Assignment -1

1. Let the basis vectors be B1= $\begin{bmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \end{bmatrix}$ B2= $\begin{bmatrix} 1/\sqrt{2} \\ -1/\sqrt{2} \end{bmatrix}$ .Consider a signal x= $\begin{bmatrix} 2 \\ 5 \end{bmatrix}$, decompose the signal using given basis vectors.

2. Given a signal x(n) as shown below

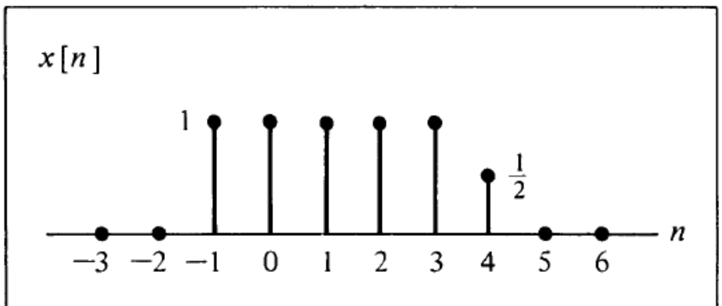


Figure P2.3

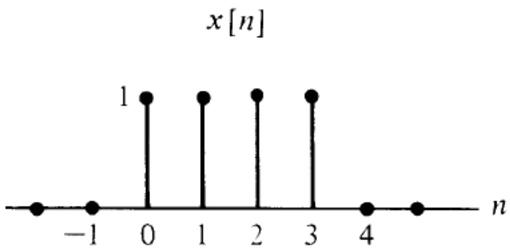
Sketch and carefully label each of the following signals:

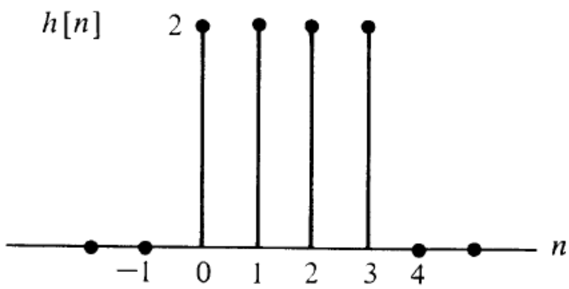
a) x(n-3)
b) 2.x(n)

3. Determine Fourier transform of x(t)= $e^{-\frac{t}{2}}.u(t)$, where u(t) represents unit step function. Calculate and plot the magnitude and phase spectrum by varying the frequency.

4. If the signal amplitude is measured as 2 V and the noise is 25mV, evaluate the SNR in dB.

5. The impulse response of a linear time-invariant (LTI) system is given as h(n). what will be the output y(n), for an input signal x(n) to the system





6. What is aliasing? demonstrate through an example
7. Define Power Spectral Density (PSD). How does it differ from the power spectrum? Plot for a signal. Theoretical part, MATLAB code, plots, and analysis. MATLAB code should be well-commented to explain each step.
8. Discuss the effect of windowing on the power spectrum estimate. Why is windowing necessary, and how does it affect the spectral leakage/distortion?

9. Write a note on Interpolation of Discrete-Time Signals with Different Sampling Frequencies. Assume the original signal was sampled at 50 Hz. Interpolate the signal to a new sampling frequency of 100 Hz using any of the interpolation techniques.
10. The file heart_rate_sample contains 2 heart rates – hr_med and hr_pre during two conditions with corresponding time vectors t_med and t_pre. Both these signals are unevenly sampled. Convert the hr_pre to evenly spaced data (resample) using interpolation. You can take the sampling frequency as 100Hz.
11. Create a noisy signal to generate a waveform of 200,400 Hz in MATLAB with SNR -8 dB, sampling frequency=1000Hz, and N=512 samples. Plot magnitude spectrum
    - Repeat with -4dB, -16dB, plot the magnitude spectrums – write your observation in detecting the signal frequency
    - Repeat with N =1000 and N=200 samples, plot the magnitude spectrums - write the inference when detecting the signal frequency