Homework #2: Chapter 1 (due Sep. 9, 2016)

Preliminary

- Textbook reading Ch. 1.0 - 1.3 (p. 1 - 30), Mathematical Review (p. 71)
- Answers to the "Basic Problems with Answers" can be found starting on p. 932.
- As a reminder, the required format for homework can be found at
  http://www.ece.nmsu.edu/~pdeleon/Teaching/EE312/Homework/HomeworkFormat.pdf
- 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.
- Download the CompanionFiles2.zip file that includes signals for the software problems.
  http://www.ece.nmsu.edu/~pdeleon/Teaching/EE312/Homework/CompanionFiles2.zip.

Textbook Problems

1.3 (a)[1], (b), (d)[2]	1.5 (a), (d)
1.9 (b), (c), (e)	1.10
1.11	1.21 (b), (d)
1.22 (b), (c)	1.25 (b)
1.26 (b), (d)	

[1] Equivalently, $x_1(t) = \begin{cases} e^{-2t}, & t \geq 0 \\ 0, & t < 0. \end{cases}$ [2] Equivalently, $x_1[n] = \begin{cases} \left(\frac{1}{2}\right)^n, & n \geq 0 \\ 0, & n < 0. \end{cases}$

Software Problems

Although MATLAB example code will be given, you may use Python to solve the following problems. Attach the printouts to your solution.

1. Use the following MATLAB code to load a .wav file and plot 101 samples of an interesting segment.

```
info = audioinfo('Speech.wav');
bits = info.BitsPerSample;fs = info.SampleRate;
x = audioread('Speech.wav'); % load .wav audio file
N1 = 230050;N2 = N1+100; % indices of interesting signal segment
n = [N1:N2]; % index vector
stem(n,x(n)); % use stem to emphasize discrete-time signal
xlabel('n');ylabel('x[n]');
grid;axis([N1 N2 -1 1]);
title(sprintf('Problem 1: Speech signal (sample rate = %d Hz, resolution = %d bits)',fs,bits));
```

2. Use the following MATLAB code to digitally create a sinusoid and plot it as if it were continuous-time.

```
A0 = 2;f0 = 200;phi = pi/2; % amp, freq (Hz), phase (rads)
T0 = 0.025; % duration of signal
fs = 4000; T = 1/fs; % sample rate, sample period
n = [0:T0*fs-1]; % index vector
t = n.*T; % corresponding time vector
x = A0*sin(2*pi*f0.*t+phi);
plot(t,x);
xlabel('t (s)'); ylabel('x(t)');
grid; axis([0 T0 -2 2]);
title(sprintf('Problem 2: %d Hz Sinusoidal signal',f0));
```

3. Replot the speech signal in Problem 1 as if it were continuous time, i.e. $x(t)$ vs. t. Use the `'plot'` command with the appropriate time vector.

4. Plot the heart beat signal as a continuous-time signal and identify the following components: P wave, QRS complex, and T wave. You can determine what these components are using your favorite online resource.

5. The Gait.csv file contains acceleration data from the triaxial accelerometer of an iPhone 6; the data is sampled at 100 samples/s for 10 s. Peaks in the x-axis acceleration signal can indicate a single stride. Plot the x-axis acceleration signal and measure the time duration, D for a number of gait cycles, G and the fact that the subject has a stride length of 1 m to determine the forward velocity:

$$v \text{ (m/s)} = \frac{1 \text{ m}}{\text{stride}} \times \frac{G \text{ strides}}{1} \times \frac{1}{D \text{ s}}$$

```
accelerationData = csvread('accelerationData.csv',1,0); % first row is the header
x = accelerationData(:,1); % first column is x-axis, second column is y-axis, ...
fs = 100;
T = 1/fs; % sample period
n = [0:length(x)-1]; % index vector
t = n.*T; % corresponding time vector
plot(t,accelerationData(:,1))
xlabel('t (s)');ylabel('x(t)');
grid;axis([0 length(x)*T -0.8 0.8]);
title(sprintf('Problem 5: Gait signal (x-axis acceleration)'));
```