EE 210

MIDTERM # 2

March 3, 2003

Last Name:______________  First Name:______________

Student ID#:_____________________

Section # (Important):_____________

Note:
1. This is a closed-book closed-note exam. No study materials should be visible or accessible during the exam.
2. Exam is comprised of five (5) problems, some with multiple parts.
3. Exam consists of nine (9) pages including cover-page and a blank page.
4. You must return all nine pages including cover page and the blank page.
5. You must show all work and box your answers.
6. You have one hour and 15 minutes to complete the exam.

DO NOT WRITE BELOW THIS LINE:

Problem 1 (20 points)_____________

Problem 2 (20 points)_____________

Problem 3 (20 points)_____________

Problem 4 (20 points)_____________

Problem 5 (20 points)_____________

TOTAL (100 points) : ______________
1. For the op amp circuit in figure (a), consider the case when the op amp is non-ideal with a finite open-loop gain $A = 500$ but with infinite input resistance $R_{\text{in}} \to \infty$ and zero output resistance $R_{\text{out}} = 0$. The model of such an op amp is shown in figure (b).
   a. Redraw the entire network of figure (a) by replacing the non-ideal op amp with the op amp model of figure (b). (7 points)
   b. What are the nodal voltages $V_+, V_A,$ and $V_B$? (3 points)
   c. Write the nodal equation needed to find $V_o$. (7 points)
   d. Combine the results of Parts (b) and (c) to find $V_{\text{out}}$. (3 points)
1. (cont.)
2. Using source transformations, find the voltage $V_x$ in the circuit below. For full credit, you must reduce the network to the 2 $\Omega$ resistor and no more than two practical sources (a practical source is a voltage source in series with a resistor or current source in parallel with a resistor). (20 points)
3. Using superposition, find the value of \( V_x \) in the circuit below. (20 points)
4. Consider the circuit shown below. For full credit, answer the following questions in the order.

a. What value of load resistance $R_L$ will result in the maximum power transfer? (5 points)

b. What is the value of the open-circuit voltage when the load resistance is removed? (5 points)

c. What is the maximum power that can be delivered to the load resistance (assume $R_L$ has the value found in Part a and has been re-installed)? (5 points)

d. If the load resistance is now changed to 20 Ω, what is the power delivered to it? (5 points)
5. For the circuit shown in figure (a), $a$ and $b$ represent the output terminals.

a. Find the short circuit current for the Norton equivalent circuit. (8 points)
b. Find the equivalent resistance for the Norton equivalent circuit. (8 points)
c. If a load resistor, $R_L = 12\ \Omega$, is attached across the output terminals, as shown in figure (b), find the voltage $V_o$ across it. (4 points)
5. (cont.)
Blank page to be used for any problem(s) requiring additional space. Be sure to indicate that a problem is continued on this page. If multiple problems are continued on this page, be sure that the work is clearly identified with the appropriate problem number.