ENGR201 Midterm 2

11/10/2011

Access/use of any calculating devices other than those approved for this test are forbidden. Use of writings, papers, communications devices or other assistance, including communicating with other students or looking at anyone else's papers are forbidden during this test. All are cheating. Do not use your own scrap paper. If any is needed, it will be supplied. Do not communicate with other students until they have submitted your tests and have left the room.

By signing below, I certify that:

I am the person whose name appears of this test.
I am currently registered in this course.
I understand all the class policies, both those in the syllabus and stated here.
I understand that all acts of cheating or other misconduct will be subject to disciplinary action.

Signature: ____________________________

Student Name: _______________________
(printed)

Date: ______________________________

Lab Section: ________________________

Individual problem scoring:

| Problem 1 | ________ | /20 |
| Problem 2 | ________ | /30 |
| Problem 3 | ________ | /20 |
| Problem 4 | ________ | /30 |
| Total | ________ | /100 |

This area to be filled in by the grading TAs only.
1. Use superposition to find \( I_x \) in the circuit below. Your work should clearly show the use of superposition or no credit will be given.

\[ I_x = -0.3 + 0.125 + 0.05 = -0.125A \]
2. Find the Norton equivalent circuit between terminals A and B in the circuit below. Dependent SRC present, find \( R_N \) by applying ext. SRC + kill 4V SRC.

\[ -\frac{V_2}{2000} + \frac{V_x}{4000} + \frac{1 - V_2}{3000} = 0 \]
\[ -6V_2 + 3V_x + 4 - 4V_2 = 0 \]
\[ -10V_2 + 3V_x = -4 \]

Need to relate \( V_2 + V_x \), stuck?

Instead, try 1A SRC...

\[ \frac{V_2}{2000} + \frac{V_x}{4000} = -1 \]

Needs to relate \( V_2 + V_x \) again...

\[ V_2 = V_x - 1(3000) \]
\[ V_2 = V_x - 3000 \]

\[ -\frac{(V_x - 3000)}{2000} + \frac{V_x}{4000} = -1 \]
\[ -2V_x + 6000 + V_x = -4000 \]
\[ -V_x = -10000 \]
\[ V_x = 10000 \]

\( R_N \) = \( \frac{10000}{1} = 10k\Omega \)

Short circuit current:

\[ I_{sc} = \frac{4}{5000} = 0.8mA \]
3. C  I use source transformation to change the circuit to the left of the terminals to a single series loop that includes $R_L$. Using that circuit...

a) If $R_L = 1.4 \Omega$, how much power is dissipated by $R_L$?

b) What is the maximum power that can be delivered to $R_L$?

$$a) R_L = 1.4 \Omega \quad R_{\text{total}} = 3 \Omega \quad I = \frac{240}{3} = 80A$$

$$P_{R_L} = (80)^2(1.4) = 8760 \text{W}$$

$$b) P_{\text{max}} \text{ occurs when } R_L = R_{\text{th}}$$

$$I = \frac{240}{3.2} = 75A$$

$$P_{\text{max}} = (75)^2(1.6) = 9000 \text{W}$$
For the circuit below, find $i_x + V_o$. Assume an ideal opamp.

$+$ terminal: $V_2 = 6 \left( \frac{2}{12} \right) = 1V$; so $V_1 + V_2 = 1V$

$KCL$: $V_1 \frac{1-V_1}{2000} + \frac{0.5-V_1}{2000} - \frac{V_1-V_0}{10000} = 0$; and $V_1 = 1V$

$\frac{4-1}{2000} + \frac{0.5-1}{2000} - \frac{1-V_0}{10000} = 0$

$\frac{-0.5}{2000} - \frac{1-V_0}{10000} = 0$

$-2.5 - 1 + V_0 = 0$

$V_0 = 1 + 2.5$

$V_0 = 3.5V$

$i_x = \frac{V_1 - V_0}{10000} = \frac{4 - 3.5}{10000} = \frac{2.5}{10000}$

$= 250mA$

6 min