Assignment on Continuous-Time and Discrete-time Signals *

Signals and Systems (ELC 321)
Department of Electrical and Computer Engineering
The College of New Jersey.

Instructions:

1. The assignment questions are extracted from the Text (Signals, Systems, and Transforms, Fifth edition)
2. Figure reference in this assignment refers to the Text's Figure label.
3. When using MATLAB to plot signals, scale your time axis such as to allow sufficient amount of the signal to be plotted. Use subplot to give 3 or 4 plots per page; label the axes of your plots accordingly e.g Time (sec) on the x-axis and x(t) on the y-axis; the title should be the problem number, for example 2a).
4. Type-set your solutions for the assignment using microsoft office or any other word processor and include your Matlab codes in an appendix section. Matlab generated figures must be included as part of the solution.
5. Upload your final solution to canvas using appropriate naming convention e.g.

   `Firstame_Lastname_Assignment_1`

6. **Due Date: February 15, 2016**.

Problem 1 (10 Marks)**.** *For the signal $x(t)$ of Figure P2.1a plot Use Matlab to plot the following functions*

a) $x(3t-6)$*, and*

b) $-4x(t)+2$.

□

Problem 2 (10 Marks)**.** *For the general case of transformations of discrete signals, given signals $x[n]$ and $x_t[n]$ can be expressed as*

$$x_t[n] = Ax[an + n_o] + B \tag{1}$$

where a is rational and n_o is an integer.

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a) Solve this expression for $x[n]$.

b) Suppose that for the signal of Figure p9.7

$$x_1[n] = 0.5x_3[-n+1] + 2 \tag{2}$$

Use Matlab to plot $x_3[n]$.

□

Problem 3 (20 Marks)**.** *For each of the signals*

1. $x[n] = 2\mu[n]$*, and*
2. $x[n] = cos[0.1n]$.
   - *(a) Determine mathematically whether the signal is* **even, odd, or neither**, *and*
   - *(b) Find the even part and the odd part of each of the signals.*
   - *(c) Use Matlab to plot the signals, their even and odd parts.*

□

Problem 4 (20 Marks)**.** *For each of the signals*

1. $x(t) = -4t$*, and*
2. $x(t) = -\mu(t-1) + \mu(-t-1)$.
   - *(a) Determine mathematically whether the signal is* **even, odd, or neither**, *and*
   - *(b) Find the even part and the odd part of each of the signals.*
   - *(c) Use Matlab to plot the signals, their even and odd parts.*

□

Problem 5 (10 Marks)**.** *Consider the signal*

$$x(t) = 5sin(15t - \frac{\pi}{3}) + 2\sin(7t) \tag{3}$$

a) Use an analytical method to determine if the signal is periodic. If so, find its fundamental period T_o.

b) Use Matlab to plot the signal. Use a small enough time increments.

□

Problem 6 (20 Marks)**.** *A continuous-time signal $x(t) = cos(\pi t)$ is sampled every T seconds resulting in the discrete-time signal $x[n] = x(nT)$. Determine whether the sampled signal is periodic for*

1. $T = 0.125s$*,*
2. $T = 0.130s$.

For the sampled signal that is periodic, find

a) the number of periods of $x(t)$ in one period of $x[n]$, and the number of samples in one period of $x[n]$

b) Use Matlab to plot both the continuous-time signal and its discretized version, for each of the sampling times, on same figure.

□

Problem 7 (10 Marks)**.** *Prove the time-scaling property of the Dirac delta function*

$$\int_{-\infty}^{\infty} \delta(at - t_o)dt = \frac{1}{|a|}\int_{-\infty}^{\infty} \delta(t - \frac{t_o}{a})dt \tag{4}$$

Hence or otherwise, evaluate the following integral

$$\int_{-\infty}^{\infty} sin[t - \frac{\pi}{6}]\delta(2t - \frac{2\pi}{3})dt \tag{5}$$

□