Score summary
(leave blank):

Extra: ____
P1: ____
P2: ____
P3: ____
P4: ____
Total: ____

Name: ___________________________
SID: ___________________________
Name of student at your left:
____________________________________
Name of student at your right:
____________________________________

UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering
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Midterm 1 EECS 42/100
Solution FALL 2006

• Closed book, closed notes.
• No calculators.
• Copy your answers into marked boxes on exam sheets.
• Simplify numerical and algebraic results as much as possible.
  Up to 10 points penalty for results that are not reasonably simplified.
• Mark your name and SID at the top of the exam and all extra sheets.
• Be kind to the graders and write legibly. No credit for illegible results.
• No credit for multiple differing answers for same problem.

Grading:
• Max partial credit for any problem: 23pts (25pts only for correct results)
• Sign error: -3pts
• Result in terms of G’s (rather than R’s): -3pts
Problem 1 [25 points]

Find an algebraic expression for $V_o$. Assume that the operational amplifier is ideal.

$$V_o = \left( I_1 - \frac{V_1}{R_4} \right) \left( R_1 \parallel R_3 \right) = \left( I_1 - \frac{V_1}{R_4} \right) \frac{R_4 R_3}{R_1 + R_3}$$

Partial credit:
- I1 term: 12 pts max
- V1 term: 13 pts max
- Sign error -3pts
- If result wrong but recognized that I2, R2, R5 are irrelevant: 4pts each
- Recognized R1//R3: 8pts
Problem 2 [25 points]

Find an algebraic expression for $V_x$.

\[
V_x = \left( V_1 - I_1 R_5 \right) \frac{R_6}{R_5 + R_6}
\]

Partial credit:
- V1 term: 12 pts max
- I1 term: 13 pts max
- Sign error -3pts (each sign)
- If result wrong but recognized that independent of
  - R2: 4pts
  - R1: 5pts
  - R3: 5pts
  - R4: 7pts
- If result wrong but attempted to solve with superposition: 6pts
Problem 3 [25 points]

Draw a Norton equivalent for terminals (A,B) in the circuit shown above and specify algebraic expressions for the element values.

Norton equivalent circuit (mark terminals A, B):

\[ I_N = -I_2 \text{ (plus arbitrary current though I1)} \]

\[ R_N = R_1(1-a_x) + R_2 \]

Partial credit:
- Equivalent circuit: 10pts
- \( I_N \): 5pts
- \( R_N \): 10pts (Voc only: 8pts)
- Sign errors: -3pts
Problem 4 [25 points]

Find an algebraic expression for the power delivered to the circuit by the controlled current source $I_1$.

\[
i_x = \frac{-V_1}{R_2(1-A) + R_3}
\]

\[
V_x = -i_x R_3
\]

\[
P = -V_x A i_x = AR_3 i_x^2
\]

\[
P = AR_3 \left(\frac{V_1}{R_2(1-A) + R_3}\right)^2
\]

Partial credit:
- Power $-V_x A i_x$ is 10 pts
- $i_x = f(V_1, R_2, R_3, A)$ is 18 pts
- $V_x$ is 10 pts (5 pts for $-i_x R_3$)
- Correct units (result $\sim V_1^2$: 8 pts)
- Sign errors: -3 pts