ECEN 2420, Electronics for Wireless, Spring 2016
Prof. Zoya Popovic

IN-LAB HOMEWORK 1

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**Turn in:** Monday, January 25, in Homework Session 6:15-9:30pm

**Homework Policy:** You are allowed to work with others on homework, BUT under 2 rules:

- **Rule 1:** You write your own solutions.
- **Rule 2:** You list all the other students with whom you collaborated on the assignment at the top of your homework.

1. What is the following in dB?

2V → ____________ dB

10mW → ____________ dBm

1kW → ____________ dBW

0.1mV → ____________ dBV

G=20 → ____________ dB (assume power gain)

2. What is the following in volts or watts?

-13dBm → ____________

6dBV → ____________

-100dBm → ____________

30dBm → ____________

33dBm → ____________

43dBW → ____________
3. A few resistors are shown in the photograph below. Identify the value and power handling of each resistor.

\[ \begin{align*}
R_1 &= \quad R_2 &= \quad R_3 &= \quad R_4 &= \quad R_5 &= \quad R_6 &=
\end{align*} \]

4. The figure below shows a Thevenin source with a load resistor \( R_l \). Find the formula for the power in the load. Find the load resistance \( R_l \) that gives the maximum power. What is the maximum load power? Repeat for the Norton equivalent source to check that the result is the same. (Problem 1.A in the book.)
5. The figure below shows two resistive circuits that appear often in attenuators, which are used to reduce the power of a signal and can prevent radios from overloading or sensitive instruments from blowing up. The left is called a $T$ network and the right a $\pi$ network. For each network, find the parameters needed to make Thevenin and Norton equivalent circuits: $V_0$, $I_S$, and $R_S$. (Problem 1.B in the book.)

6. Write the equivalent resistance $R_{eq}$ for 3 resistor ($R_1$, $R_2$, $R_3$) in parallel, capacitance $C_{eq}$ for 3 capacitors ($C_1$, $C_2$, $C_3$) in parallel and inductance $L_{eq}$ for 3 inductors ($L_1$, $L_2$, $L_3$) in parallel.
7(E): Sources (after Problem 2 in textbook)

In this exercise, we will find the Thevenin equivalent circuit of a source (battery). Connect the positive lead from the 9-V battery to the top row of holes on the breadboard, and the negative lead to the bottom row. Use black wire for low voltage and red for higher voltage, this is the usual convention and if you follow it you will blow fewer circuits.

Measure the open-circuit voltage of your source.

\[ V_{oc} = \quad \] 

The battery has a low internal resistance (a few ohms). Connect the \( \frac{1}{2} \)-watt 270-Ω resistor between the positive and negative terminals by plugging them into the corresponding holes. Measure the voltage and current using a multimeter. It might be hard to get a reading, so you can put a 100-ohm resistor in parallel. Plot the voltage as a function of the current using the nominal value for the resistors you used.

When you fill in the plot, make sure you add:
- Units
- Axes scales that you carefully chose to represent the data as meaningfully as possible
- Draw a smooth curve connecting the points
8(E): Equivalent circuit for source

Find an equivalent circuit for the battery, consisting on an ideal voltage source $V_0$ and a resistor $R_S$ when the current is around 20mA. This circuit will not be accurate for different current values.

$$V_0 = \text{__________} \quad R_S = \text{______________}$$

9(E): NorCal 40A current draw

Assume that the NorCal 40A radio draws 20mA when it is receiving. What voltage would you expect from the battery?

Supply (battery) voltage for 20mA will be ________________

If the battery has an amp-hour rating of 0.04A-hr, how long would you be able to operate the radio in receive mode?

The radio could receive for ________________. (time)
10. An RC and an LC circuit are shown below.
   a) Find the time constant and sketch the voltage waveforms for the circuit on the left.
   b) Find the time constant and sketch the current waveforms for the circuit on the right.