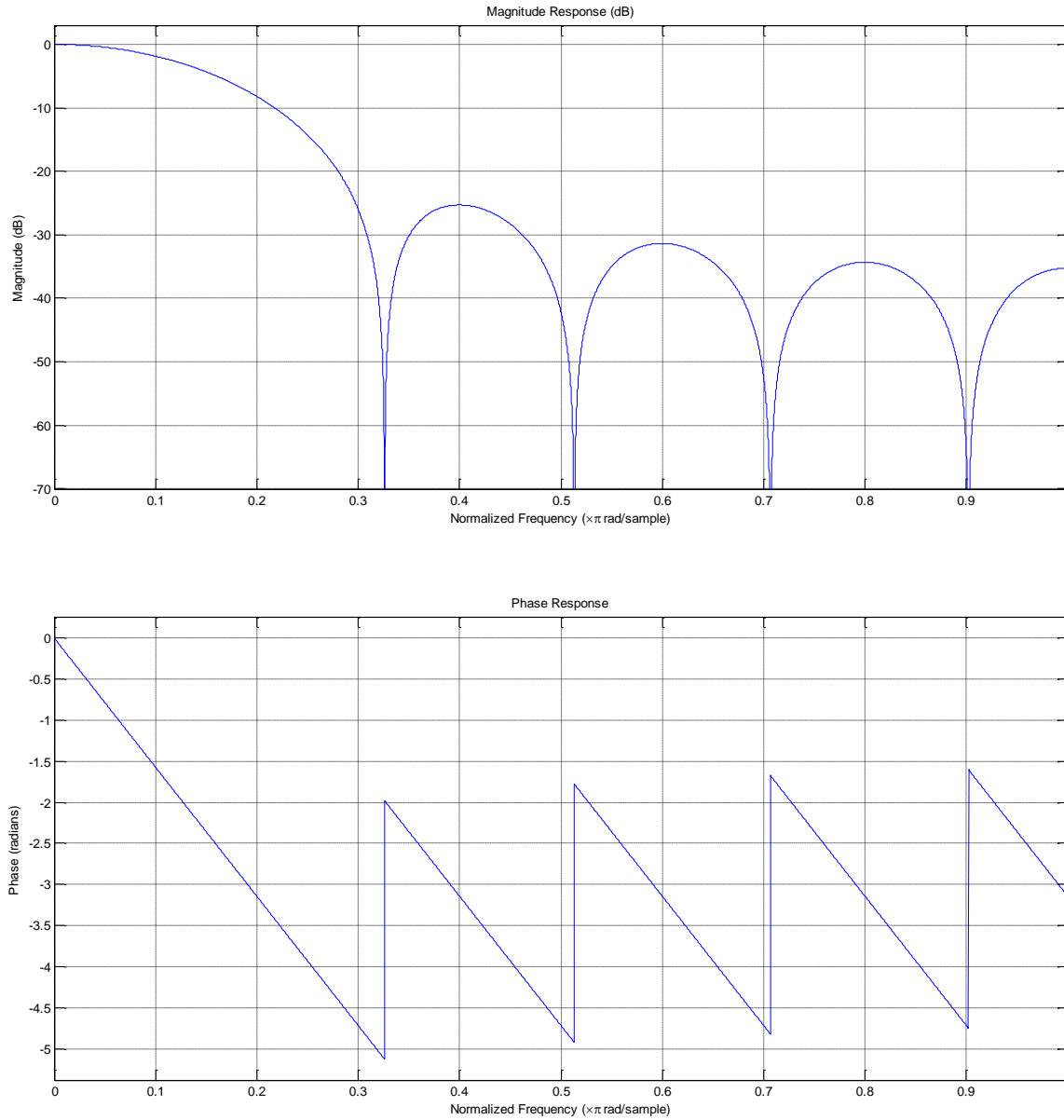
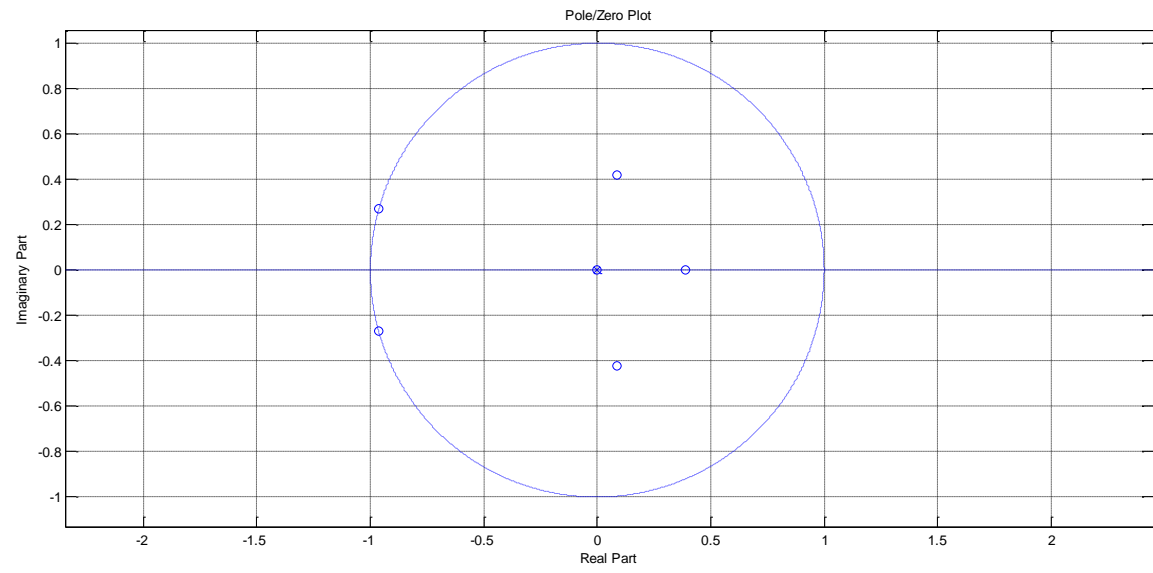
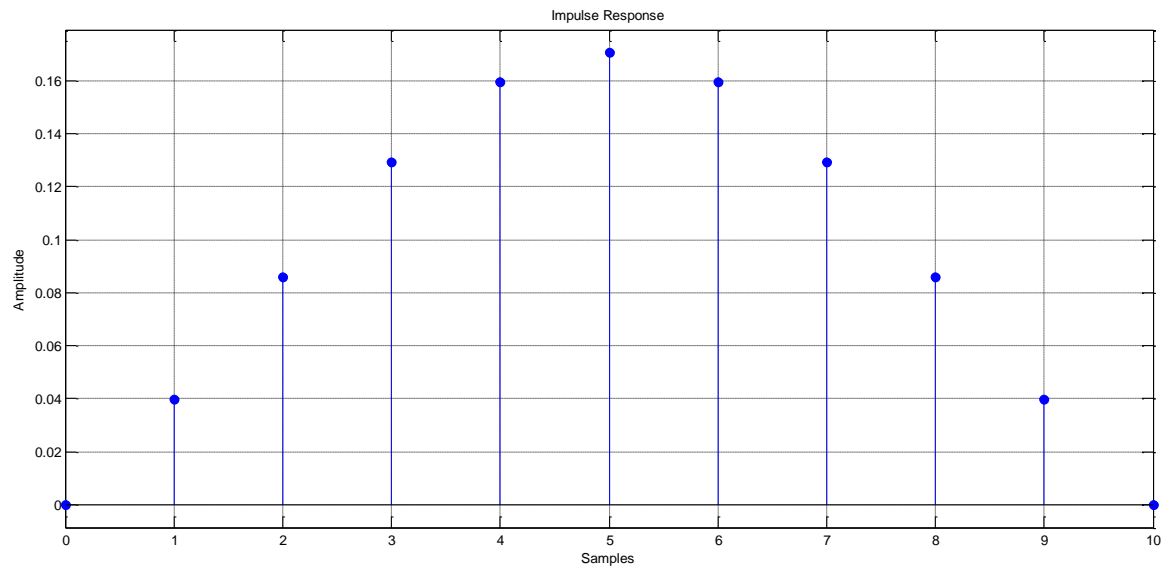


# Appendix 1

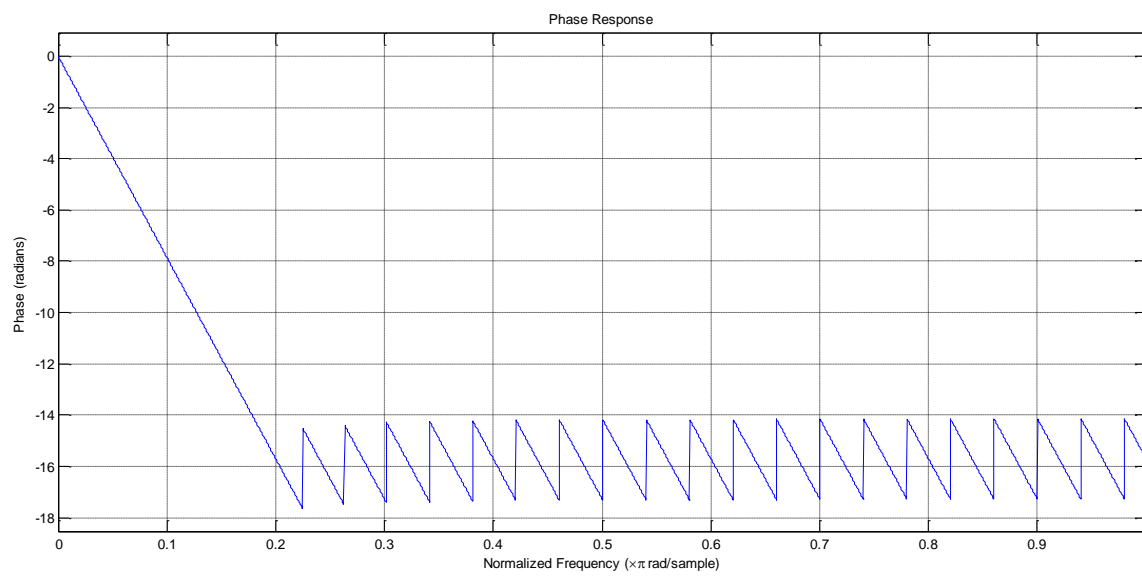
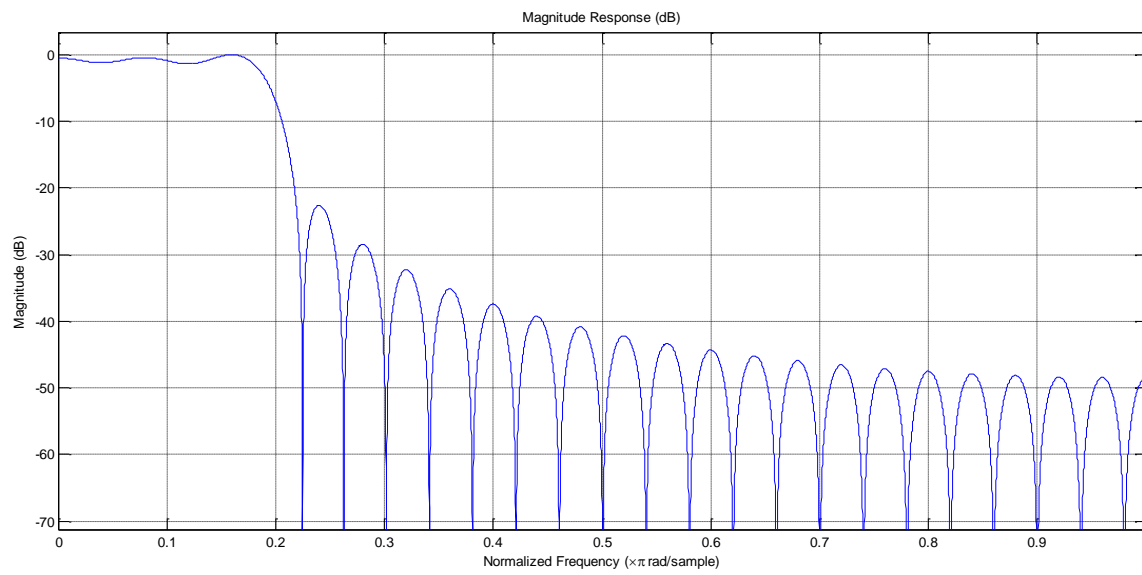
## Filter design by windowing method

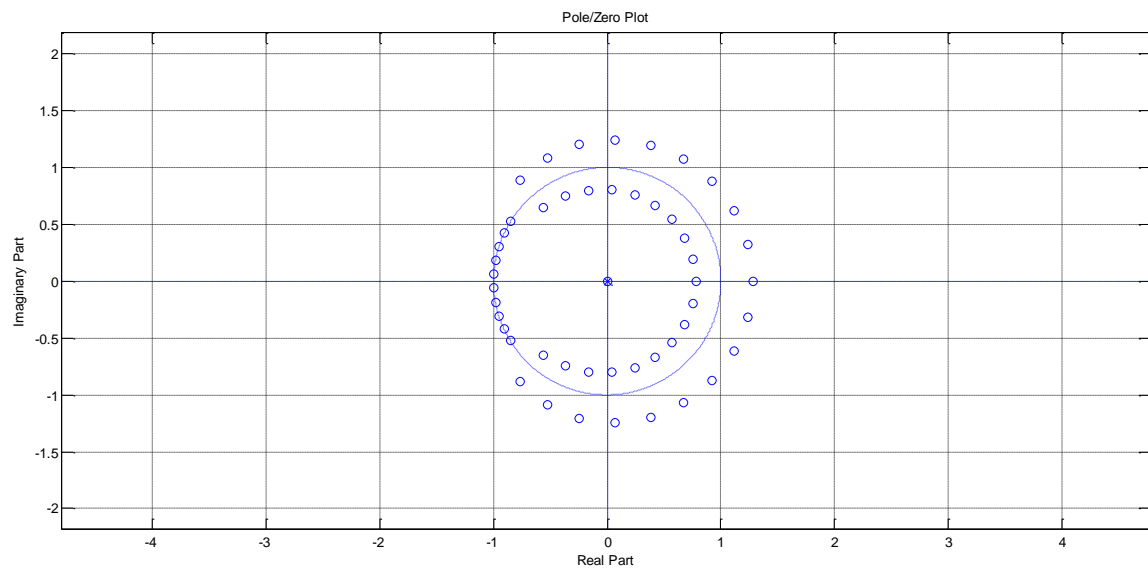
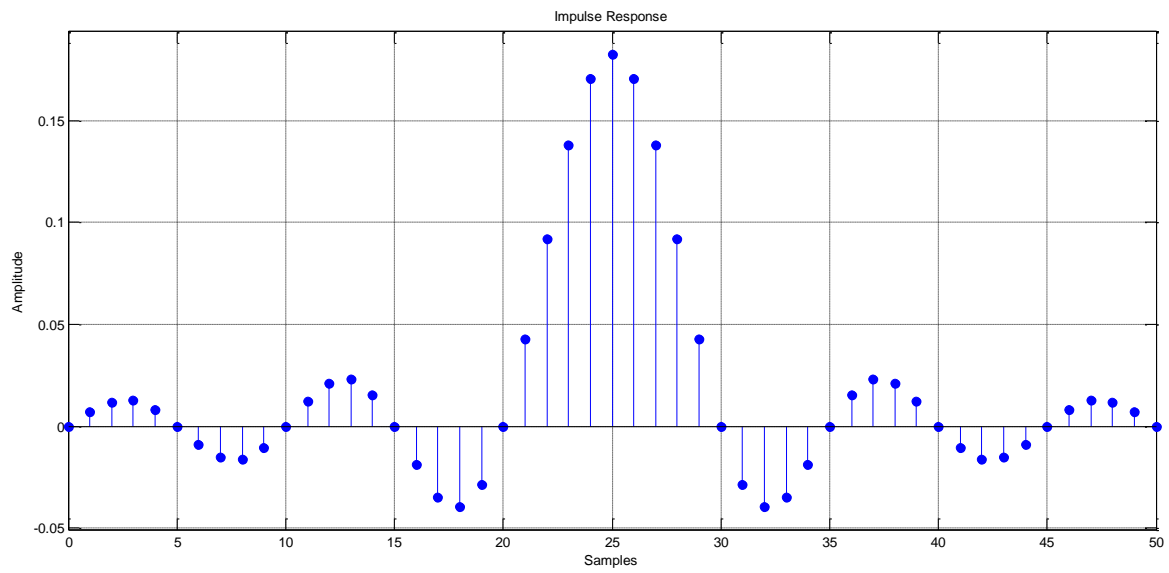
### 1) LPF design





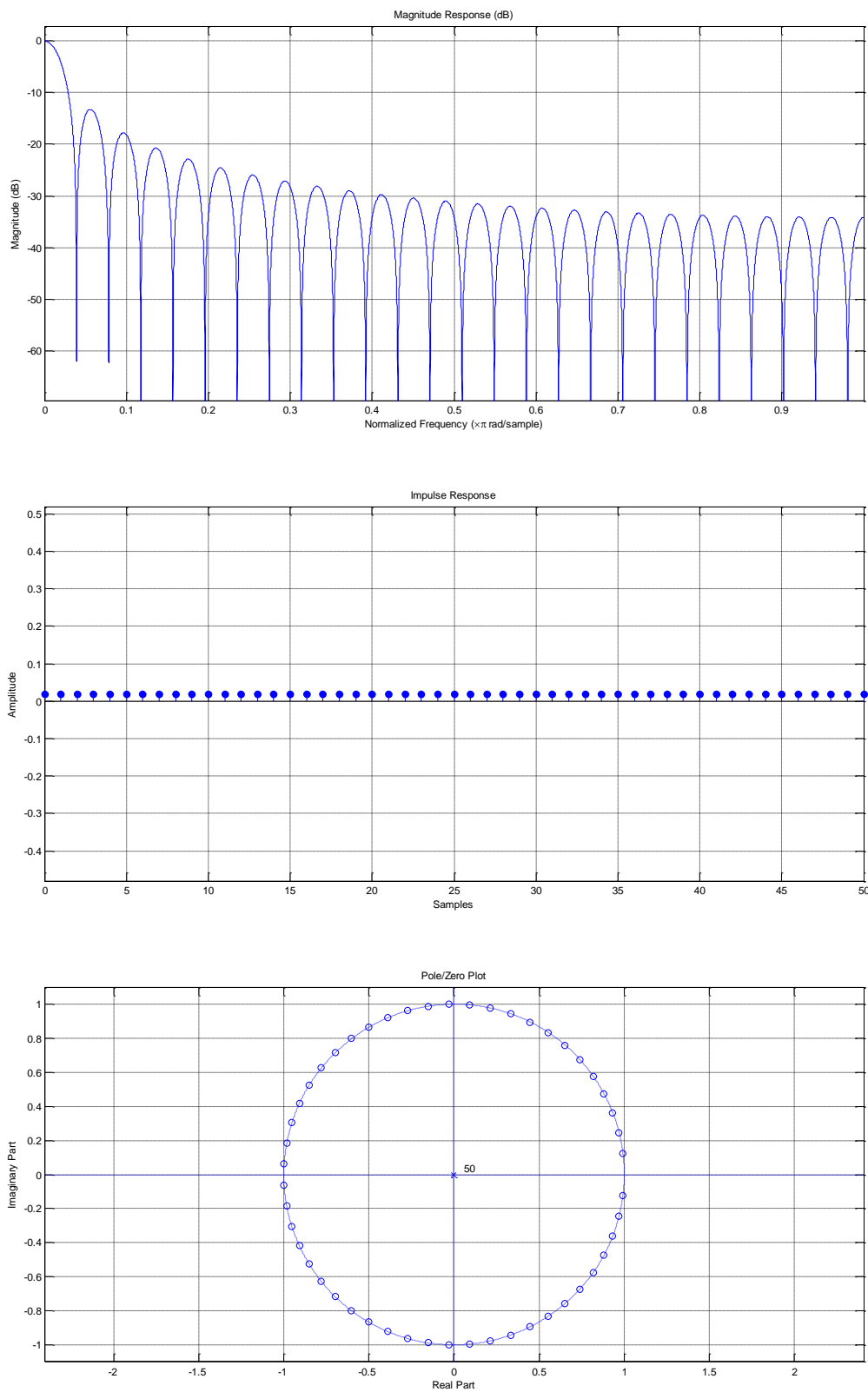
## 2) Effect of longer filter length



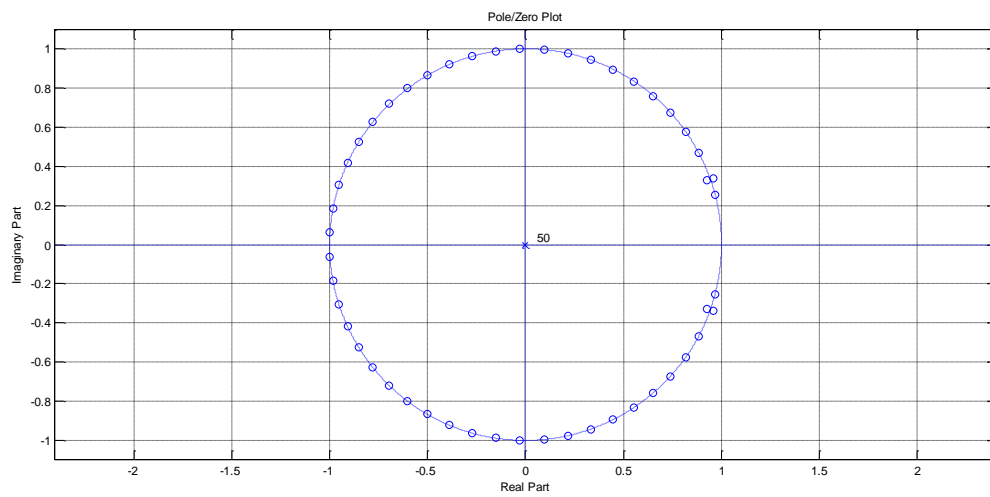
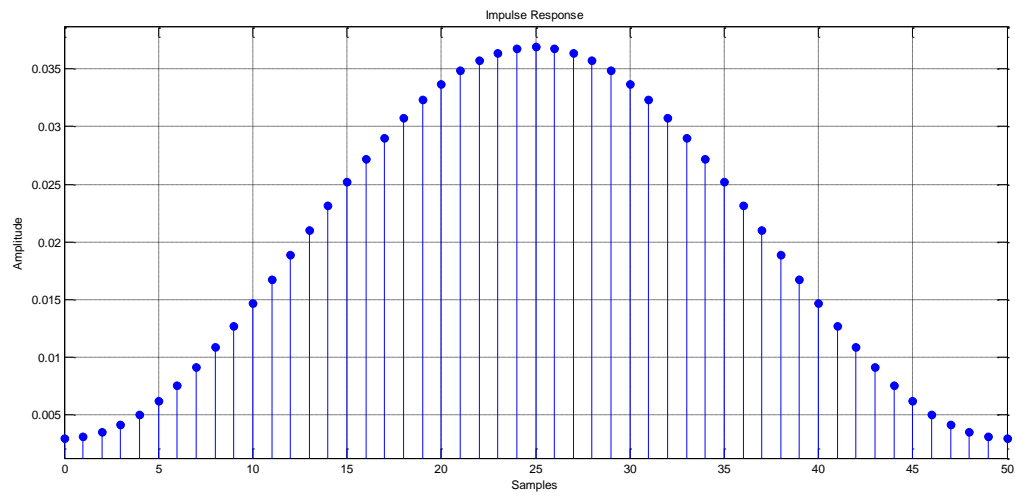
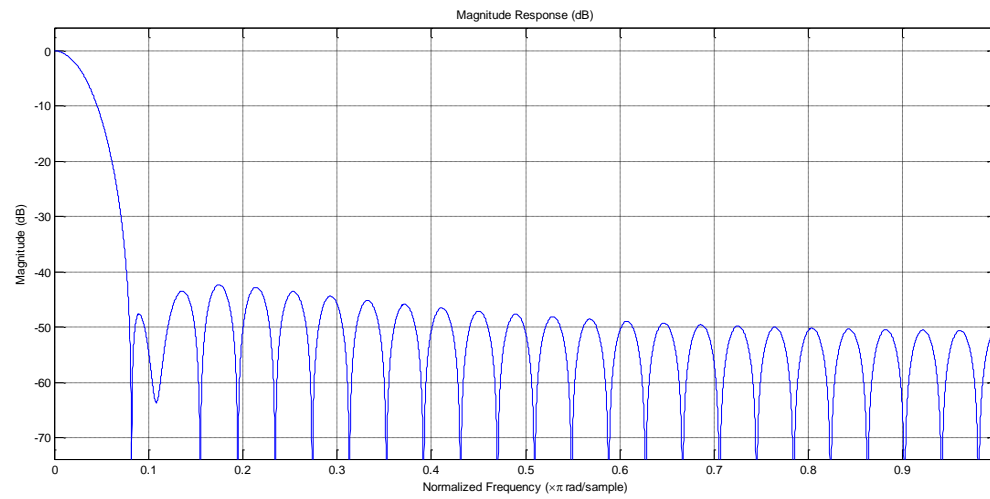


### 3) Characteristics of windowing functions

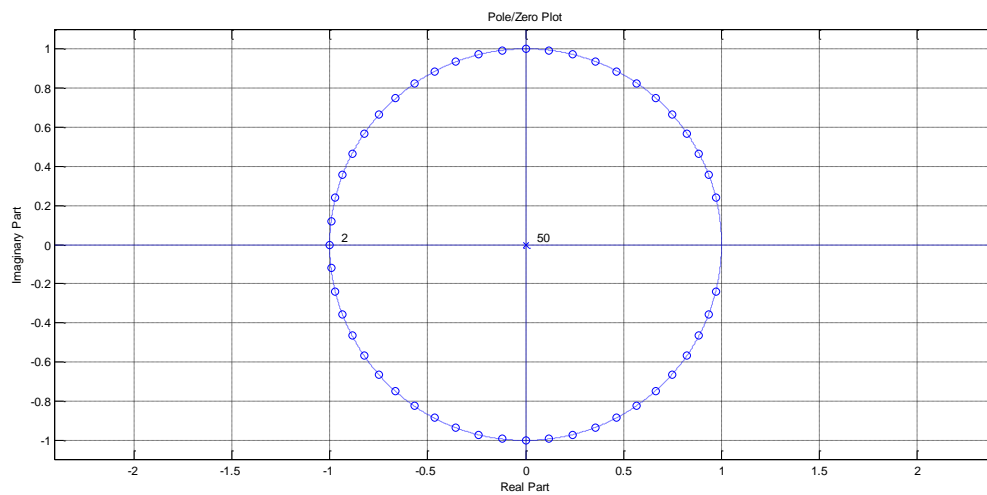
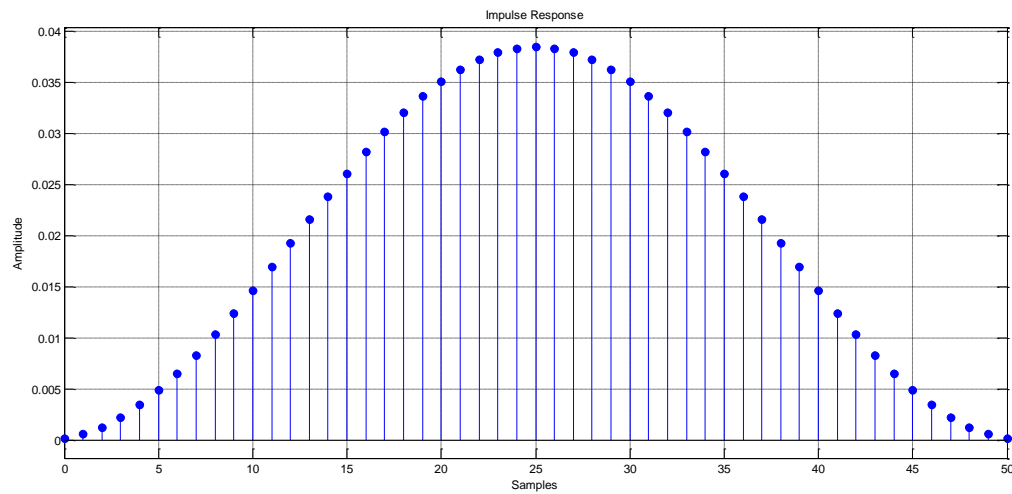
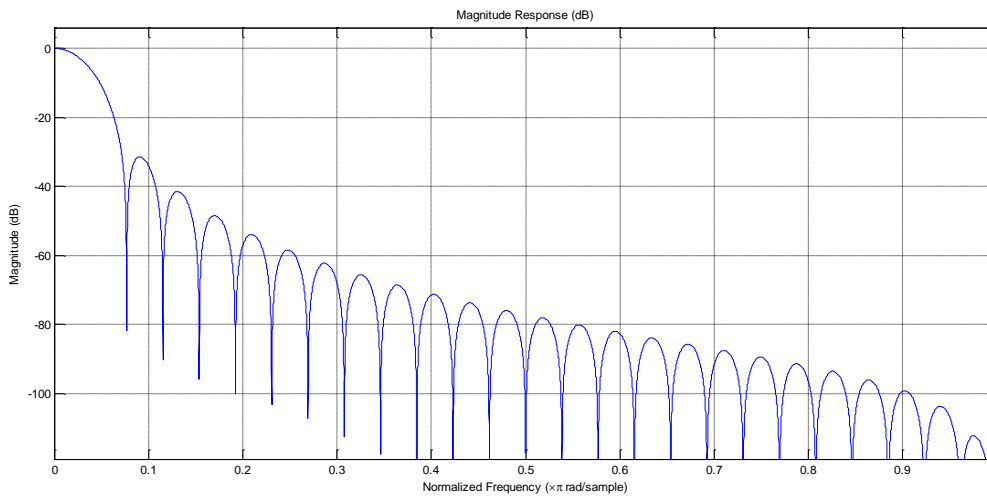
#### Rectangular window



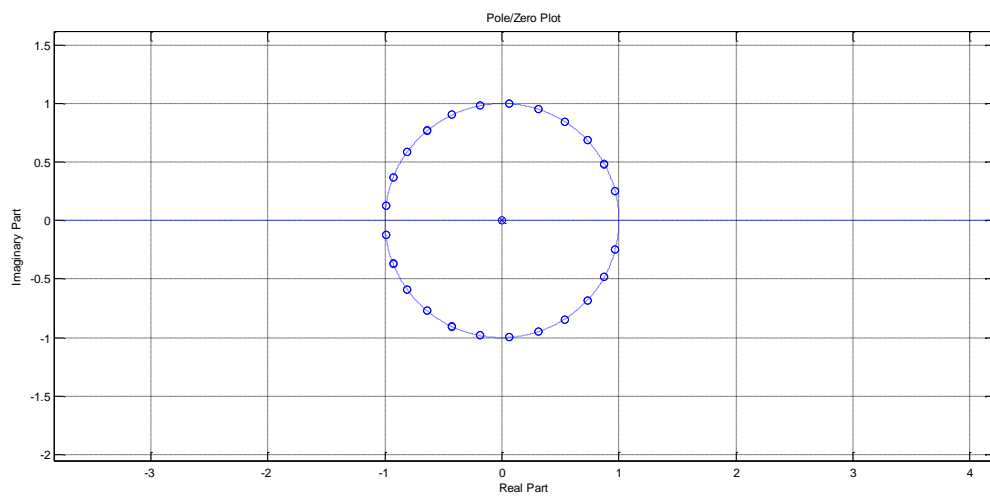
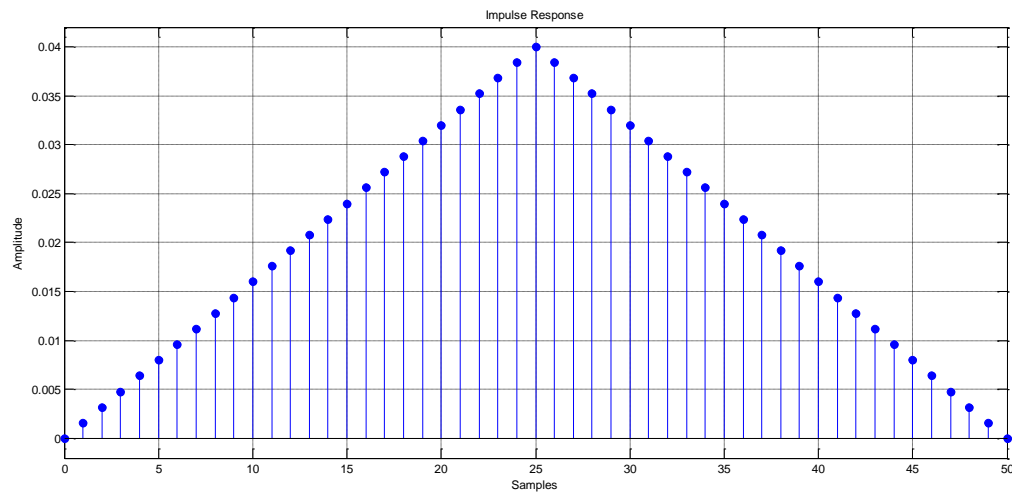
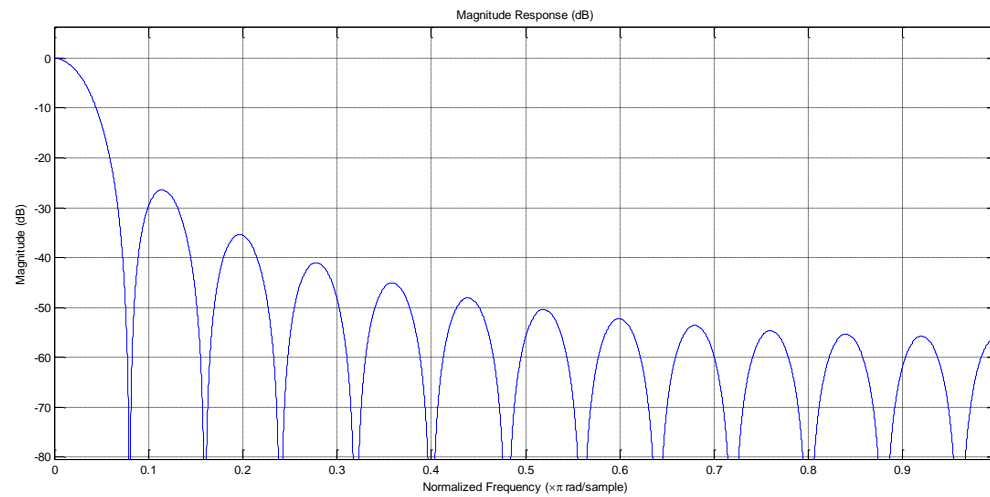
## Hamming window



# Hanning window



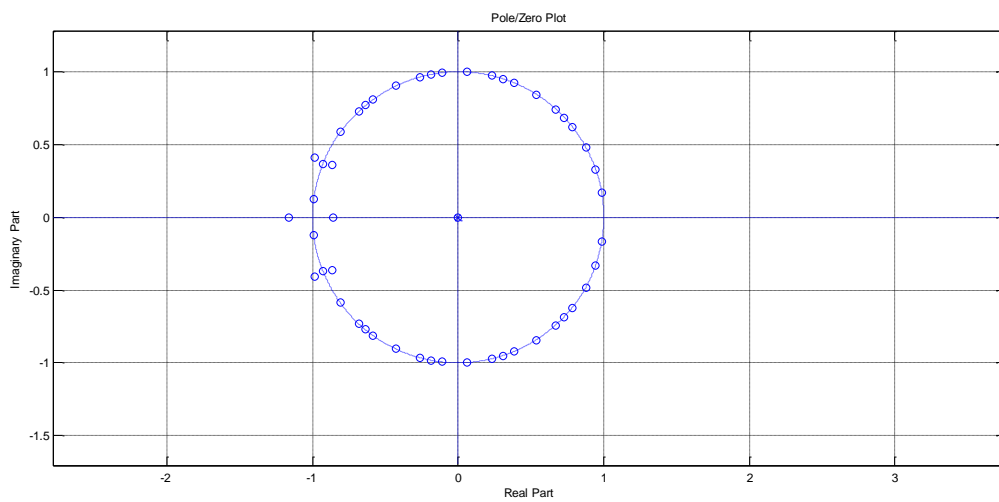
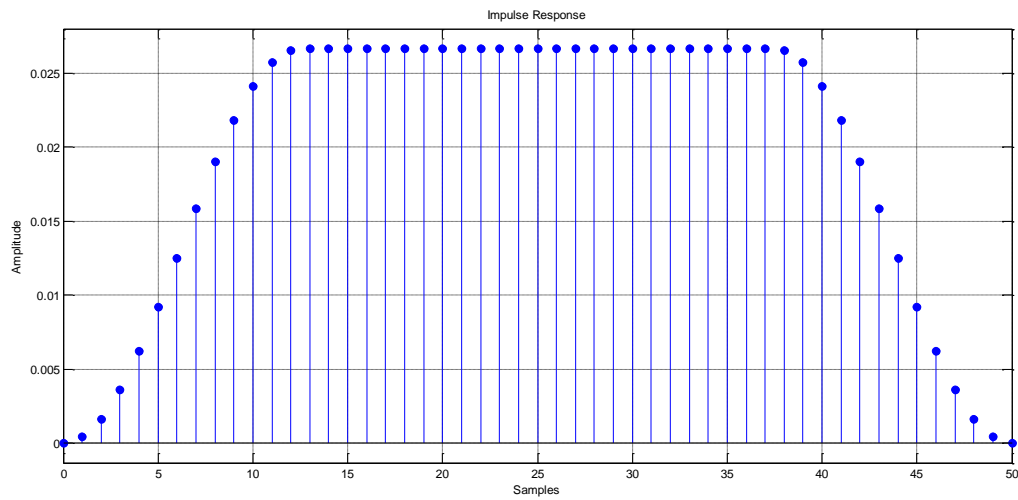
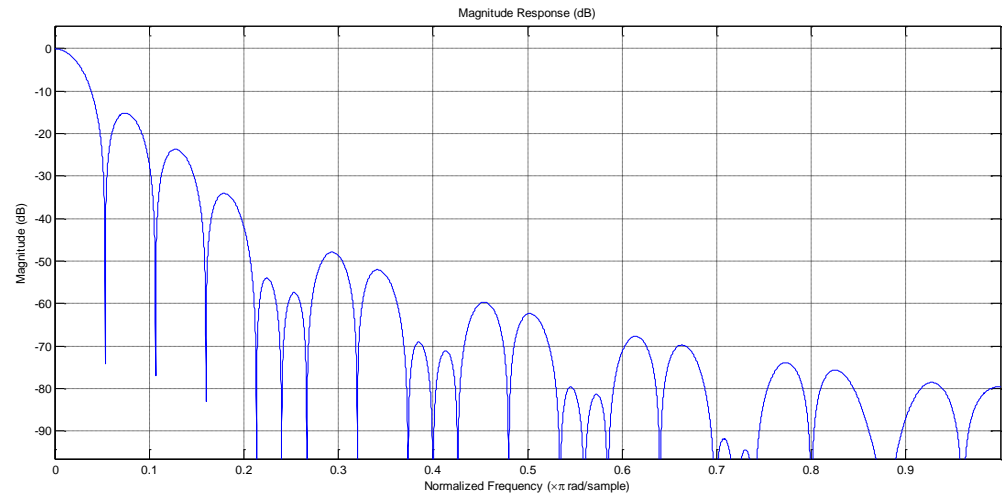
## Bartlett window



Plus a zero at plus infinity which is not shown here because of scaling reasons



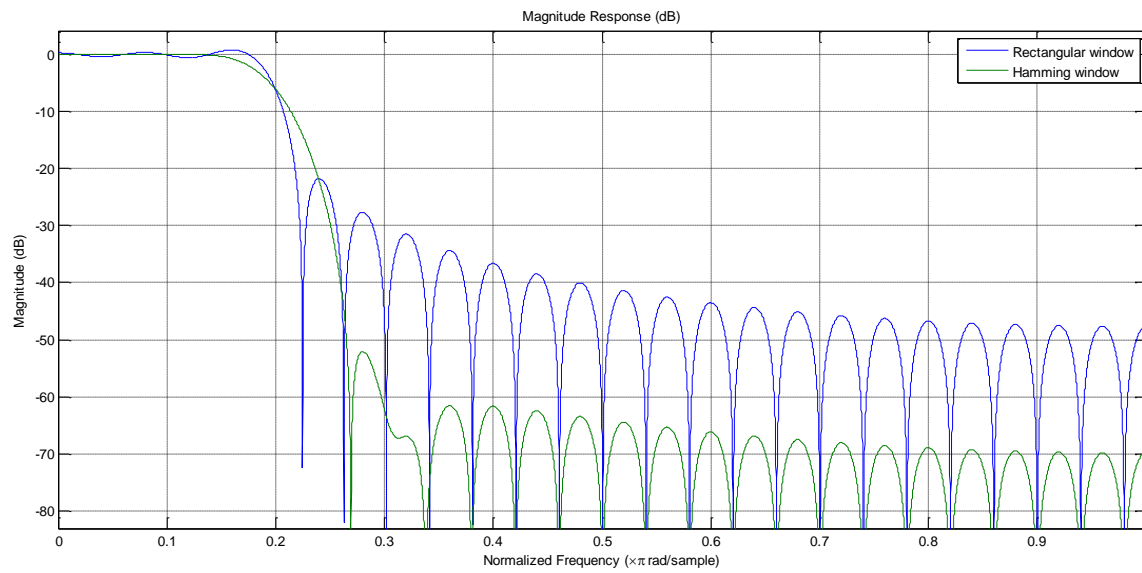
## Tukey window



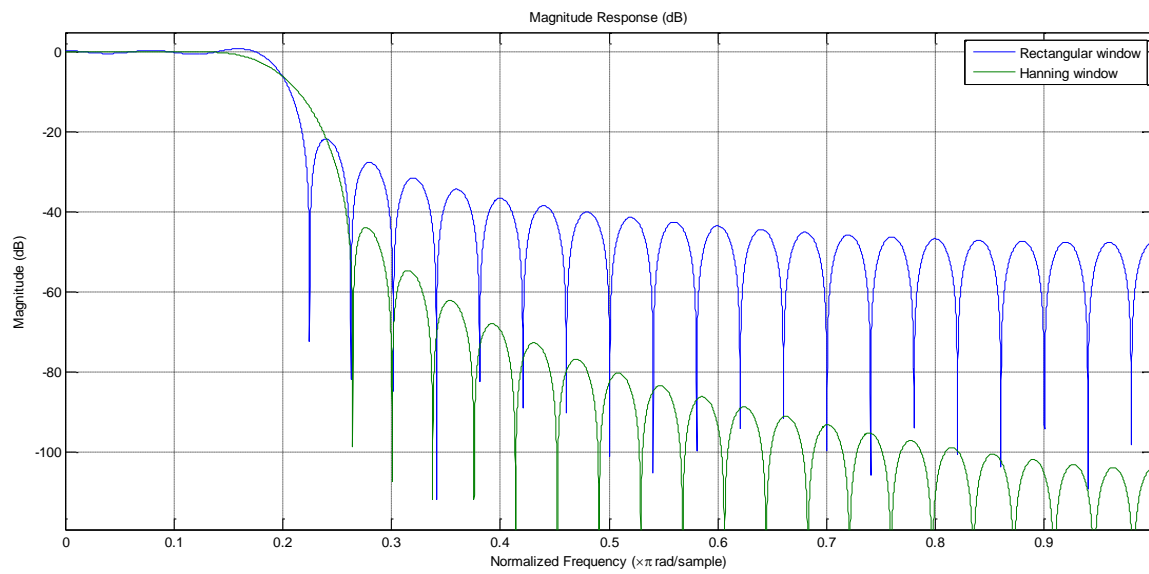
Plus a zero at minus infinity which is not shown here because of scaling reasons

#### 4) Effect of windowing on LPF design

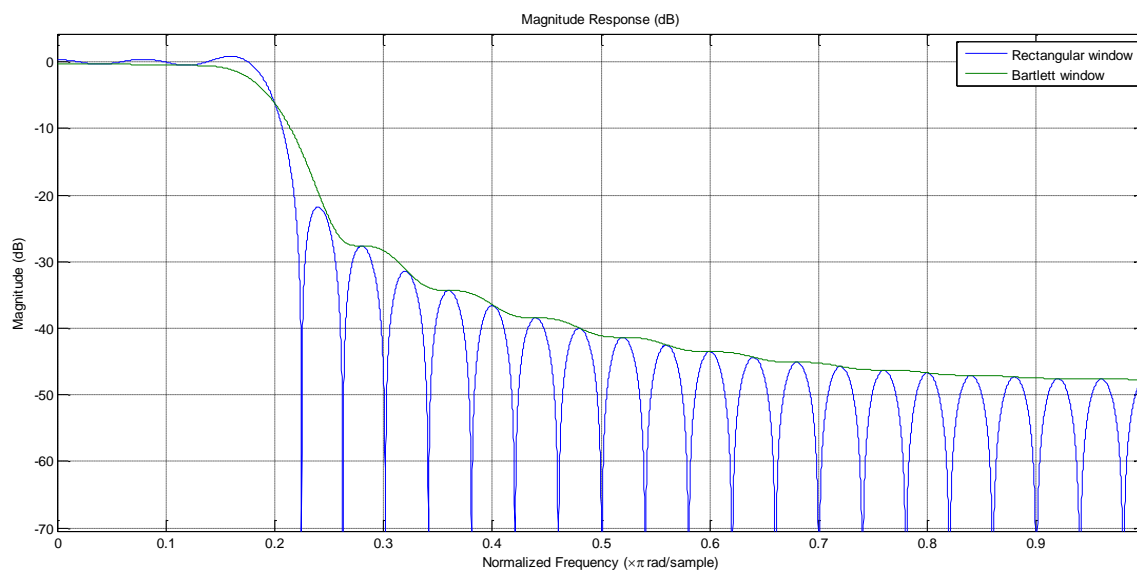
##### Hamming vs rectangular window



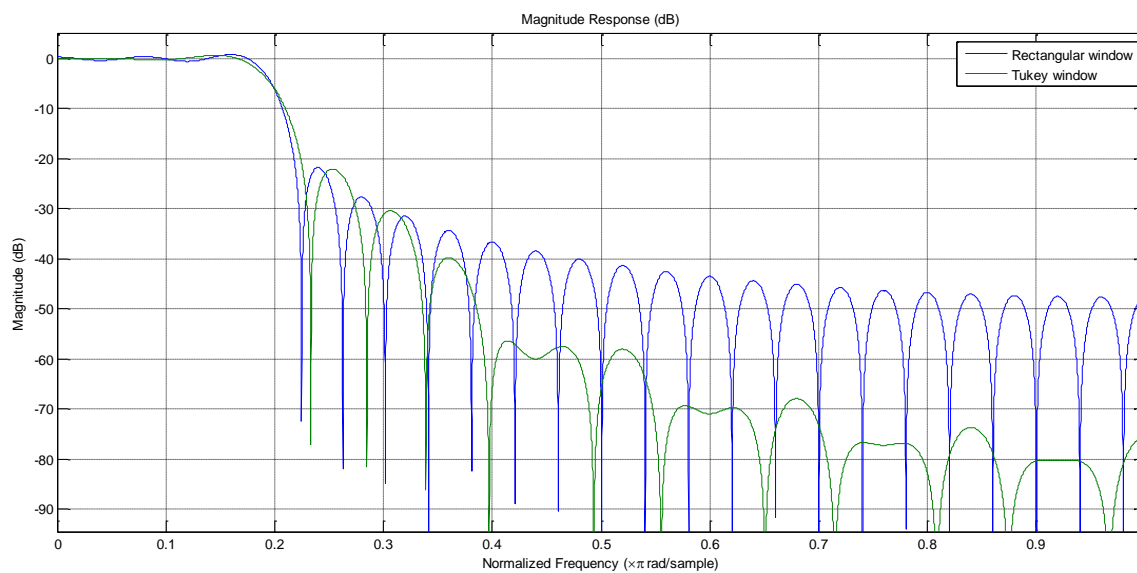
##### Hanning vs rectangular window



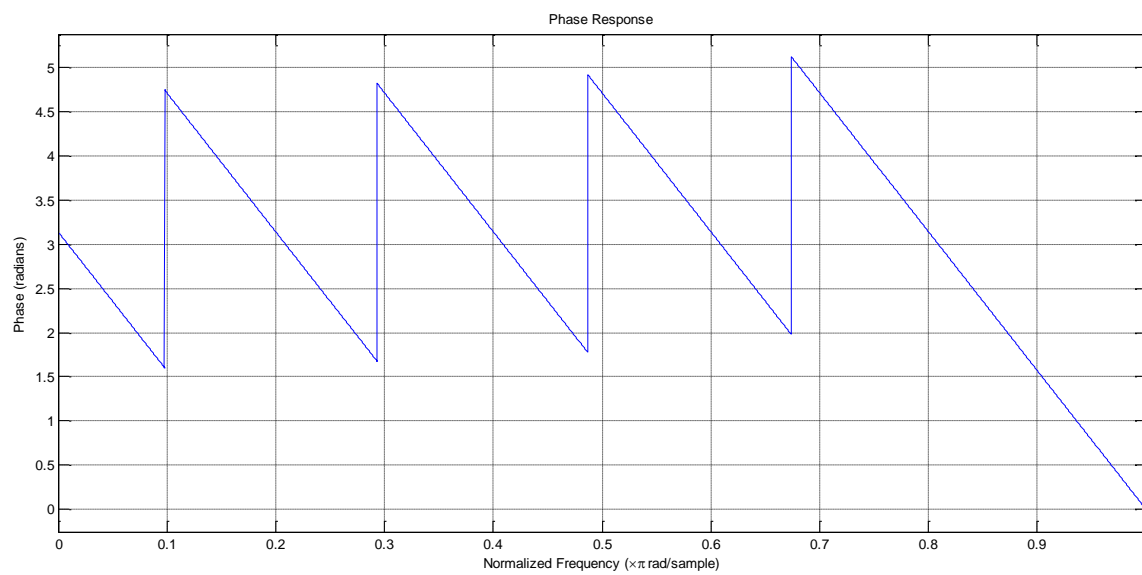
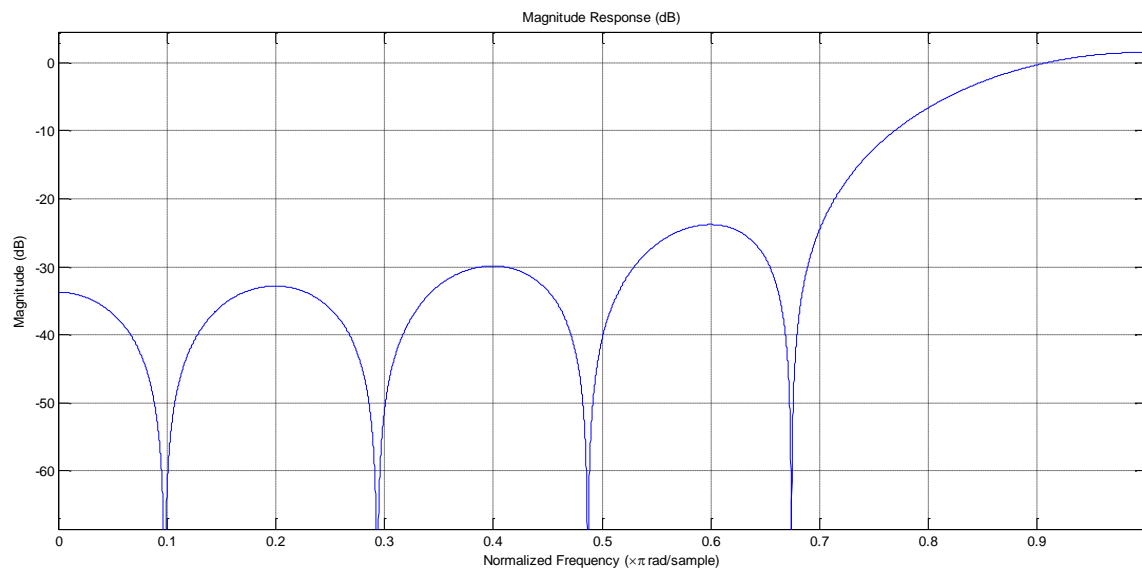
## Bartlett vs rectangular window

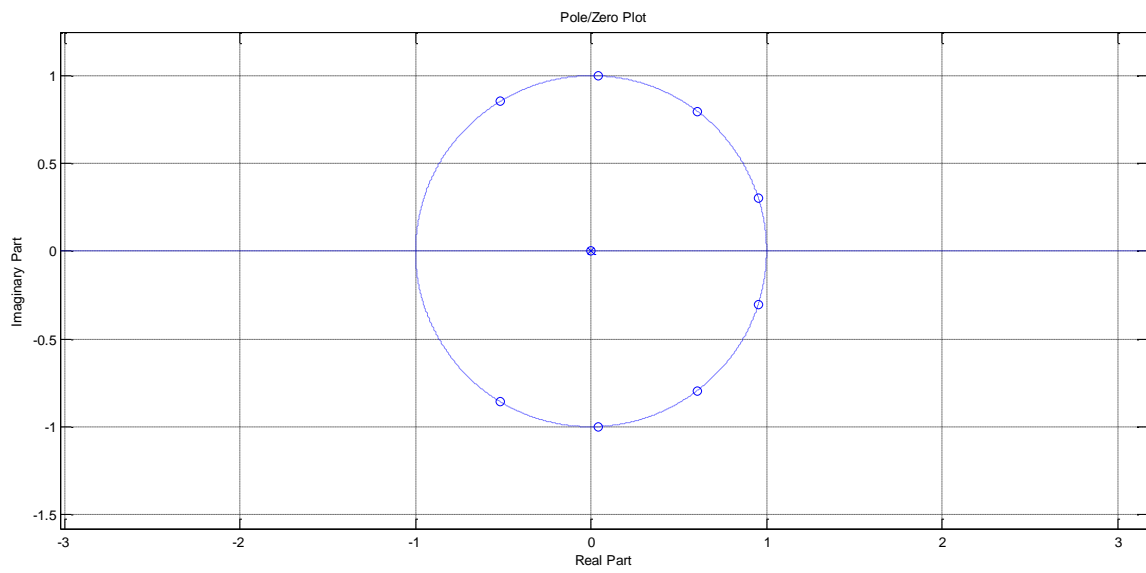
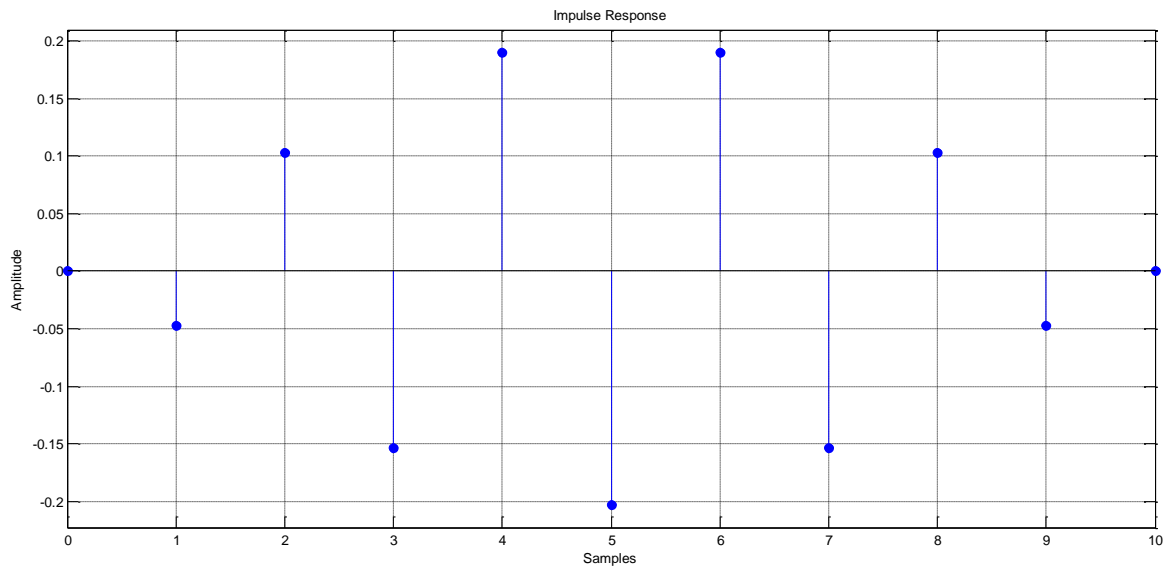


## Tukey vs rectangular window



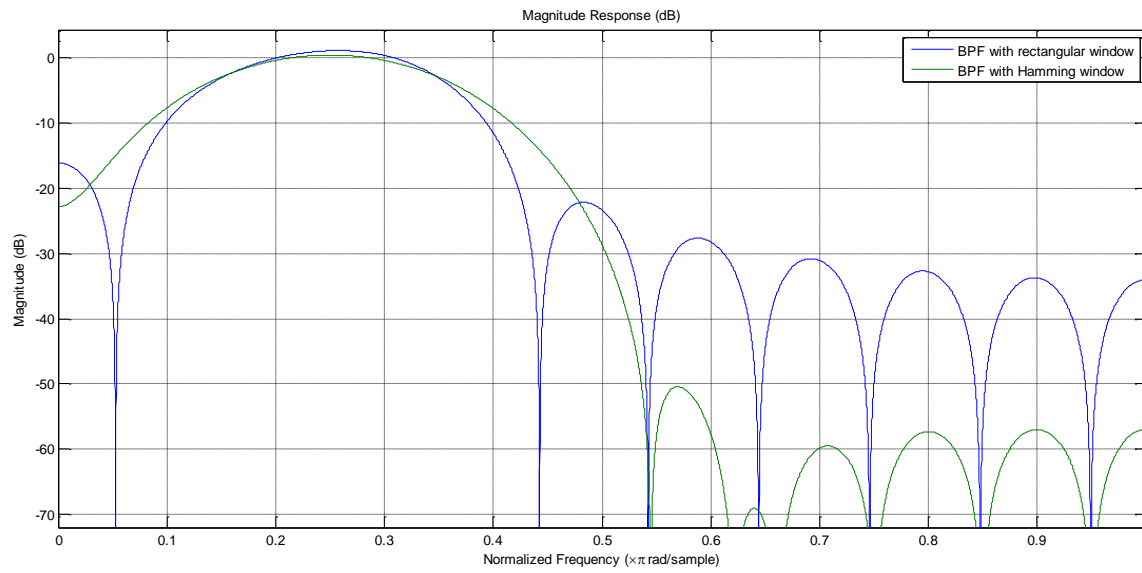
## 5) HPF design



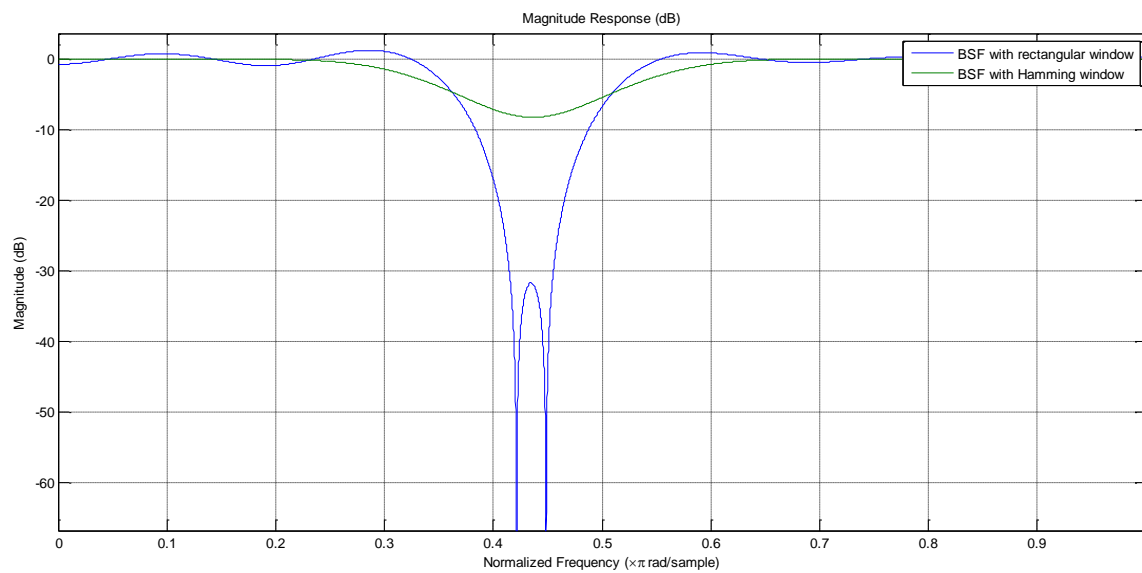


Plus a zero at plus infinity which is not shown here because of scaling reasons

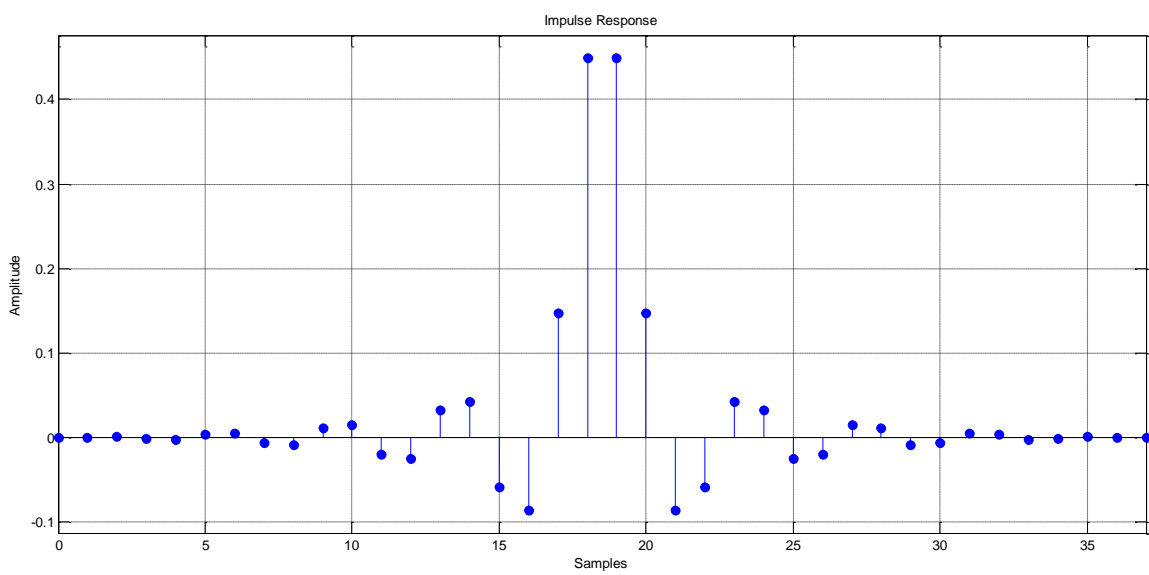
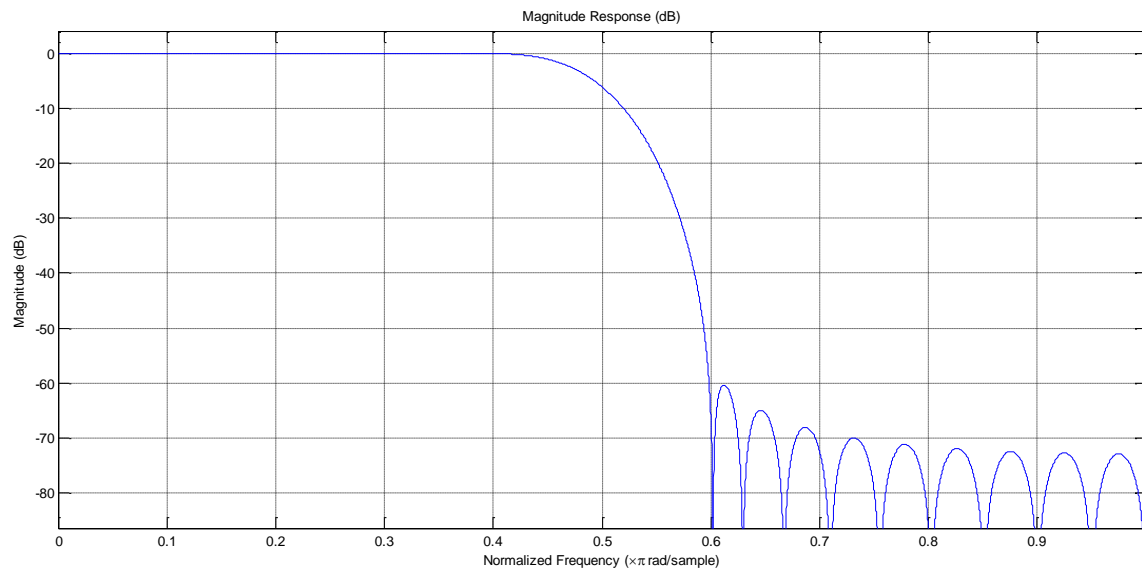
## 6) Band-pass filter design



## 7) Band-stop filter design

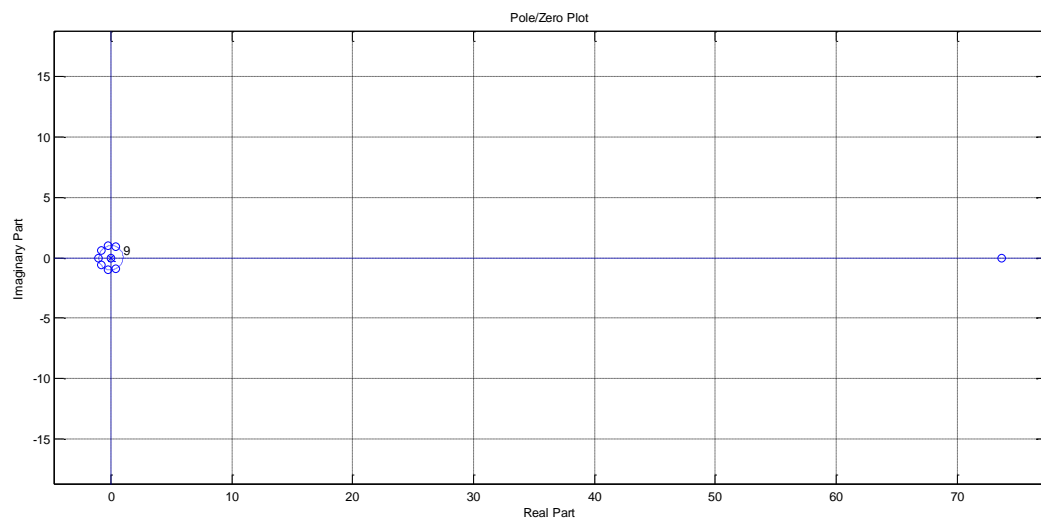
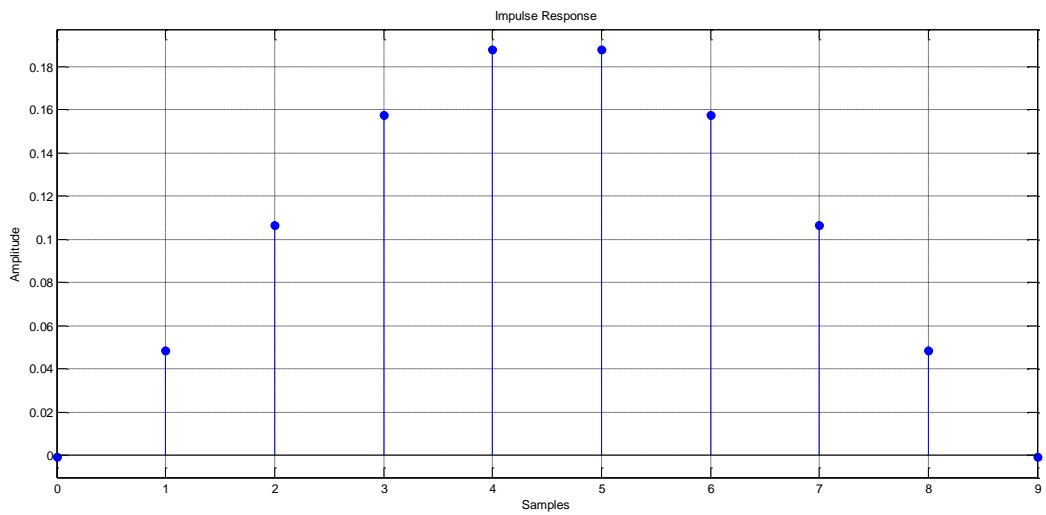
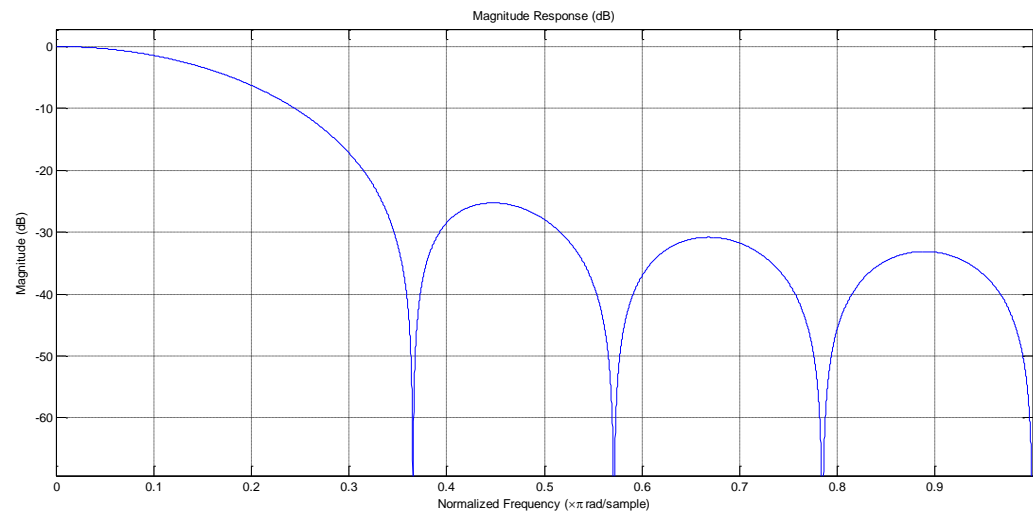


## 8) Kaiser Window



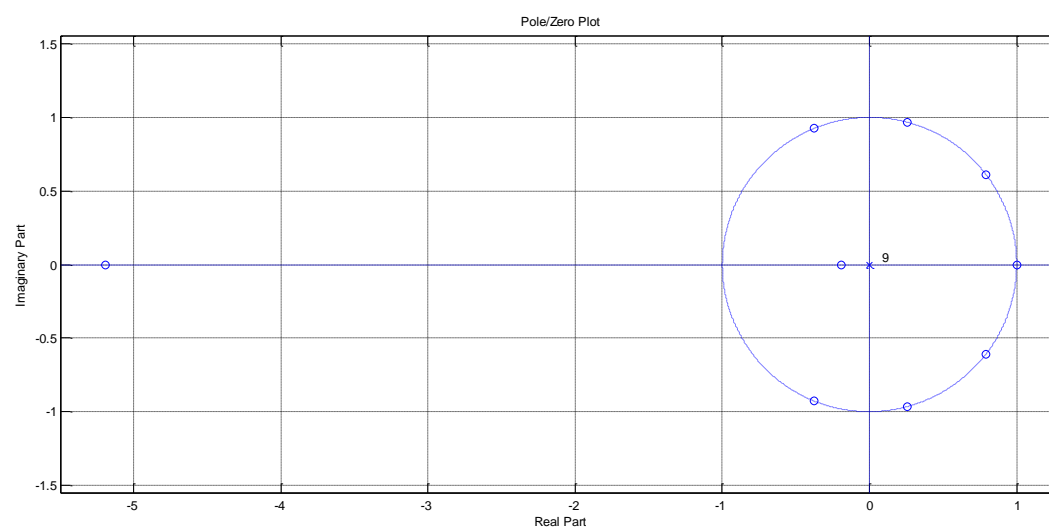
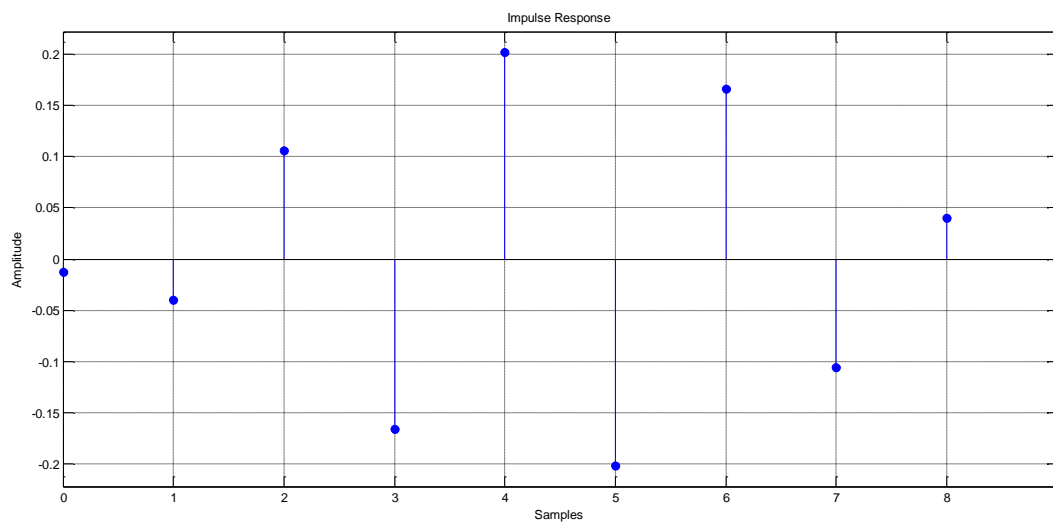
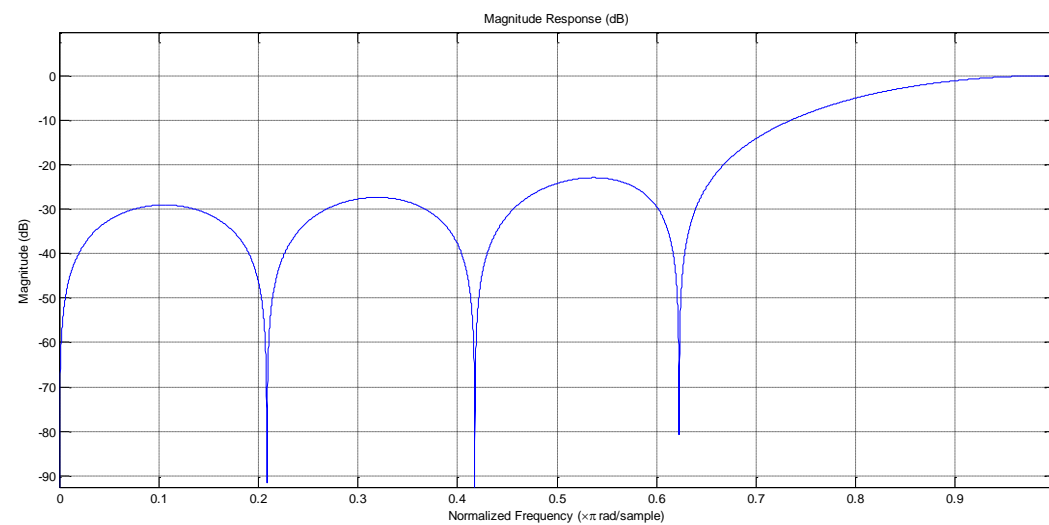
# Filter Design by Optimization

## 1) Low-pass Filter (LPF) Design



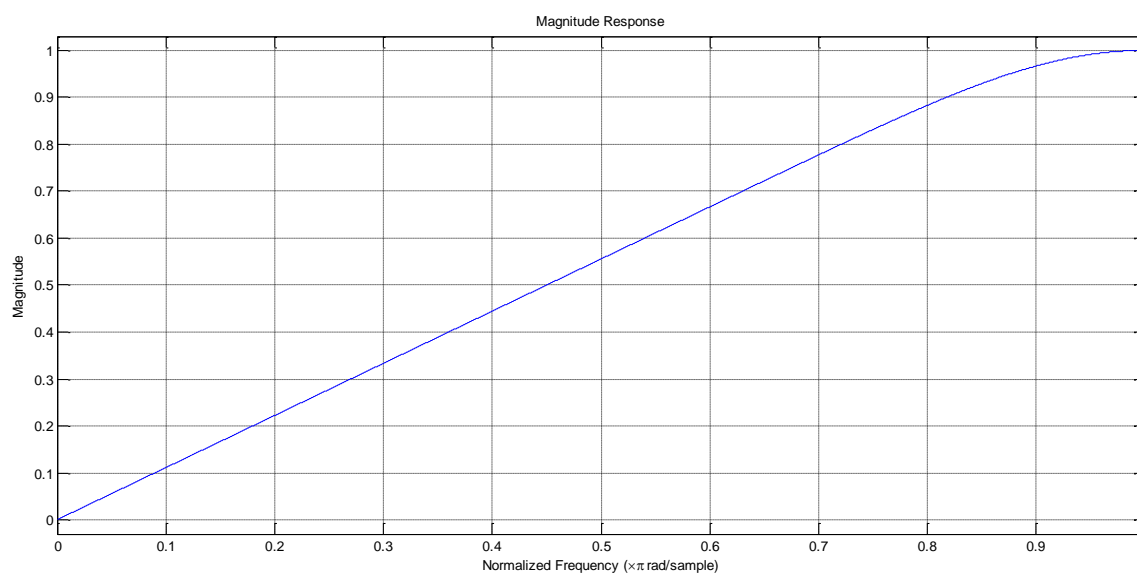


## 2) High-pass Filter (HPF) Design

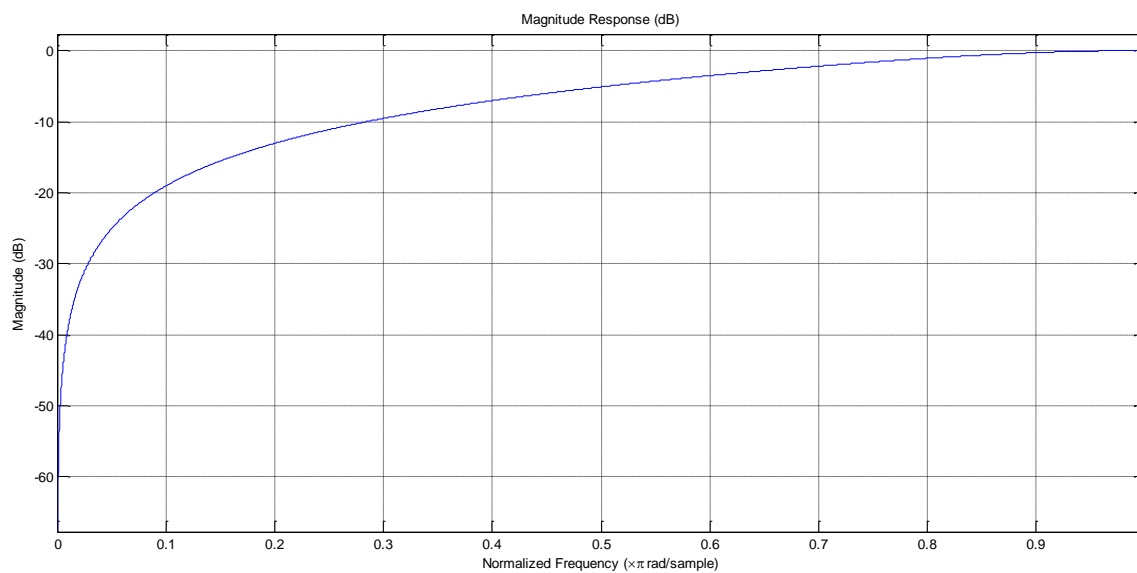


### 3) Differentiator Design

#### Magnitude response in linear scale



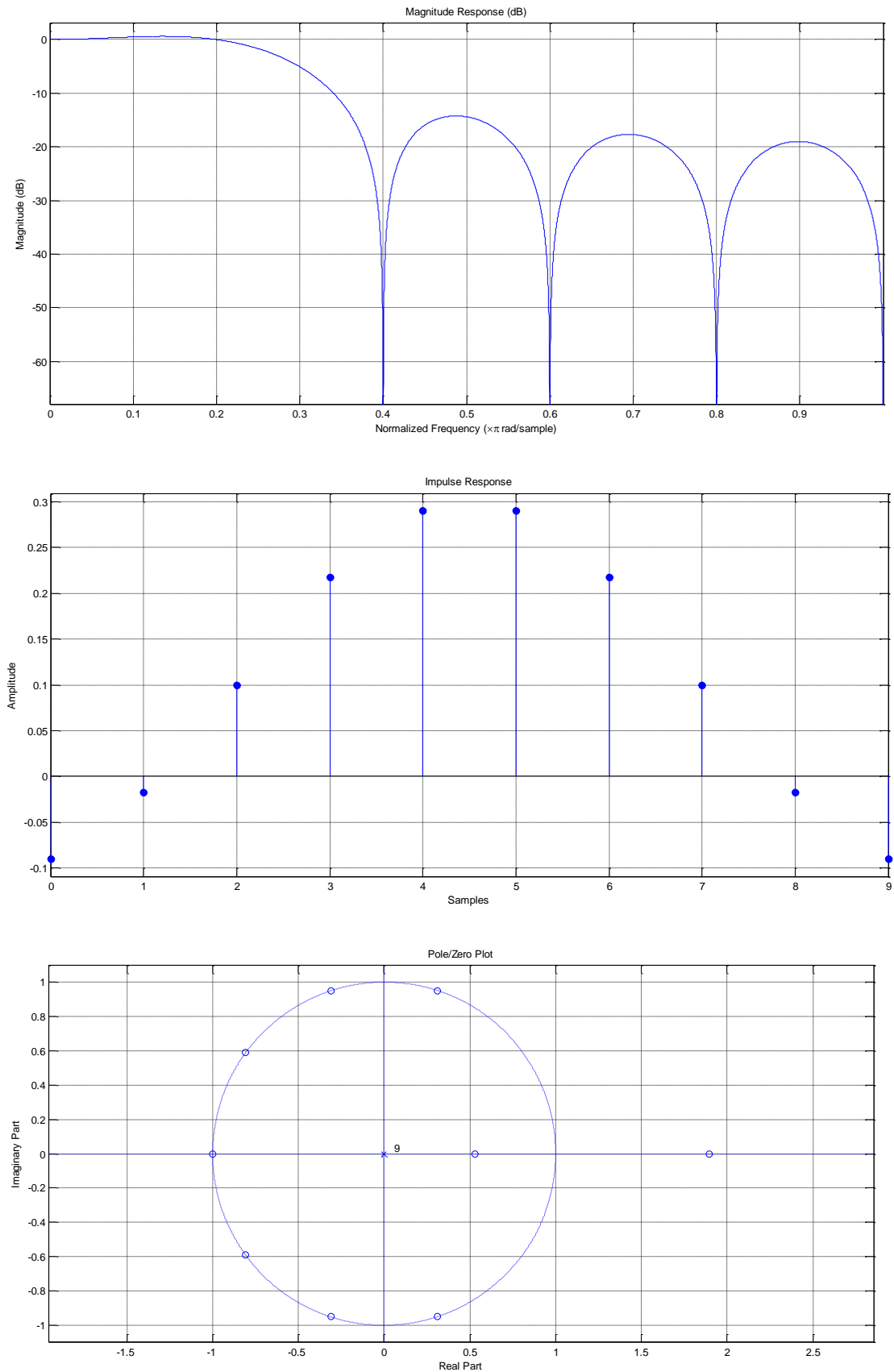
#### Magnitude response in logarithmic scale



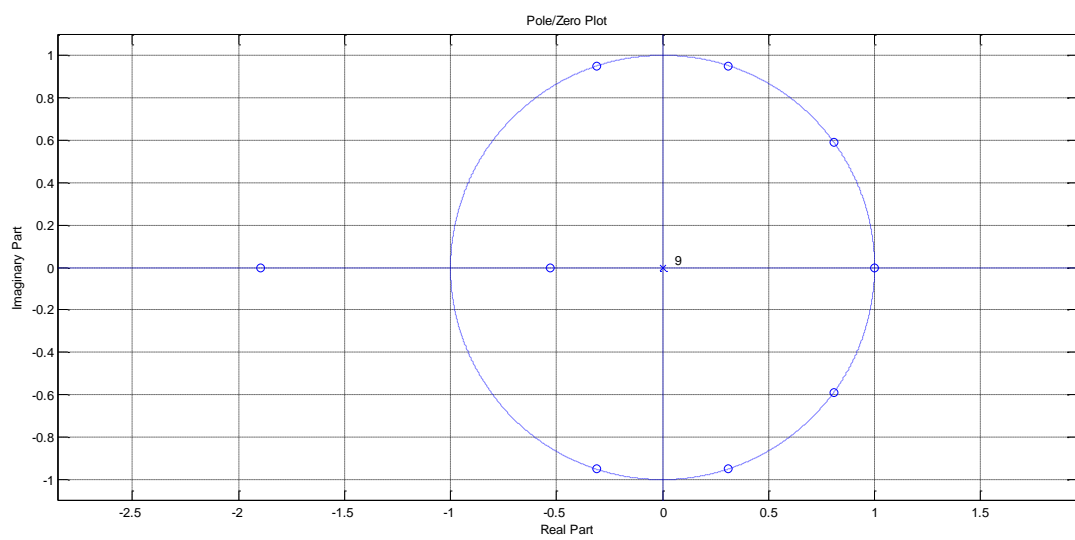
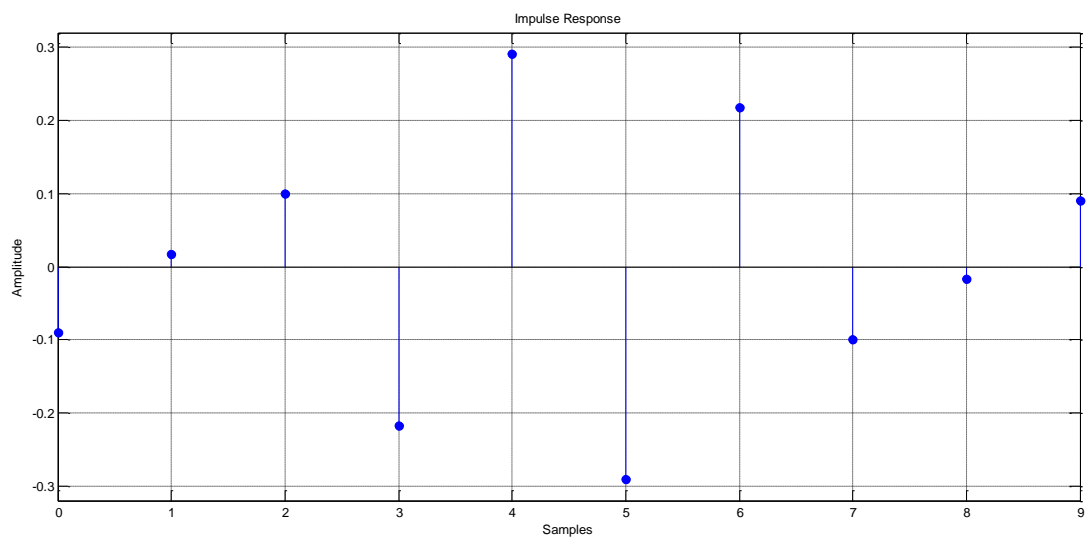
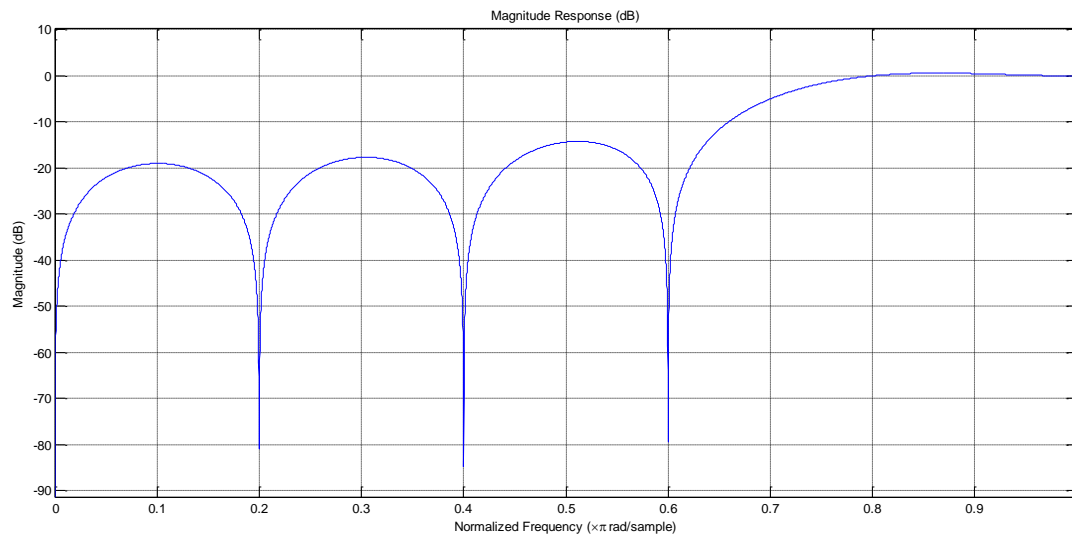


# Filter Design by Frequency Sampling

## 1) Low-pass Filter (LPF) Design

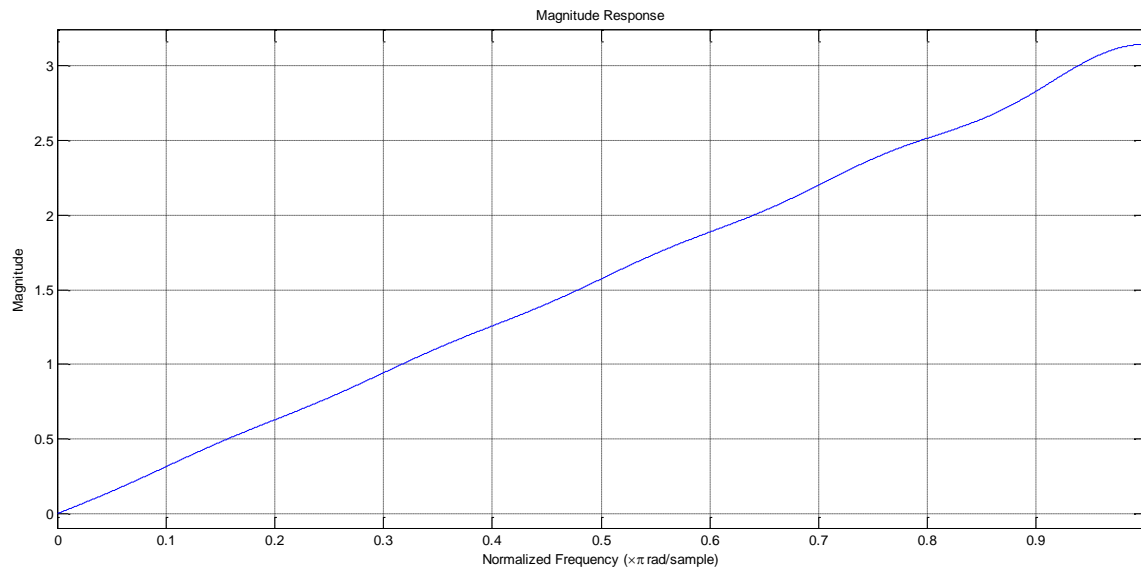


## 2) High-pass Filter (HPF) Design



### 3) Differentiator Design

#### Magnitude response in linear scale



#### Magnitude response in logarithmic scale

