LABORATORY ACTIVITY #2

BASIC OPERATIONS IN SIGNALS

I. BASIC OPERATIONS

a. Signal Addition

This is a sample-by-sample addition, and $x_1(n)$ and $x_2(n)$ must have the same length.

$$\{x_1(n)\} + \{x_2(n)\} = \{x_1(n) + x_2(n)\}$$

b. Signal Multiplication

This is a sample-by-sample multiplication, and $x_1(n)$ and $x_2(n)$ must have the same length.

$$\{x_1(n)\} \cdot \{x_2(n)\} = \{x_1(n)x_2(n)\}$$

c. Scaling

Amplitude scaling:

In this operation, each sample of $x(n)$ will be multiplied by a scalar α.

$$\alpha\{x(n)\} = \{\alpha x(n)\}$$

Time Scaling:

In this operation, a signal $x(n)$ is compresses or dilates by multiplying the time variable by some quantity α. If that quantity is greater than one, the signal becomes narrower and the operation is called compression, while if the quantity is less than one, the signal becomes wider and is called dilation.

$$y(n) = x(\alpha n)$$

d. Shifting

In this operation, each sample of $x(n)$ will be shifted by amount of m to obtain a shifted sequence $y(n)$.

$$y(n) = \{y(n - m)\}$$

e. Time Reversal

In this operation, each sample of $x(n)$ is flipped around $n = 0$ to obtain a time reversal (folded) sequence $y(n)$. (MATLAB: **fliplr** function)

$$y(n) = \{x(-n)\}$$

II. Simulations

1.

$$x_1(n) = \begin{Bmatrix} 0.5n\ for -10 \leq n \leq -5, \\ -3\ for -4 \leq n \leq -1 \\ n\ for\ 0 \leq n \leq 5, \\ 1\ for\ 6 \leq n \leq 10 \end{Bmatrix} \qquad x_2(n) = \begin{Bmatrix} -1\ for -7 \leq n \leq 0, \\ -2\ for\ 1 \leq n \leq 5 \\ n/2\ for\ 6 \leq n \leq 9 \end{Bmatrix}$$

Perform the following in MATLAB/SCILAB:

a. $y_1(n) = \{x_1(n) + x_2(n)\}$
b. $y_2(n) = \{x_1(n)x_2(n)\}$
c. $y_3(n) = 3x_2(n)$

Use subplot in performing the simulation: subplot 1 for signal $x_1(n)$, subplot 2 for signal $x_2(n)$ in a, b and a constant in c, and subplot 3 for $y_i(n)$.

2. Show the stem plot of the step-by-step procedures of the signal using the subplot command.
   (a) Write a MATLAB/SCILAB program to generate and display a random discrete signal whose elements are distributed in the interval [−5, 14]. (b) Stem plot the signal $y(n) = x(-1/3n + 4)$.

Note: Label the simulations with the **title** command and include your family name. Comment your complete name in the MATLAB/SCILAB code.