E9 241 Time Frequency Analysis
Assignment 1

September 14, 2025

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1. Fundamentals of Fourier

Ans:

2. Simulation of Plots

Ans:

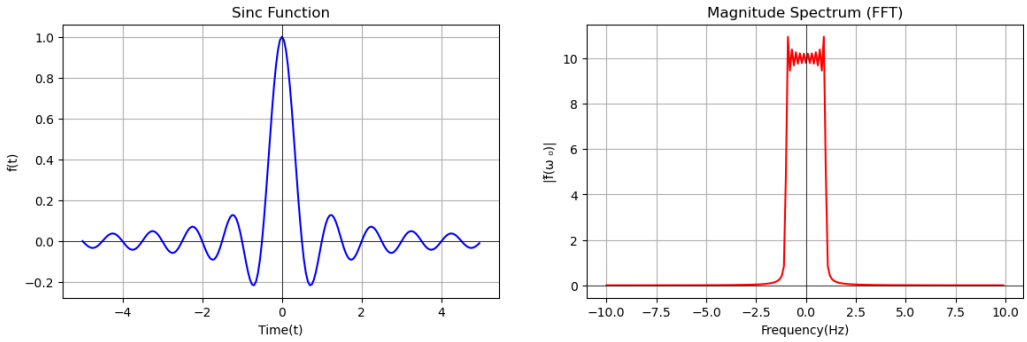

Figure 1: Time Domain and Frequency Domain representation of $\text{sinc}(2\pi t)$

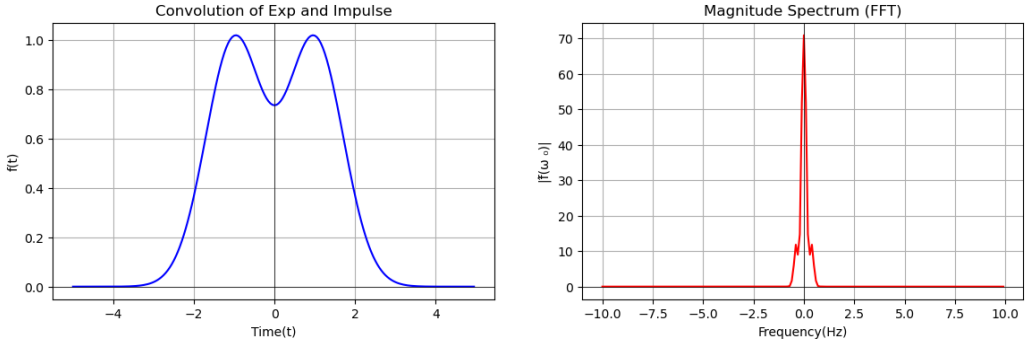

Figure 2: Time Domain and Frequency Domain representation of $(\delta(t-1)+\delta(t+1)) * e^{-at^2}$

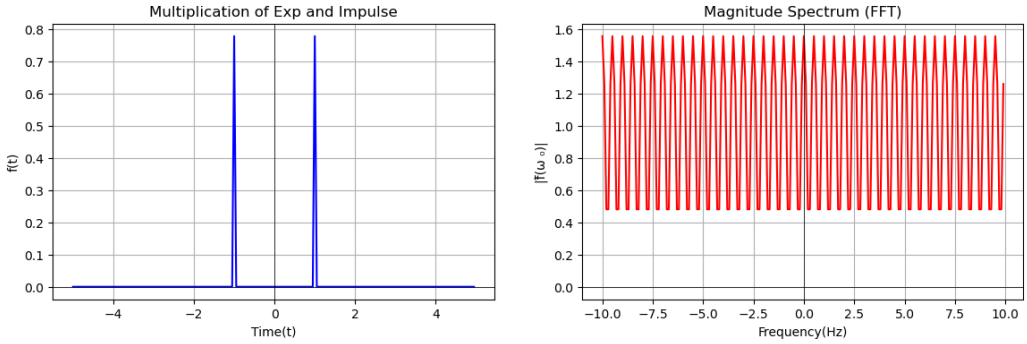

Figure 3: Time Domain and Frequency Domain representation of $(\delta(t-1)+\delta(t+1)) \times e^{-at^2}$

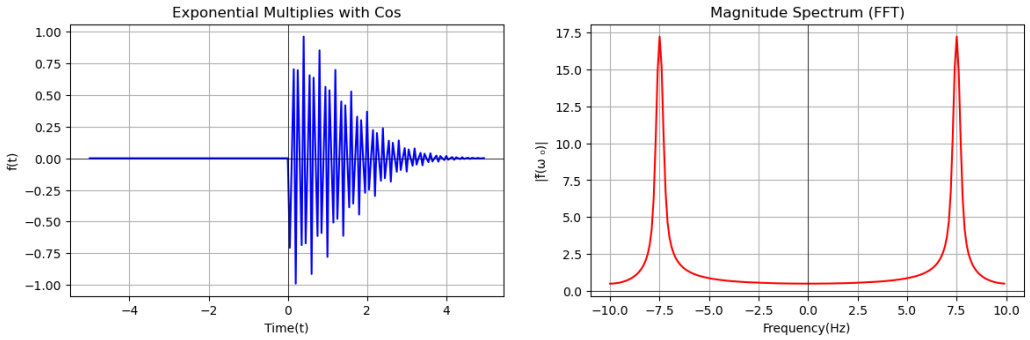

Figure 4: Time Domain and Frequency Domain representation of $e^{-at^2}\cos(\omega_0 t)u(t),\ \text{for } a > 0, a \in \mathbb{R}$

3. Discrete Fourier Transform(DFT)

Ans:

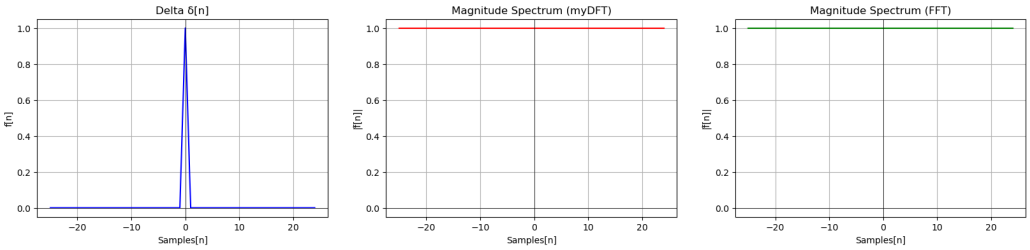

Figure 5: Fourier Transform of $\delta[n]$ with $myDFT$ function and comparison with fft library function

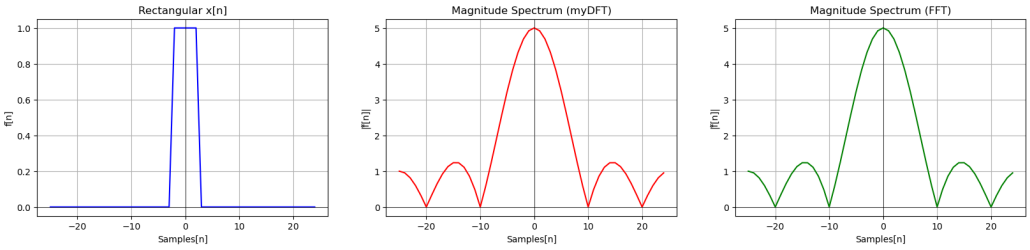

Figure 6: Fourier Transform of $box[n]$ with $myDFT$ function and comparison with fft library function

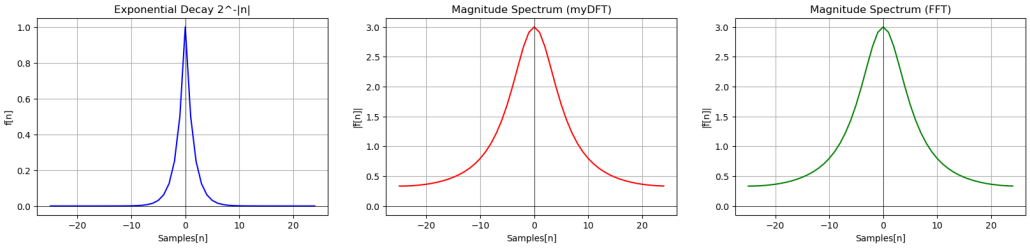

Figure 7: Fourier Transform of $2^{-|n|}$ with $myDFT$ function and comparison with fft library function

4. Learning Learning

Ans:

- Cauchy Density forms a Fourier pair with $e^{-|t|}$.
- In practical cases, we would never get a perfect box function from the *sinc*. It will have the Gibbs Phenomenon.
- The DFT of the box function will not give the *sinc* function. It is give something like $|sinc|$ function.