**Digital Signal Processing Fundamentals [5ESC0]**

**Lab1**

**‘Answer form’**

***Assignment 1 to 10***

**Group number:**

**Names with ID:**

**Date:**

**Assignment 1: Convolution**

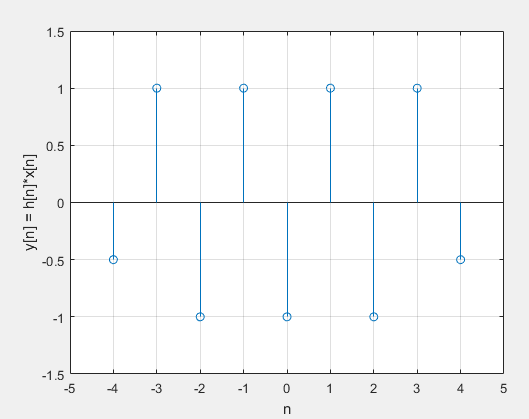


Figure 1: Convolution result of assignment 1

**Assignment 2: Fade-in and fade-out of convolution**

1. What is the length of the output and the length of the fade-in and fade-out phenomenon, as a function of N and M?

Suppose N is the length of h[n] and M is the length of x[n] and the function y[n] = x[n]\*h[n] is evaluated

Length(y) = N + M -1

Length(fade-in) =

1. How many, and which, output samples have no fade-in and/or fade-out?

**Assignment 3: Causality**

1. Value for L in order to make the impulse response causal:  
   L = 5

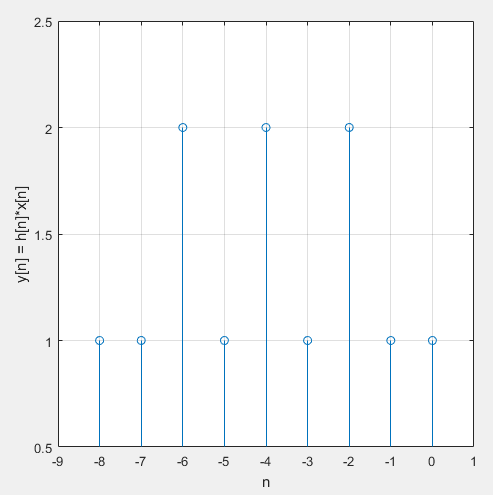


Figure 2: Convolution result of assignment 3 with non-causal filter

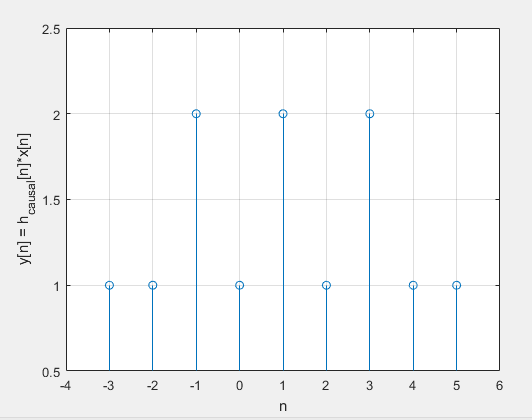


Figure 3: Convolution result of assignment 3 with causal filter

**Assignment 4: Frequency response**

1. Frequency response H­­(ejθ) of non-causal impulse response:

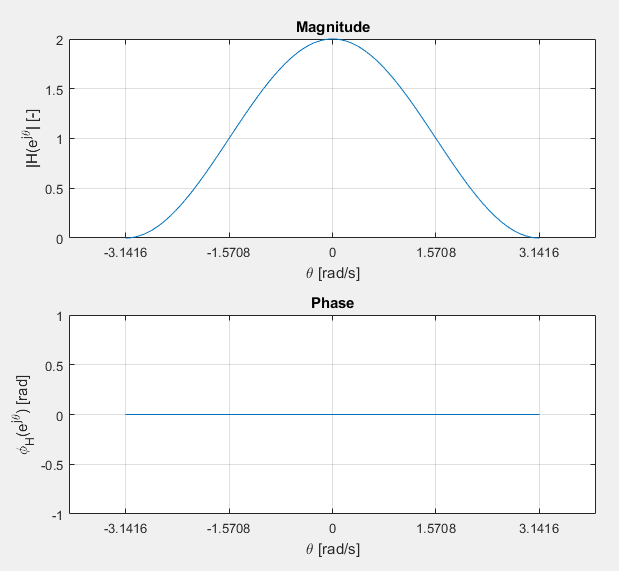


Figure 4: Magnitude and phase of H­­(ejθ)

1. What is the main character of this filter (low-pass, high-pass or band-pass)? Give a short explanation:

In my explanation, I will use the following equation:

From Figure 4, it can be seen that for low values of , the magnitude of the filter is high. Using the equation introduced 2 lines ago, shows that, if we keep constant, low values of correspond to low values of , the frequency. From this we conclude that this filter is a low-pass filter.

**Assignment 5: Frequency response of causal filter**

1. Expression for the frequency response H­causal­­(ejθ):

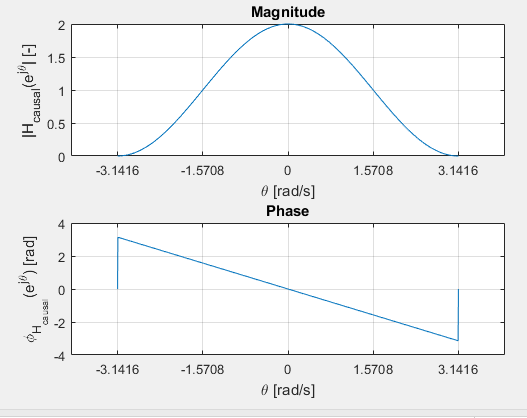


Figure 5: Magnitude and phase of Hcausal­­(ejθ)

1. Write H­causal­­(ejθ) as the product H(ejθ)∙D­­(ejθ) and explain the difference between H(ejθ) and H­causal­­(ejθ):

The difference between and is only the phase. Because has been shifted one sample to the right compared to , it has a different phase.

**Assignment 6: Impulse response of low pass filter**

1. Expression for the impulse response:



Figure 6: impulse response for N = 11

1. Play x[n] and explain what you hear:

**Assignment 7: Calculation of convolution via FTD and IFTD**

Calculation:

**Assignment 8: Sampling a sinusoidal signal**



Figure 8: continuous signal xc(t) and samples x[n]

1. What do you notice when playing the sound?

**Assignment 9: Visualization of ‘aliasing’ via time domain**

Think of at least two different sinuses with different frequencies between 0Hz and 1Hz which cross the same sample points and plot these signals.



Figure 9: Plot of assignment 8

Explain your results:

**Assignment 10: Up- and down-sampling**

1. Implement all 3 versions. Print Matlab code in appendix and upload Matlab code. Explain results:
2. Implement all 3 versions. Print Matlab code in appendix and upload Matlab code. Explain results: