2023 DSP Final Project - Filter Design (Deadline: 1 week after final exam)

1. Design a digital Butterworth lowpass filter operating at a sampling rate of 300 KHz with a 0.3 dB cutoff frequency at 30 kHz and a minimum stopband attenuation of 60 dB at 60 kHz using the bilinear transformation method. You should first determine the order of the analog filter prototype and design the analog prototype filter using `buttap` function. Afterward, transform the analog filter transfer function to the desired digital transfer function using the `bilinear` function. Plot the gain and phase responses. Show all steps used in the design.

2. FIR design
    (a) Using the window method, design a linear-phase FIR low pass filter with the following specifications: passband edge at 3 rad/sec, stopband edge at 6 rad/sec, maximum passband attenuation of 0.2 dB, minimum stopband attenuation of 44 dB, and a sampling frequency of 24 rad/sec. Use each of the following windows for the design: **Hamming, Hann, and Blackman**. Show the impulse response coefficients, and plot the gain response of the designed filters for each case. Comment on your results. **Do not use the `fir1` function**.
    (b) repeat (a) with the **Kaiser** window method. **Do not use `fir1` function**.
    (c) repeat (a) with the **Parks-McClellan** method.
    (d) Compare the results of (a), (b) and (c).

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