Signals Processing Lab-1

This lab schedule will give you first hand knowledge about signals and systems. The programming environment will be executed in MATLAB; students may try to implement the algorithm in open source platform like Python.

Exercises

1. Write functions for unit delta function, unit step, signal addition, signal multiplication, signal shifting, signal folding.
2. Generate and plot each of the following sequences using the above defined functions:
   a. $x(n) = 5\delta(n+3) - 2\delta(n-4), \qquad -10 \le n \le 10$
   b. $x(n) = n\big[\big(u(n)\big) - \big(u(n-10)\big)\big] + 10e^{-0.3(n-10)}[u(n-10) - u(n-20)]$, $0 \le n \le 20$
   c. $x(n) = \cos(0.04\pi n) + 0.2\beta(n), \quad 0 \le n \le 50,$ where $\beta(n)$ is a Gaussian random sequence with zero mean and unit variance.
   d. Given$x(n) = \{1,2,3,\underset{\uparrow}{4},5,6,7,6,5,4,3,2,1\}$. Plot the following sequences:
      i. $x_1(n) = 3x(n+4) - 6x(n)x(n-2)$
      ii. $x_2(n) = x(5-n) + 2x(-n)x(4+n)$
3. Generate a sinusoidal wave with the following parameters: frequency (f_0=10 Hz) and time instances varying from 0 to 1000.
4. Write a function for decomposing a signal into its even and odd components.
   Hint: $x_e(n) = \frac{1}{2}[x(n) + x(-n)] \qquad x_o(n) = \frac{1}{2}[x(n) - x(-n)]$
5. Implement *Sinc* function with $a = 2.5,1,0.5.$ Hint: $\mathrm{sinc}_a(t) = \frac{\sin(at)}{t}$
6. Plot e^{j2t} for $t = 0$ to $t = \pi$ in the complex plane and define the shape of the curve.
7. If $f(t) = e^{-0.5t}u(t)$, plot the functions below and compare their values with exact ones for $n = 0,1,2,3, \ldots$.
   a. $f_1(n) = e^{-0.5n}u(n)$
   b. $f_2(n0.5) = e^{-0.5n0.5}u(0.5n)$