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ELECTRICAL COMMUNICATION
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Experiment 1: Sampling

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13 August 2024

1 Objectives

1. To design FIR filters for various orders and cutoff frequencies.
2. To assess whether passband and stop band frequencies are attenuated by the filter designed.
3. To assess the response of such FIR filters to noise contaminated signals.

2 Definitions of windows and LPF

2.1 LPF

$$h_d[n] = \begin{cases} \frac{\omega_c}{\pi} & n = k \\ \frac{\sin(\omega_c(n-k))}{\pi(n-k)} & \text{otherwise} \end{cases} \quad (1)$$

2.2 Rectangular Window

$$w[n] = \begin{cases} 1 & n = 0, 1, \dots, N-1 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

2.3 Triangular Window

$$w[n] = \begin{cases} 1 - 2\frac{n - \frac{N-1}{2}}{N-1} & n = 0, 1, \dots, N-1 \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

2.4 Hanning Window

$$w[n] = \begin{cases} \frac{1}{2} - \frac{1}{2} \cos\left(\frac{2\pi n}{N-1}\right) & n = 0, 1, \dots, N-1 \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

2.5 Hanning Window

$$w[n] = \begin{cases} 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right) & n = 0, 1, \dots, N-1 \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

2.6 Blackmann Window

$$w[n] = \begin{cases} 0.42 - 0.5 \cos\left(\frac{2\pi n}{N-1}\right) + 0.08 \cos\left(\frac{4\pi n}{N-1}\right) & n = 0, 1, \dots, N-1 \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

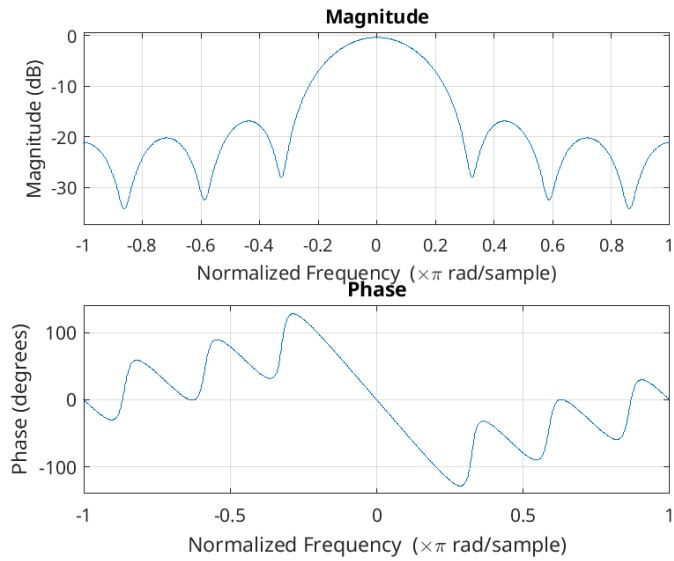
3 Observation Tables, Graphs and Diagrams

3.1 Rectangular Window

N	Transition Width (kHz)	First Side Lobe (dB)	Max Attenuation (dB)
8	2.30	-19.4	-45
64	0.25	-20.9	-51
512	0.02	-21.1	-70

Outputs of the `freqz` function

3.1.1 N=8

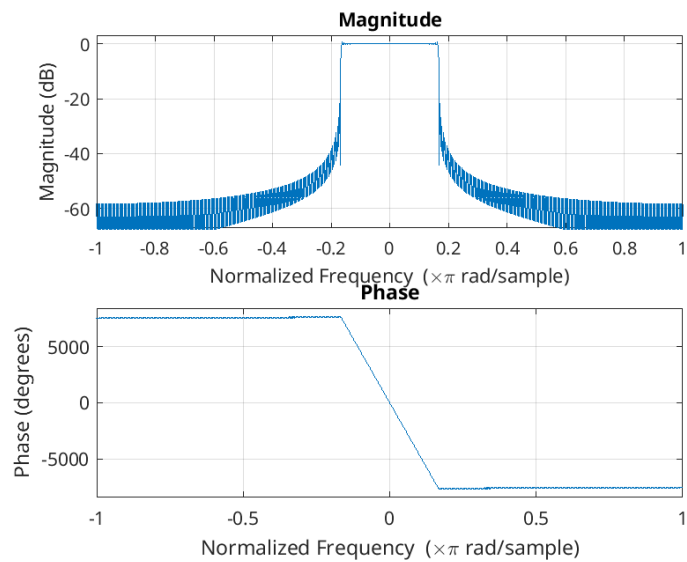
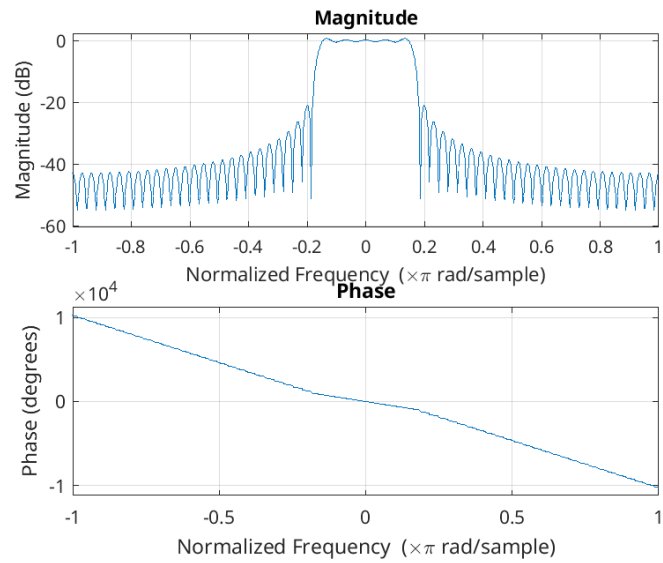


3.1.2 N=64

3.1.3 N=512

3.2 Triangular Window

N	Transition Width (kHz)	First Side Lobe (dB)	Max Attenuation (dB)
8	2.63	-20.9	-26
64	0.28	-20.6	-37
512	0.05	-20.7	-60



3.2.1 N=8

3.2.2 N=64

3.2.3 N=512

3.3 Hanning Window

3.3.1 N=8

3.3.2 N=64

3.3.3 N=512

3

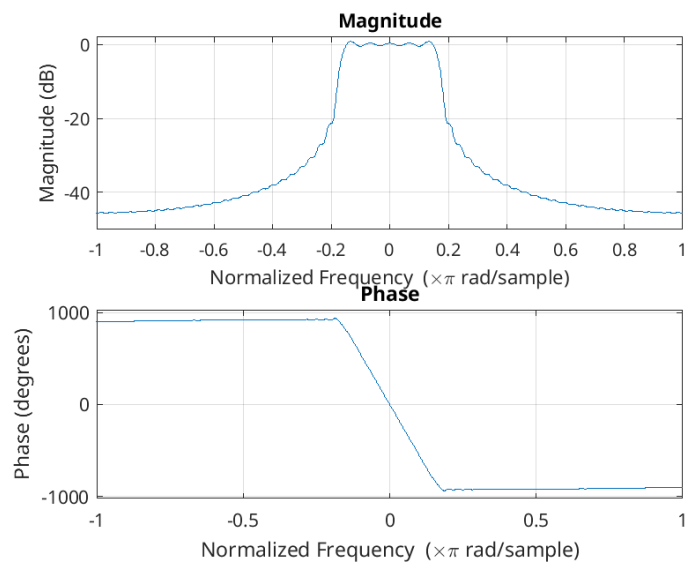
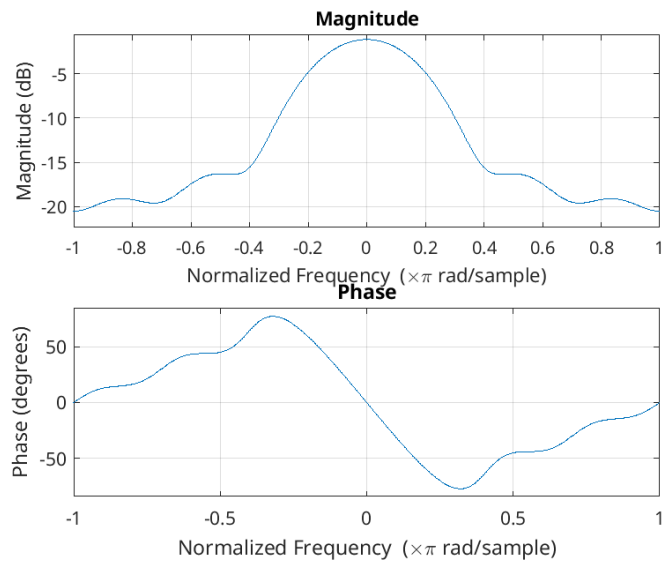
3.4 Hamming Window

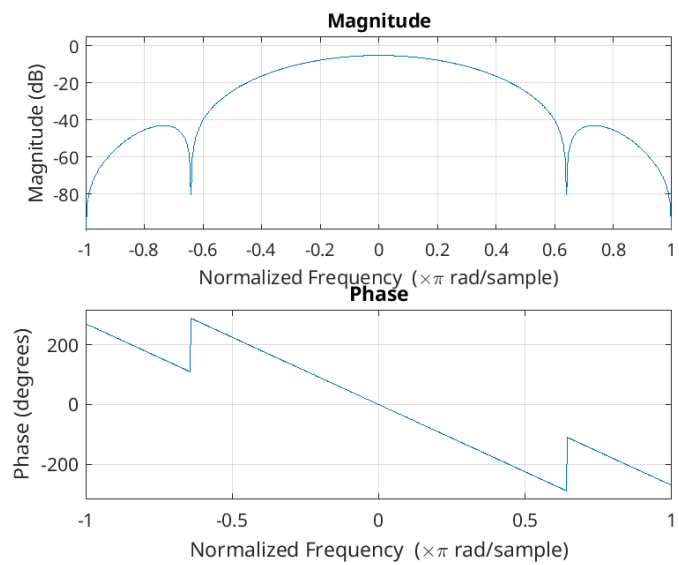
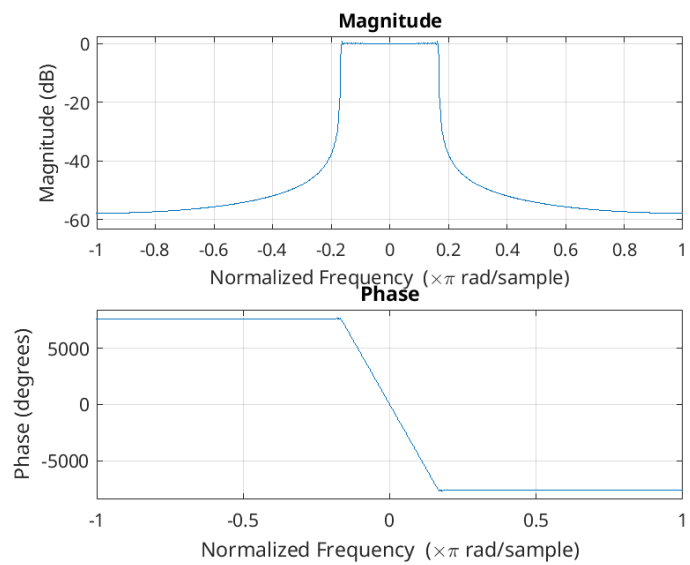
3.4.1 N=8

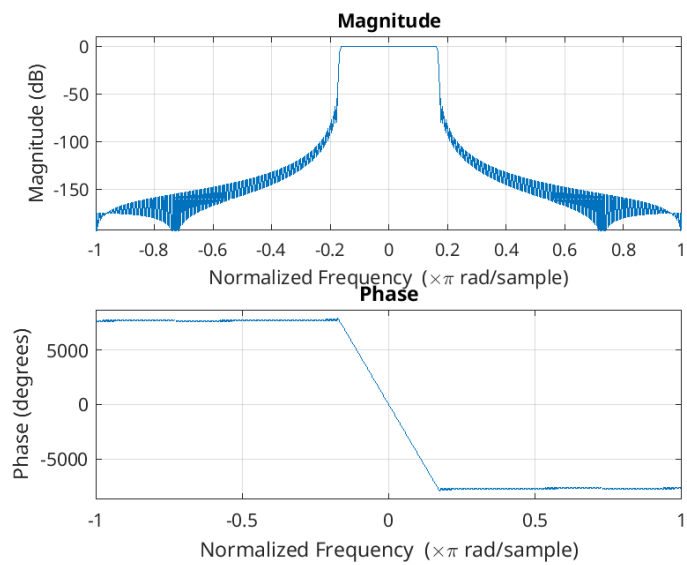
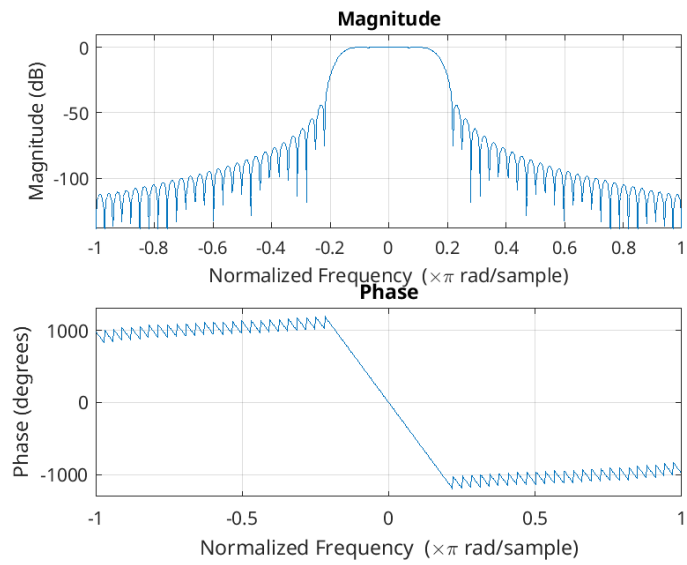
3.4.2 N=64

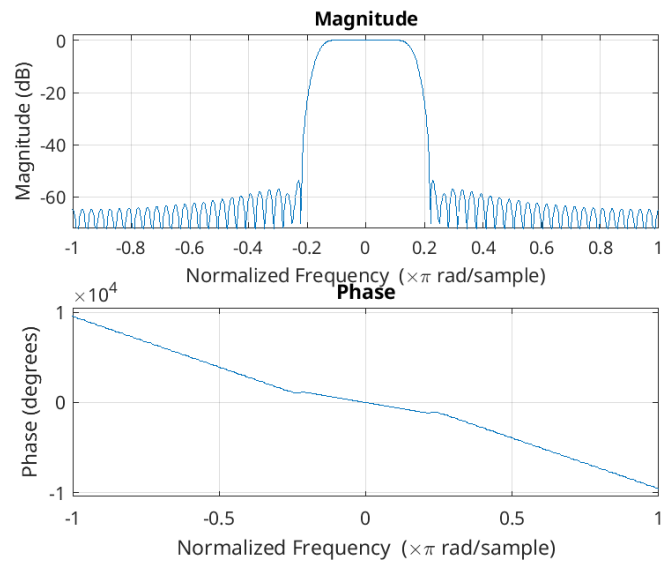
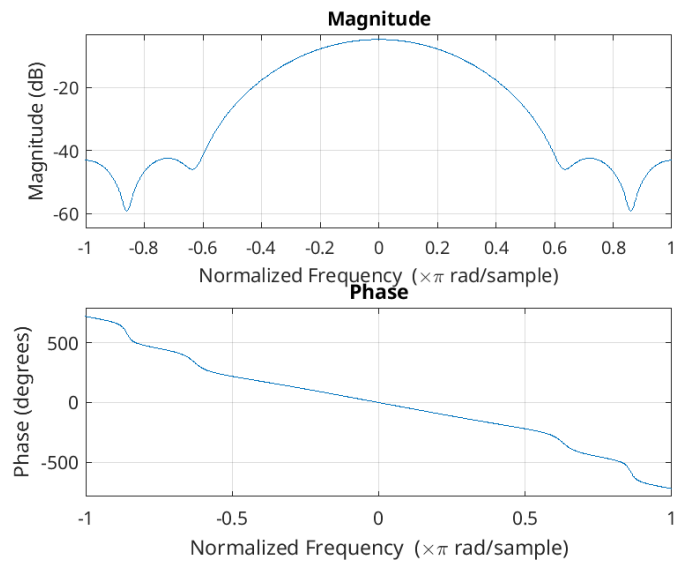
3.4.3 N=512

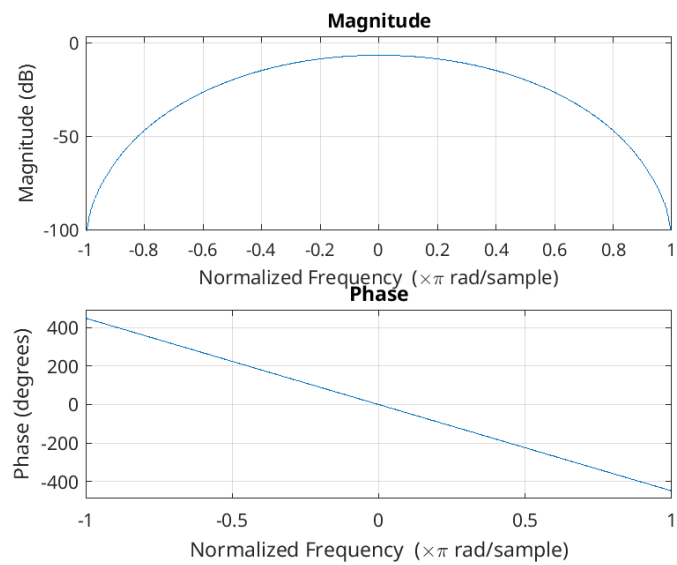
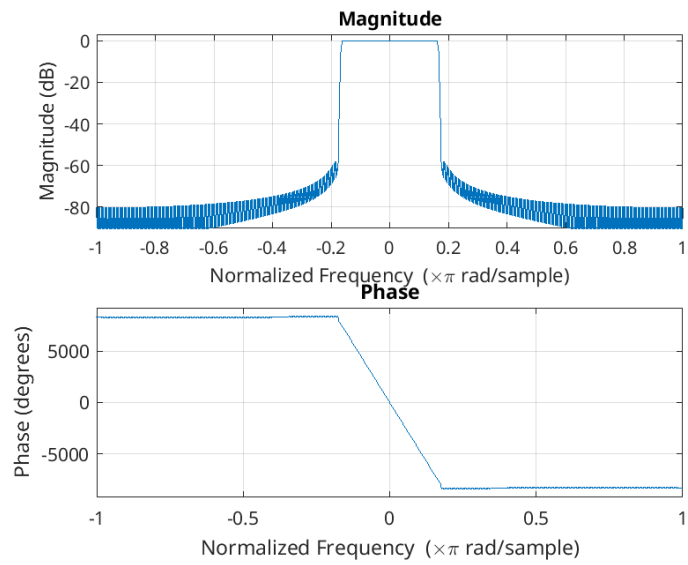
3.5 Blackmann Window

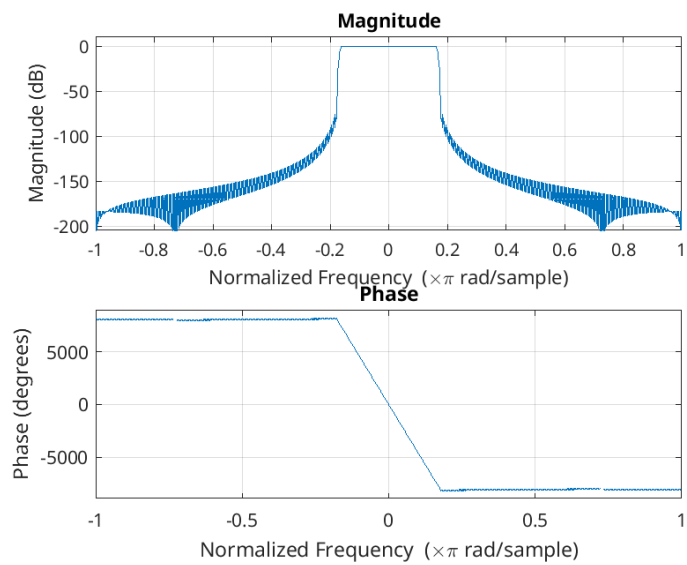
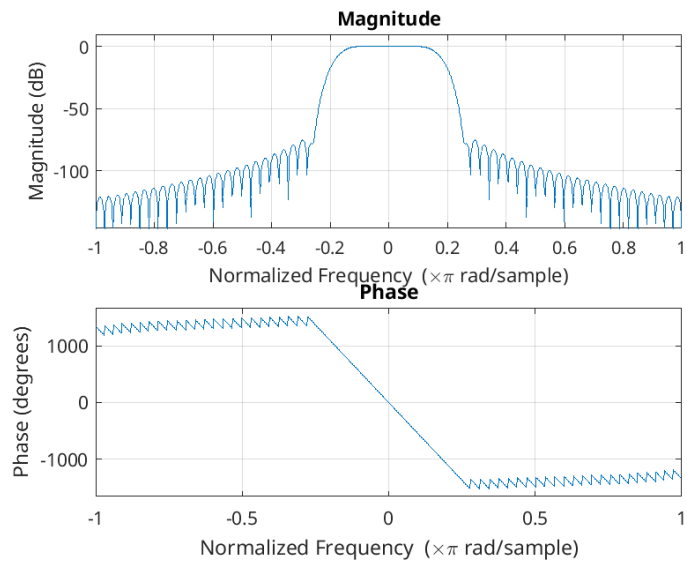












4 Discussion: Samyak Sheersh

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