## Homework 10: due 04/13/18

EE 324: Signals and Systems II

## **1** Discrete-time differentiator

1. Design a discrete-time differentiator with M = 10 and Hamming window. Plot the bode diagram.

## 2 FIR

1. Design a low-pass filter with  $\Omega_c = 0.3\pi rad/s$ , M = 11. Use both Hamming window and rectangular window, and compare their bode diagrams.

2. Design a high-pass filter with  $\Omega_c = 0.7\pi rad/s$ , M = 11. Use both Hamming window and rectangular window, and compare their bode diagrams.

## 3 IIR

Goal: low-pass filter with pass band (2dB) frequency  $f_p = 100Hz$  and stop band (60dB) frequency  $f_s = 130$ .

- 1. Pick a proper sampling time T and sampling frequency f = 1/T.
- 2. Calculate the significant frequencies  $\Omega_p$  and  $\Omega_s$ .
- 3. Prewarpping: get new  $f_p, f_s$ .
- 4. Design both Butterworth and Chebyshev analog filters based on these new  $f_p, f_s$ .
- 5. Apply Tustin transform to obtain your digital IIR filters.

6. Plot the bode diagrams of your filters to see if they satisfy the requirements. You may need to try different filter orders to get the proper one.