Set #1

Due Friday September 7, 2018

Make note of the following:

- Papers are due at the start of class, or at the time and date specified
- Write only on one side of the paper
- Please try if possible to start each new problem on a clean sheet of paper
- Use engineering paper if you like

Problems:

1. Solve the following equations for $R_1$ and also $R_2$ in (b)
   (a) $5x + 200 = 2x$
   
   (b) $\frac{500}{R_1} = \frac{R_2}{2 \times 10^3}$ with $25R_2 - 16R_1 = 1 \times 10^3$. **Hint:** Solve for $R_2$ in terms of $R_1$ in the second equation, then insert this expression in place of $R_2$ in the first equation. Finally solve for $R_1$, then $R_2$.
   
   (c) Find a value for $R_1$ in the equation
   $$\frac{1}{100 \times 10^3} + \frac{1}{56 \times 10^3} + \frac{1}{R_1} = 33 \times 10^3$$

2. Some practice with exponents by solving for $y_i$, $i = 1, 2, 3$:
   (a) $y_1 = a^2 + b^5$, where $a = 3$ and $b = 2.5$.
   (b) $y_2 = (3^3)^{\sqrt{2}}$
   (c) $y_3 = x/(\sqrt{1 + x + x^2})$, where $x = 4$.

3. Using chapter2.xlsx plotting examples, plot the following:
   (a) $g_1(x) = e^{-2x} \cdot \cos(3x)$ for $0 \leq x \leq 4$.
   (b) $20 \log_{10}[g_2(x)]$, which is a voltage gain function in dB, where
   $$g_2(x) = \frac{1}{\sqrt{1 + \left[Q \left(\frac{x - x_0}{x_0} - \frac{x_0}{x}\right)\right]^2}}$$
   
   Let $Q = 1$ and $x_0 = 455$. Plot for $x$ values ranging from $10^1 = 10$ to $10^3$ using the log-spaced data values approach found in the spreadsheet. I suggest plotting 500 points over this interval. Set the y-axis limits to run from -50 to 0 dB.
   
   (c) Overlay on part (b) a second plot with $Q$ changed to 10.

(continued on next page)
4. Using the spectrum shape shown below

\[ \text{Total width} = 10 \text{ kHz} \]

540 \( \leq \) \( f_c \) \( \leq \) 1700 kHz

sketch the approximate composite AM radio spectrum found in the Colorado Springs market. The frequency band you need to consider runs from 540 kHz to 1700 kHz with all stations on a 10 KHz spacing. Assume the same spectrum height for each radio station. In reality will all of the signals at a receiver appear to have the same amplitude? Explain. **Hint:** Use the Internet to search for AM radio stations in just Colorado Springs. Your sketch will take the form:

Optionally rather than creating a paper sketch, use the spreadsheet set_1_am_spectrum.xlsx as the starting point for a computer generated spectrum plot using an Excel bar plot.