Homework #3: Chapter 1 (due Sep. 16, 2016)

Preliminary

- Textbook reading Ch. 1.4 - 1.7 (pp. 30-56), Ch. 2.0 - 2.2 (pp. 74-102)
- As a reminder, EE312 office hours are on Wed. from 9:00-10:00am and Thu. from 3:00-4:00pm.
- Please direct all email to pdeleon@nmsu.edu (do not send email via Canvas). All requests for bonus points will receive a confirmation email within 48 hours.
- In order to receive full credit for homework problems, you must provide a detailed solution. Simply writing a few, summarized steps toward the answer will result in minimal credit.
- All problems are worth +10 points unless otherwise noted.
- You can find Prof. Boucheron's excellent tutorial on convolution at

  `http://www.ece.nmsu.edu/~pdeleon/Teaching/EE312/ConvolutionExamplesBoucheron.pdf`
- Download the CompanionFiles3.zip file that contains the functions, `plotdsig` and `cexpgen` needed for the software problems.

  `http://www.ece.nmsu.edu/~pdeleon/Teaching/EE312/Homework/CompanionFiles3.zip`.

Textbook Problems

1.19(b),(c)	1.27(b),(d)	1.18
1.28(a),(c)	2.1(a)	2.5
2.6	2.8	2.11(a)
2.23(b)		

Software Problems

Please submit printouts and commentary to your solutions for the following problems.

1. **Distinguishability** We showed in class that DT complex exponential signals with frequency ω_0 are indistinguishable from those with frequency $\omega_0 + 2\pi r$ where r is an integer. Plot (`plotdsig`, option = 0) both real and imaginary parts of the following signals and <u>comment</u> on the (in)distinguishability.

   (a) $x_0[n] = \exp\left[j\left(\pi/8\right)n\right]$, $x_1[n] = \exp\left[j\left(\pi/8 + 2\pi\right)n\right]$

   (b) $x_0[n] = \exp\left[j\left(\pi/8\right)n\right]$, $x_1[n] = \exp\left[j\left(\pi/8 + 3.7\pi\right)n\right]$

   Assume in your call to `cexpgen` for $x_0[n]$ and $x_1[n]$ that $f_0 = \pi/8,\ \pi/8 + 2\pi,$ or $\pi/8 + 3.7\pi$; $f_s = 2\pi$; and duration is selected so that the signal has approximately 50 samples for a nice, clear plot.

```
A = 1;f = pi/8;phi = 0;
fs = 2*pi;duration = 50/fs;
x0 = cexpgen(A,f,phi,fs,duration);
plotdsig(real(x0),0);
xlabel('n');ylabel('Real x_0[n]');
title('Problem 1(a): Real x0[n]');
% plotdsig(imag(x0),0);
% xlabel('n');ylabel('Imag x_0[n]');
% title('Problem 1(a): Imag x0[n]');
```

2. **Periodicity** We showed in class that DT complex exponentials are periodic with period N only when $\omega_0 N = 2\pi r$ where r is an integer. Plot (`plotdsig`, option = 0) both real and imaginary parts of the complex exponential signals, <u>comment</u> on the (a)periodicity, and if applicable, determine the period of the signal.

   (a) $x[n] = \exp\left[j\left(2\pi/3\right)n\right]$

   (b) $x[n] = \exp\left(j2.7n\right)$

   Assume in your call to `cexpgen` for $x[n]$, $f_s = 2\pi$ and duration is selected so that the signal has approximately 50 samples.

3. **Oscillation Rate** We showed in class that a DT complex exponential oscillates more rapidly as ω_0 increases over the range $0 \le \omega_0 < \pi$ and oscillates less rapidly as ω_0 increases over the range $\pi \le \omega_0 < 2\pi$. Plot (`plotdsig`, option = 0) only the real part of $x[n] = \exp\left[j\left(\pi/8\right)kn\right]$ for k =0, 2, 4, 14, and 15 (five plots!) and <u>comment</u>. Note: your plots will be reproductions of Figure 1.27.

   Assume in your call to `cexpgen` for $x[n]$, $f_s = 2\pi$, and duration is selected so that the signal has approximately 50 samples.

4. Recreate the plots in Example 2.1 of $h[n]$, $x[n]$, and $y[n]$ using the following MATLAB code.

```
h = [1;1;1];
x = [0.5;2];
y = conv(h,x);
figure(1);plotdsig(h);ylabel('h[n]');axis([-2 4 0 3]);
figure(2);plotdsig(x);axis([-2 4 0 3]);
figure(3);plotdsig(y);ylabel('y[n]');axis([-2 4 0 3]);
```