Name: ______________________________________ **(Print)**

Signature ______________________________________

Date: ____________

ECE 2300 -- Quiz #4

S.R. Brankovic Section – TuTh 8:30 AM

Tuesday, March 21, 2006

KEEP THIS QUIZ CLOSED AND FACE UP UNTIL YOU ARE TOLD TO BEGIN.

1. This quiz is closed book, closed notes.
2. Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit. **If your work continues on to another page, indicate clearly where your work can be found. Failure to indicate this clearly will result in a loss of credit.**
4. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
5. Do not use red ink. Do not use red pencil.
6. You will have 25 minutes to work on this quiz.

________________/100 %

Problem #1.

For the circuit shown in Figure 1, R_1=2 kΩ, R_2 = 20 kΩ, R_3 = 5kΩ, R_4=3 kΩ, R_5 =15 kΩ, E_2 = 24 V, and i_g = 20mA. Find the current i_x.

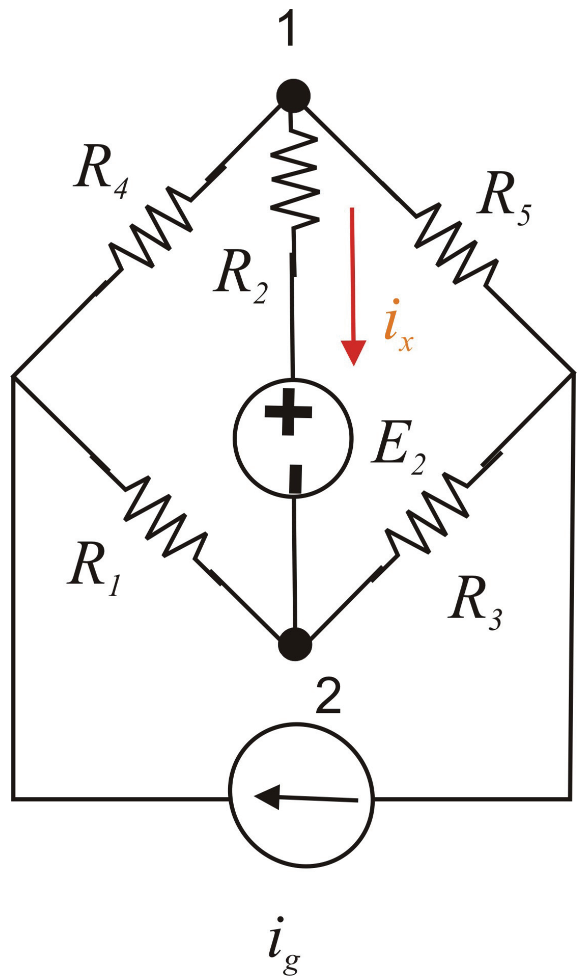

Figure 1

<u>Solution.</u>

This problem could be solved on many different ways; however, the one that is straight forward in terms of the engineering logic is to use our knowledge of Thevenin's and Norton's theorem. This means that we should look to the branch of the circuit with current i_x as the one that could be connected to the rest of the circuit represented by Thevenin's or Norton's equivalent. Since we have only a current source involved, choosing the Norton's equivalent is more convenient. So, the simplified circuit now should look like the one presented in Figure 2.

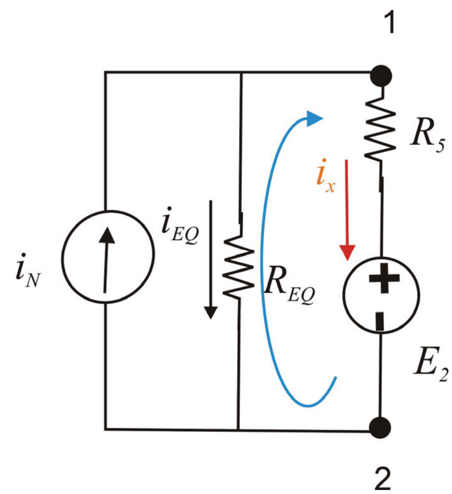

Figure 2

Now we have to find the R_{EQ} and i_N. To find the R_{EQ}=R_N is straight forward if we consider the circuit in Figure 3, which is the circuit seen by the branch 1-2 with the current source taken out.

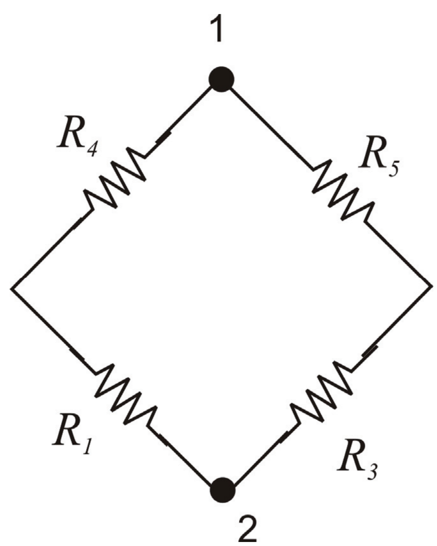

Figure 3.

The R_{EQ} is then;

$$R_{EQ} = R_N = \frac{(R_1 + R_4)\cdot(R_3 + R_5)}{R_1 + R_4 + R_3 + R_5} = 4[k\Omega] \tag{1}$$

In order to find the short circuit current i_{SC}, (i_{SC}, = i_N), we have to consider the circuit shown in Figure 4,

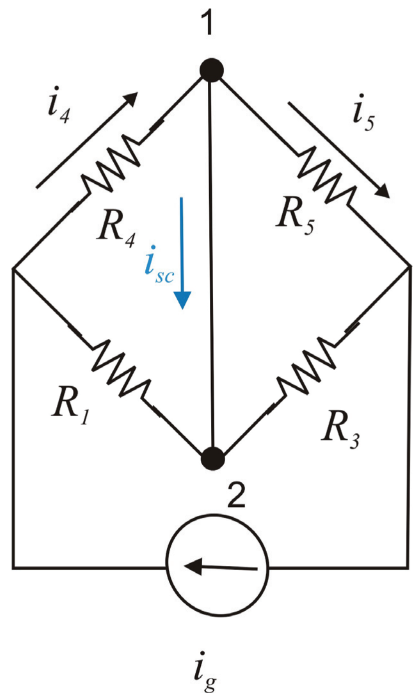

Figure 4.

Using the current divider rule, and writing the KCL for the node 1, we get:

$$i_{SC} = i_N = i_4 - i_5 = i_g\left(\frac{R_1}{R_1 + R_4} - \frac{R_3}{R_3 + R_5}\right) = 3[mA] \quad (2)$$

Now from Figure 2 it is straight forward that:

$$i_{EQ} = i_N - i_x \text{ (KCL, upper node)} \quad (3)$$

and

$$(R_{EQ}(i_x - i_N) + i_x R_5 + E_2 = 0 \Rightarrow i_x = \frac{i_N R_{EQ} - E_2}{R_5 + R_{EQ}}; \text{ (blue KVL)} \quad (4)$$

Substituting values of R_{EQ} from (1) and i_N from (2) into (4) yields:

$$i_x = -0.5[mA]$$