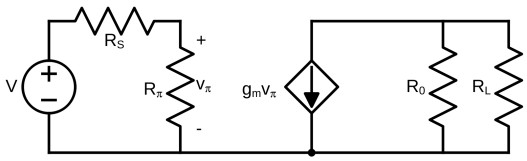

Figure 1: A circuit from your exam!

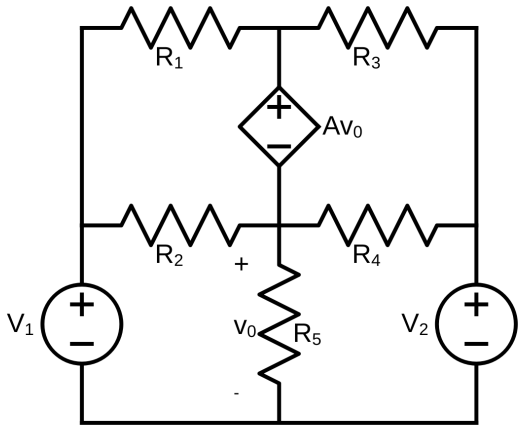

Figure 2: Another!

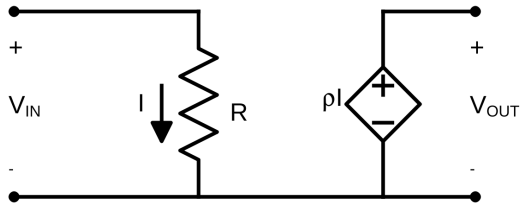

Figure 3: And another!