EE101 Homework #1 Answers Fall 2011

Due at the beginning of class Monday, Oct. 3, 2011

This homework is based on lectures 1 through 3, and chapters 1 & 2 of your textbook. The problems are in the order of your textbook chapter and are related to different sections of the text as noted below. Each problem is worth 9 points out of 100 – you get one point for turning in the homework. (On the handed out sheets 2.54 was circled by mistake – If you did it you get a little extra credit.) You must show your work for each problem and put a box around your answer.

Textbook Section 2.2 on Ohm’s Law: Problems on page 67: 2.3 & 2.4

2.3: For silicon, \( \rho = \text{6.4} \times 10^2 \text{ } \Omega \cdot \text{m} \). \( A = \pi r^2 \). Hence,

\[
R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2} \quad \Rightarrow \quad r^2 = \frac{\rho L}{\pi R} = \frac{6.4 \times 10^2 \times 4 \times 10^{-2}}{\pi \times 240} = 0.033953
\]

\( r = \text{0.1843 m} \)

2.4:

(a) \( i = \frac{15}{100} = \text{150 mA} \)
(b) \( i = \frac{15}{150} = \text{100 mA} \)

Textbook Section 2.3 on Nodes, Branches and Loops: Problem on page 68: 2.7

2.7:

(a)

6 branches and 5 nodes.

(b)

7 branches and 5 nodes.
Textbook Section 2.4 on Kirchoff’s Laws: Problems on pages 68 & 69: 2.11 & 2.17

2.11

\[-V_1 + 1 + 5 = 0 \rightarrow V_1 = 6 \text{ V}\]
\[-5 + 2 + V_2 = 0 \rightarrow V_2 = 3 \text{ V}\]

2.17

Applying KVL around the entire outside loop we get,

\[-24 + v_1 + 10 + 12 = 0 \text{ or } v_1 = 2\text{V}\]

Applying KVL around the loop containing \(v_2\), the 10-volt source, and the 12-volt source we get,

\[v_2 + 10 + 12 = 0 \text{ or } v_2 = -22\text{V}\]

Applying KVL around the loop containing \(v_3\) and the 10-volt source we get,

\[-v_3 + 10 = 0 \text{ or } v_3 = 10\text{V}\]

Textbook Sections 2.5 on Series resistors and voltage division and Section 2.6 on parallel resistors and current division: Problems on page 70 & 71: 2.32 and 2.40

2.32 We first combine resistors in parallel to get .

\[12 \Omega \text{ and } 8 \Omega\]

Using current division principle we find currents 1 through 4 below (in order),

\[3.2 \text{ A }\]  \[4.8 \text{ A }\]  \[2.4 \text{ A }\]  \[9.6 \text{ A}\]

2.40:

Use series and parallel combination of resistors, beginning at the right of the circuit to get.

\[R_{eq} = 5 \Omega \quad I = 2 \text{ A}\]

Textbook Section 2.7 on Wye-Delta transformations: Problem on page 74: 2.51

2.51:

This one was on delta and wye transformations and as noted on the homework in section 2.7 of your text. You must read all the appropriate Chapters in your textbook to do well in this course.
2.54:

a to b: Ignore 60Ω, no current can flow through it. 100Ω, and two 150Ω are in series to make 350Ω which is in parallel with the 100Ω making 77.8Ω. The 77.8Ω in series with the 50Ω makes \( R_{eq} = 127.7 \Omega \).

c to d: Ignore the 50Ω and proceed as in the part above.

Textbook Section 2.8 on Applications: Problem on page 75: 2.62

2.62:

\[ p_A = 110 \times 8 = 880 \text{ W}, \quad p_B = 110 \times 2 = 220 \text{ W} \]

Energy cost = $0.06 \times 365 \times 10 \times (880 + 220)/1000 = \$240.90
Comprehensive problems drawing on all parts of Ch. 2: Problems on pages 78 & 79: 2.79 & 2.82.

2.79:
Since $p = \frac{v^2}{R}$, the resistance of the sharpener is

$R = \frac{v^2}{(p)} = \frac{6^2}{(240 \times 10^{-3})} = 150$

$I = \frac{p}{(v)} = \frac{240 \text{ mW}}{6 \text{ V}} = 40 \text{ mA}$

Since $R$ and $R_x$ are in series, $I$ flows through both.

$IR_x = V_x = 9 - 6 = 3 \text{ V}$

$R_x = \frac{3}{(I)} = \frac{3}{(40 \text{ mA})} = \frac{3000}{(40)} = 75 \Omega$

2.82:
This is similar to problem 2.54 and proceeds similarly using series and parallel resistor combinations to get

$R_{12} = 80 + 8.33 = 88.33 \Omega$

$R_{13} = 80 + 8.33 + 20 = 108.33 \Omega$

$R_{14} = 80 + 20 = 100 \Omega$ no current flows through the 10 and 40 ohm resistors because of the short across them