Practice Examples
Chapter-7 Filter Design

Summary

1. In terms of any filter equation, what is the idea about the relationship of filter order and it's transition band?
2. What are the four basic types of frequency selective filters such that any other filter can be constructed using their combinations.
3. Lowpass filter is called universal filter. Construct highpass, bandpass, bandstop filters using lowpass filter. You can assume all filters are ideal.
4. If a signal is analogue what are the two main transforms to see the frequency response. What if the signal is discrete?
5. An analogue Butterworth filter gain is given as $|H(s)|^2 = \frac{1}{1+\left(\frac{s}{j\Omega_c}\right)^{2N}}$, why we choose $\sigma = 0$ in $s = \sigma + j\Omega$ in the filter's equation? What implications this puts on system's stability?
6. Write all formulae we use for impulse invariance. Why we assume $T_d = 1$ in designing Butterworth Filter? Is it true for any kind of filter?
7. Why there is aliasing in impulse invariance filter design method?
8. What are the three types of writing any transfer function? Which one is more beneficial if we want to switch between frequency and time domain?
9. Impulse invariance is somewhat similar to sampling an analogue signal to discrete signal. Can we say that for Bilinear Transformation?
10. Write all formulas related to Bilinear Transformation.
11. What is the advantage and disadvantage of using FIR filters given that we have already studied IIR?
12. What is the main aim of window $w[n]$ and why we choose it to be in the range $[0 - M]$?
13. Why have we learnt to draw ideal frequency responses to be even symmetric in Signals and Systems and DSP so far?
14. Keeping in mind the shape of $w[n]$, why the IIR system must be linear phase?

Practice Examples

1. Design a Butterworth lowpass digital filter using Impulse Invariance and Bilinear Transformation given the following specifications

$$0.99 \leq \left|H\left(e^{j\omega}\right)\right| \leq 1.01, \qquad 0 \leq |\omega| \leq 0.4\pi$$
$$\left|H\left(e^{j\omega}\right)\right| \leq 0.001, \qquad 0.6\pi \leq |\omega| \leq \pi$$