**Appendix 1**

**Filter design by windowing method**

1. **LPF design**









1. **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**

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**8) Kaiser Window**

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**Filter Design by Optimization**

1. **Low-pass Filter (LPF) Design**

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1. **High-pass Filter (HPF) Design**





1. **Differentiator Design**

**Magnitude response in linear scale**

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**Magnitude response in logarithmic scale**

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**Filter Design by Frequency Sampling**

1. **Low-pass Filter (LPF) Design******
2. **High-pass Filter (HPF) Design**



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1. **Differentiator Design**

**Magnitude response in linear scale**



**Magnitude response in logarithmic scale**



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