EE386 Digital Signal Processing Lab Aug-Dec 2023

1: Experiment 1 Report

Author: Ayushmaan Srivastava *Email:* ayushmaansrivastava.211ee217@nitk.edu.in

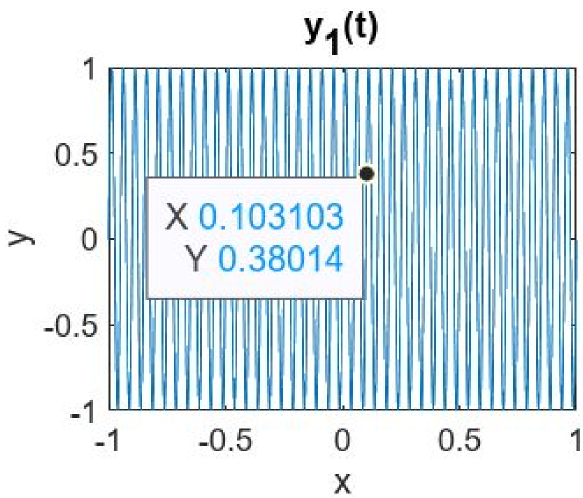
Using the built-in functions in Matlab, generate plots for the following signals for $-1 <= t <= 1$ in different subplots:

(1)$y1(t) = sin(20\pi\alpha t)$

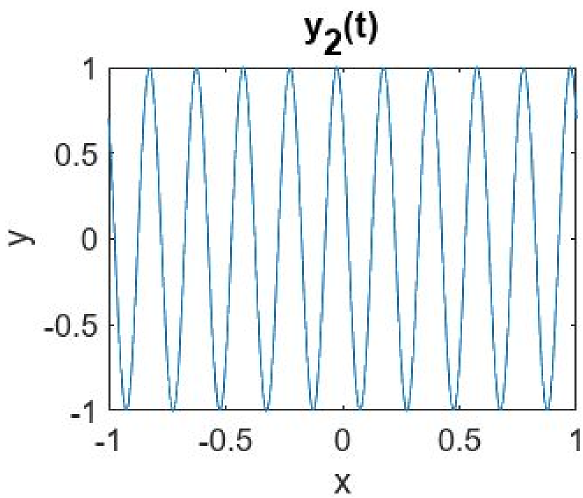
(2)$y2(t) = cos(5\pi\alpha t + \pi/4)$

(3)$y3(t) = e^{-2\alpha t}$

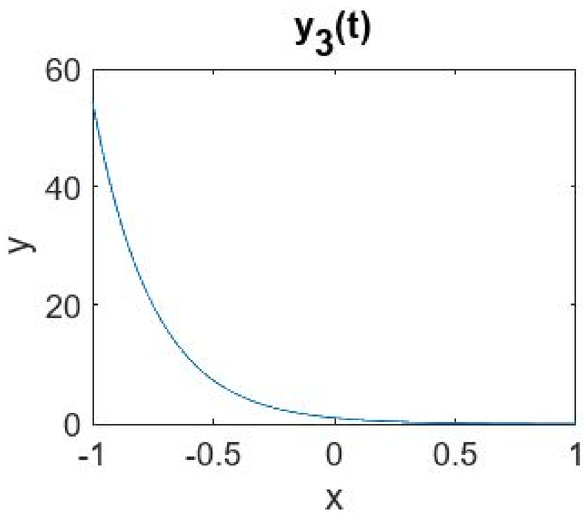
(4)$y4(t) = e^{-0.25\alpha t}sin(20\pi t)$



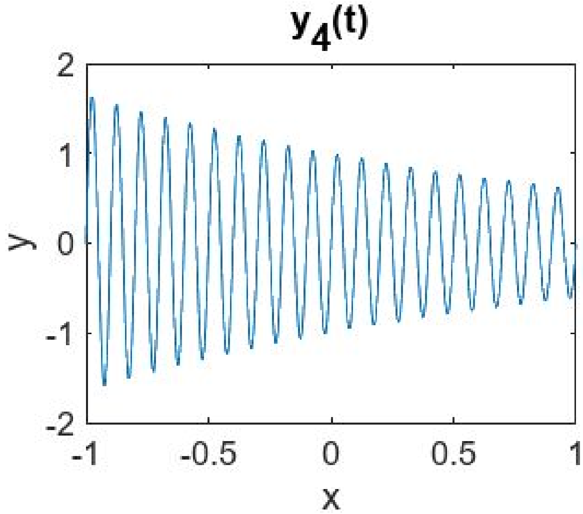
(a) $y1(t) = sin(20\pi\alpha t)$



(b) $y2(t) = cos(5\pi\alpha t + \pi/4)$



(c) $y3(t) = e^{-2\alpha t}$

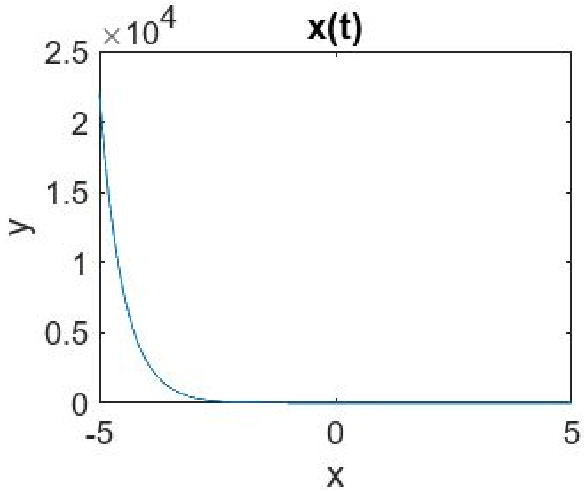


(d) $y4(t) = e^{-0.25\alpha t}sin(20\pi t)$

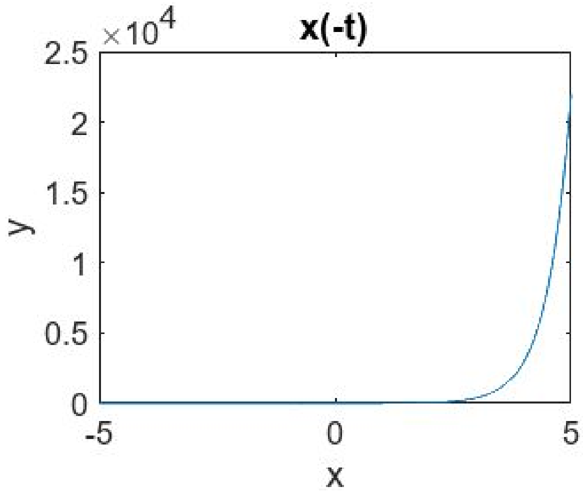
Figure 1: Signals plotted y vs x

- Plotted different signals y vs x.
- Used built in functions plot(), xlabel(), ylabel(), title(), figure, grid on.
- Results :Obtained the plot for the given signals.

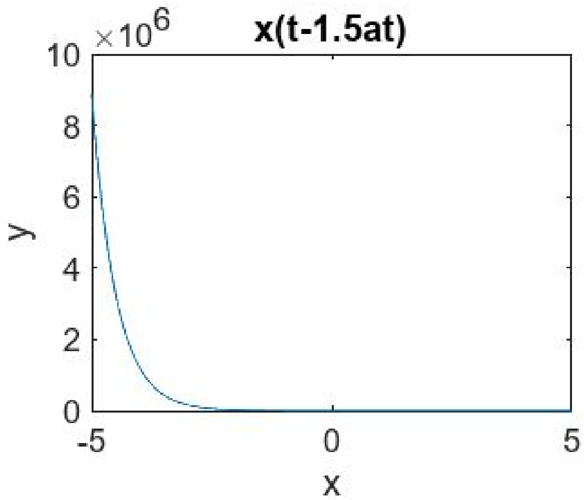
Problem 2 Create a user-defined function x(t) to generate a decaying exponential with α as the time constant. Plot the following for $-5 < t < 5$ in different subplots :
(1)$y1(t) = x(t)$
(2)$y2(t) = x(-t)$
(3)$y3(t) = x(t - 1.5\alpha)$
(3)$y4(t) = x(2\alpha t)$



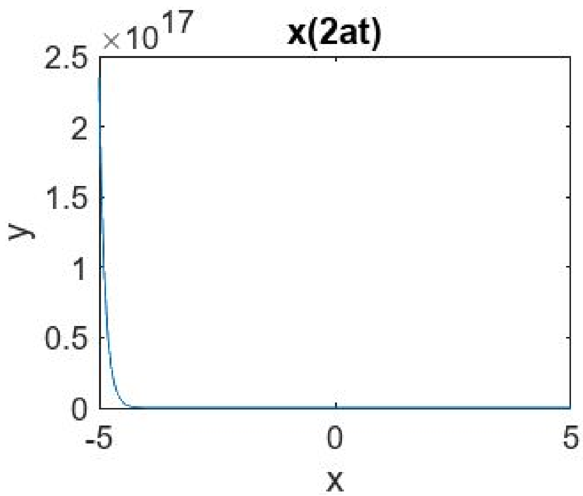
(a) $y1(t) = x(t)$



(b) $y2(t) = x(-t)$



(c) $y3(t) = x(1 - 1.5\alpha)$



(d) $y4(t) = x(2\alpha t)$

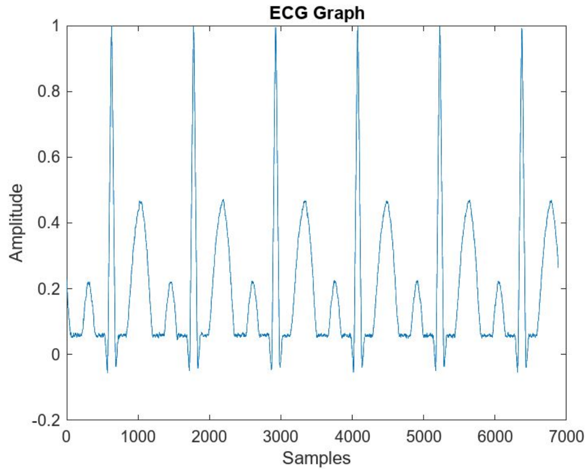
Figure 2: Signals plotted x(t) vs t

- Plotted different signals x(t) vs t.

- Used built in functions plot(), xlabel(), ylabel(), title(), figure, grid on.
- Results :Obtained the plot for the given signals.

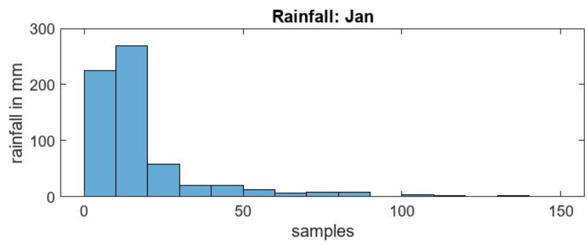
Problem 3

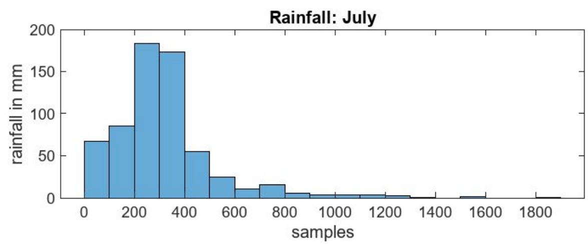
(1) Import the ECG data from ECGData.txt file and plot the data as a function of samples.



- Plotted the given ECG graph as given in text file.
- Used built in functions plot(), xlabel(), ylabel(), title(), figure, grid on.

(2) Import rainfall data from RainFallIndiaJan.txt and RainFallIndiaJuly.txt, which contain the average rainfall during the month of July, across India. Plot the distribution using histogram. Compute the mean and standard deviation of the rainfall in January and July.





- Plotted differences in histograms of rainfall of January and July.
- Used built in functions plot(), xlabel(), ylabel(), title(), figure, grid on.

(3) Import track00α.wav and play the audio.

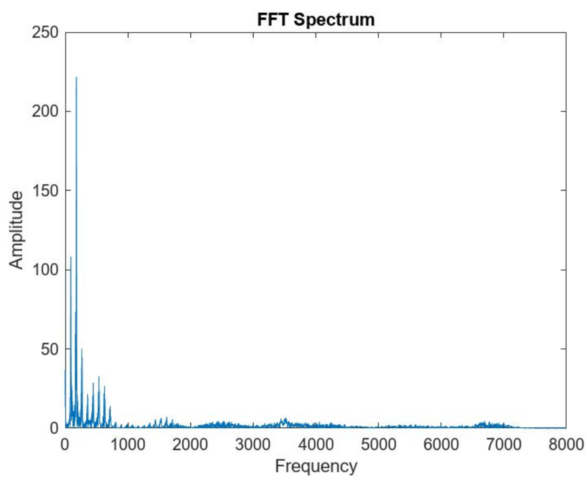
- Rainfall sound was heard for track 2.

Problem 4

Import the file speech.wav that contains the speech signal s(n) with Fs as the sampling frequency. Write a user-defined function to obtain.

$$y(n) = s(n)cos(2\pi F/Fs). \tag{0.1}$$

Generate y(n) for a particular choice of F = 250α Hz. Plot s(n) and y(n). Can you notice the differences between the signals? If yes, explain why the speech signals sound different based on the plots. If no, comment why you think the speech signals sound different. Further, comment on what the result would sound like if F were to increase from F = 250α Hz. Compute, analytically, the Fourier transform of y(t) = s(t)cos(2πF0t) in terms of the Fourier transform of s(t) and explain the observation. Try: plotting the spectrum of the signals using the fft function and verify the claims.



- The speech signals sound different based on plots and frequency dependent term cos(2*pi*F/Fs)

Problem 5

Create 5000 samples of two sinusoids of 200α Hz and 220α with a time resolution of 0.001s. Append them (to make a 1×5000 array), and write it into a .wav file. Listen to it and write down your observations.

- We observe 5s signal with 1khz sampling frequency and sinusoid signals of given frequencies are sampled.
- The output depends on type of audio data y and sound is a tone heard in a telephone.

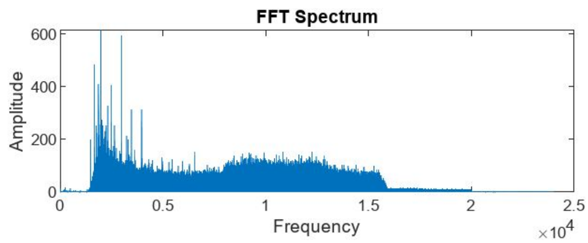
Problem 6

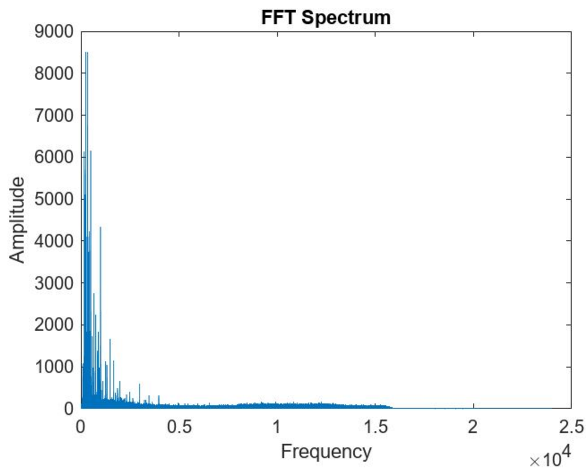
Generate a sequence containing the tones corresponding to Do Re Mi Fa So La Ti Do. Append the signals together and save the resulting signal as a .wav file.

- Heard Sa Re Ga Ma Pa Dha Ni Sa .
- Tones are saved as sine signals and played one after the other saved in a .wav file

Problem 7

Load the data Track00α.wav. Load the data from the text file ConvFileα.txt and then convolve the two data streams. Store the result into a .wav file. What do you observe? Can you guess the type of filter being used?





- Plotted FFTs of Original signal and the convolved signal for track2.
- As low frequencies pass thus it is a low pass filter.

1 Code Repositories

https://github.com/Ayushmaan-0412/DspLab_1.