MATLAB EXERCISES

1. **Signal Generation**

Generate the following signals and plot them in MATLAB

a) $x_1(t) = sin(2\pi 100t)$, Fs = 1000 Hz , $0 \leq t \leq 0.1s$

b) $x_2(t) = cos(2\pi t) + \frac{1}{3}cos(2\pi 3t) + \frac{1}{5}cos(2\pi 5t)$, Fs = 1000 Hz $0 \leq t \leq 1s$

c) $x_3(t) = e^{-5t}cos(2\pi 10t)$, Fs= 50 Hz, $0 \leq t \leq 0.1s$

2.**Sampling**

Generate a signal $x(t) = sin(2\pi 200t)$ sampling at Fs=100 Hz, 400 Hz, 800 Hz, 1600 Hz and 3200 Hz. Plot the sampled signal using the "stem" command. Also find their spectra and bring out the differences that you perceive.

3. **Convolution**

Find the convolution of the following signals and plot the result

a) $x(t) = e^{-t}u(t), h(t) = e^{-2t}u(t)$ for different sampling frequencies

b) $x[n] = 1; n = 0. = 0; 1 \leq n \leq 100, h[n] = e^{-0.2[n]} + e^{-0.4[n]}, 0 \leq n \leq 100$

c) $x(t) = sin(2\pi 100t); h(t) = e^{-0.5t}$; Fs=1000 Hz

4.**Filtering**

a) Generate the signal $x(t) = sin(2\pi 50t) + \frac{1}{3}sin(2\pi 150t)$,Fs=1000 Hz. Add white noise (zero mean unit variance) to the signal. (use randn command). Plot the original and the noisy signal. Filter the signal using an averaging filter of length 10 and plot the output. Compare the input with the output.

b) $H(s) = \frac{1+0.5s}{s^2+2s+1}, X(s) = \frac{1}{s+0.5}$, Find the output $y(t)$ using the "filter" command in MATLAB

5. **Frequency Spectrum / FFT**

Generate the signal $x(t) = sin(2\pi 50t) + sin(2\pi 100t)$ with Fs=1000 Hz. Plot the signal and find it's spectrum using the "fft" command. Plot the spectrum. Add noise to the signal and find the spectrum of the noisy signal and plot it. Compare with the true spectra.

6.**System Response**

Use MATLAB commands "impulse" , "step" to find the unit impulse response and unit step response of the following systems.

a) $H(s) = \frac{1+2s}{s^2+s+1}$ b) $h(t) = e^{-t}$

c) $H(s) = \frac{1}{1+s}$ d) $H(s) = \frac{1}{1+s} - \frac{2}{2+s} + \frac{1}{s+0.5}$

7.**Matrices**

Generate an arbitrary N x N matrix and study the following MATLAB commands

eig , inv , rank , norm , det , trace , rref , poly