Assignment 7 - FIR Filter Design

Due March 12, 1996

Please show your work. For those questions that ask you to use Matlab show the exact commands you used to compute the results. When asked to plot the frequency response you may have to make several plots over different frequency and amplitude ranges to verify that all the specifications are met.

Question 1

(a) Determine the amplitude response of an ideal linear-phase low-pass filter with a cutoff frequency equal to 0.2 F_s (the sampling frequency). You may assume the phase response is zero. Determine that impulse response of this filter. Note that these are all continuous functions of frequency or time.

Compute the values of the filter coefficients of a FIR filter of length 15 for a direct form filter implementation by sampling the ideal impulse response. Plot the resulting frequency and phase response using Matlab.

(b) Multiply the coefficients with a triangular window and re-plot the frequency response.

Question 2

This question asks you to design two filters using the Window method. For each filter select the standard window function and the filter length that will produce the shortest filter that meets the specifications. Compute the filter coefficients and plot the frequency response using Matlab.

(a) Low-Pass Filter

sampling rate	20	kHz
passband	0 – 3	kHz
stopband	5-10	kHz
stopband attenuation	50	dB

(b) Band-Pass Filter

sampling	rate 20	Hz
stopband1	0 – 3.5	Hz
stopband1 attenuation	20	dB
passband	4.5 – 5.5	Hz
stopband2	6.5 – 10	Hz
stopband2 attenuation	20	dB

Question 3

This question asks you to design two filters using the Parks-McClellan method. In each case determine the transition regions, mean signal levels and ratio of allowed ripples. Use the `remezord()` and `remez()` functions to obtain estimated filter lengths and coefficient values for the filters. Plot the frequency response using Matlab. Increase the filter order if necessary to obtain a filter that meets the requirements.

(a) Low-Pass Filter

sampling rate	100	kHz
passband	0 – 10	kHz
passband ripple	$\pm$ 0.2	dB
stopband	20-50	kHz
stopband attenuation	60	dB

(b) Band-Pass Filter

sampling rate	400	kHz
stopband1	0 – 20	kHz
stopband1 attenuation	30	dB
stopband2	30 – 80	kHz
stopband2 attenuation	50	dB
passband	90 – 110	kHz
passband ripple	$\pm$ 1	dB
stopband3	120 – 170	kHz
stopband3 attenuation	50	dB
stopband4	180 – 200	kHz
stopband4 attenuation	30	dB