Midterm #1 March 5th, 2003

Closed Book, Closed Notes
Write on the Exam paper

Print Your Name:____________________
Sign Your Name:____________________

Show your work so that the method as well as the answer can be graded for correctness and completeness. Correct answers alone are only worth 70% of full credit.

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<th>Problem</th>
<th>Possible</th>
<th>Score</th>
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<td>I</td>
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<td>II</td>
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<td>III</td>
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I (28 Points) Basic Circuit Analysis

\[
\begin{align*}
&\text{Problem Possible Score} \\
&\quad I \quad 28 \\
&\quad II \quad 22 \\
&\quad III \quad 25 \\
&\quad IV \quad 25 \\
&\quad \text{Total} \quad 100
\end{align*}
\]
$V_{AA} = 2V$  $I_{ss} = 1 \text{ mA}$

$R_1 = 1k\Omega$  $R_2 = 2k\Omega$  $R_3 = 3k\Omega$

a) (7 points) Find $R_{TH}$.

b) (7 points) Find $V_{OC}$.

c) (7 points) Find the power delivered to the circuit by $V_{AA}$.

d) (7 points) Find the voltage on the current source $I_{ss}$ in the direction shown on the diagram.
II (22 Points) Load Lines

A linear circuit is connected to a nonlinear load.

a) (12 points) Find the combination of current $I$ and voltage $V$ that satisfies both the circuit and the load.

b) (10 points) Adjust $R_2$ so that the solution passes through the point indicated on the device curve.
III (25 Points) Transient

The switch in the circuit closes at \( t = 0 \). Just before switching, the capacitor is charged to 2V.

a) (18 points) Find the voltage on the capacitor \( V_C(t) \) for \( t > 0 \).

b) (7 points) Find \( \frac{dV_C(t)}{dt} \) just prior to the switch closing at \( t = 0 \).

IV (25 Points) Node Equations
a) (15 points) Assign labels to the nodes and write a complete set of node equations for determining the node voltages. (These equations should contain only the node voltages themselves, resistances, source strengths and the device current.)

\[ R_1 = 1 \text{k}\Omega \quad R_2 = 2 \text{k}\Omega \quad R_3 = 3 \text{k}\Omega \quad R_3 = 3 \text{k}\Omega \]
\[ V_{AA} = 5 \text{ V} \quad I_{SS} = 1 \text{ mA} \]

b) (10 points) Use one of your node equations from above to find the voltage on \( I_{SS} \) when the voltage on the device is 2V. (Hint: Substitute the device voltage to break the equations apart to avoid excessive algebra).