EE 451

Homework #12

Due November 12, 2001

1. Design an FIR lowpass filter for a sampled continuous-time system with the following characteristics:

$$F_P = 2\ kHz \quad R_P = 0.5 \text{ dB}$$
$$F_S = 8\ kHz \quad R_S = 30 \text{ dB}$$

   The sampling frequency is 48 kHz. Use one of the standard windows (not Kaiser).

   (a) Find the specifications of the discrete-time filter.

   (b) What window will you use? Why?

   (c) Find the number of coefficients needed.

   (d) Compare the filter order of this FIR filter to the order of the IIR filter from Homework 11.

   (e) Find the coefficients for the filter. Use MATLAB's `stem()` function to plot the coefficients.

   (f) Use MATLAB to find and plot the gain response of the filter. Show that it meets the specifications.

   (g) Plot the phase response of the filter. Show that it is linear in the passband.

2. Consider the FIR design of Problem 1 using a Kaiser window.

   (a) What is β?

   (b) What is the order of the filter? Compare this to the order using the standard window of Problem 1.

3. Design an FIR bandstop filter for a sampled continuous-time system with the following characteristics:

$$F_{pl} = 4 \text{ kHz} \quad F_{ph} = 14 \text{ kHz} \quad R_P = 0.5 \text{ dB}$$
$$F_{sl} = 8 \text{ kHz} \quad F_{sh} = 10 \text{ kHz} \quad R_S = 50 \text{ dB}$$

   The sampling frequency is 48 kHz. Use a Kaiser window.

   (a) Find the specifications of the discrete-time filter.

   (b) Find the number of coefficients needed.

   (c) Find the coefficients for the filter. Use MATLAB's `stem()` function to plot the coefficients.

   (d) Use MATLAB to find and plot the gain response of the filter. Show that it meets the specifications.

   (e) Plot the phase response of the filter. Show that it is linear in the passband.

4. Design a filter to meet the specifications of Problem 4 using MATLAB's `remez()` function.

   (a) Find the number of coefficients needed.

   (b) Find the coefficients for the filter. Use MATLAB's `stem()` function to plot the coefficients.

(c) Use MATLAB to find and plot the gain response of the filter. Show that it meets the specifications.

(d) Plot the phase response of the filter. Show that it is linear in the passband.

5. Problem 7.40 from the text.