Homework #1
Due: January 26 at the beginning of class, i.e., 11:00am

Remember, discussion of homework questions is encouraged. Please be absolutely sure to submit your own independent homework solution.

1. (20 pts) Complex Numbers:
   Evaluate and give the answer in both rectangular and polar form. In all cases, assume that $z_1 = 2 - j3$ and $z_2 = 3 + j5$. As usual, $z^*$ is the complex conjugate of $z$.

   (a) $z_1^*$
   (b) $z_2^2$
   (c) $z_1 + z_2^*$
   (d) $jz_2/z_1^2$
   (e) $z_1^{-1}$
   (f) $z_1/(z_2 + z_1)$
   (g) $e^{z_2}$
   (h) $z_1 z_1^* z_2 z_2^*$
   (i) $z_1 z_2$

2. (10 pts) Simplify these numbers:
   
   (a) $e^{j8\pi}$
   (b) $e^{j9\pi}$
   (c) $e^{j313\pi}$
   (d) $e^{j2017\pi}$

3. (20 pts) Logarithms:
   Simplify the following as much as possible, without using a calculator (i.e. show the various steps). You can of course use a calculator to check the answers. Given: $\log_{10}(2) = 0.3$.

   (a) $\log_{10}(12800)$
   (b) $\log_2(32\pi^2/50)$
   (c) What is the signal value 730,000,000,000 in decibels?
   (d) At Austin City Limits, Bob uses a guitar amplifier with a power of 200 Watts. What is the power of the guitar amp in dB relative to 3W.

4. (20 pts) Consider the plot of signal $x(t)$ in Figure ??.

   (a) Plot $x(-t)$
   (b) Plot $x(-2t)$
   (c) Plot $x(-2t + 1)$
   (d) Plot $x(t/2)$
5. (10 pts) Consider a signal

\[ y(t) = \cos(2\pi 100t + \pi/3) + \cos(2\pi 45t - \pi/3) \]

Prove that it is periodic and determine the period of \( y(2t) \) and \( y(t/3) \).

6. (30 pts) Using Matlab to Plot Signals

This is a very basic introduction to Matlab just to make sure you know how to create and run a Matlab script.

In all Matlab homeworks, turn in your matlab code and the prints of the plots you get. Make your plots neat by labeling the axes.

(a) Enter the following code in Matlab and observe the resulting plot of \( x(t) \). (re-type the quotation ‘ character if you copy-paste from pdf to MATLAB)

```matlab
dt = 1/100;         \ %%% time increment
t = linspace(-1,1,100); \ %%% vector with 1000 points [-1, -.998, ..., .998, 1]
Fo = 3;             \ %%% frequency
x = 20 * real(exp(j*(2*pi*Fo*(t + 0.6))));
subplot(3,1,1);    \ %%% use this to plot 3 separate graphs on one window
plot(t, x), grid \ %%% time-domain plot
title( 'Section of a sinusoid' ), xlabel( 'time (sec)' )
```

(b) Now, create another signal \( y(t) \) with 8 times the frequency but one fifth of the magnitude of \( x(t) \). Multiply the two signals, i.e. find \( z(t) = x(t) \cdot y(t) \) and turn in plots of all three signals. Also turn in a plot of “\( x(t) \) multiplied by the amplitude of \( y(t) \)” and \( z(t) \) overlayed on the same graph. Notice anything cool? This is a simple example of amplitude modulation of a low frequency content signal with a high frequency sine wave.