ECE486 Test 2, Computer Portion
April 22, 2004. One Hour
Open Book, Open Notes
Calculators and Computers allowed

You may use your own printed or written reference material. Communication with other people is not allowed. Web browsers should be closed (or pointed only toward the course www site for downloading data as required by the test). Use of chat rooms, bulletin boards etc. is not allowed.

Results submitted after the end of the test will not be accepted or graded.

Do not send output to the printer. Printed output will not be accepted or graded.

All submitted filter designs should have real coefficients.

1. A discrete-time system utilizing a sample rate of 20 ksps is to implement a band-pass filter which meets the following specifications:

Passband:	4 kHz $\leq \|F\| \leq$ 5.5 kHz
Passband Gain:	12 ± 0.2 dB
Stopbands:	$\|F\| \leq 3$ kHz, and
	$\|F\| \geq 7.5$ kHz
Stopband Gain:	≤ -90 dB

   (a) Use the window method to design a linear phase filter which meets the above specification. Submit your design for grading using the MATLAB command

   ```
   ece486_submit('lastname_test2_1a',h);
   ```

   where "h" is the name of the vector containing your filter coefficients.

   (b) In the space below, give list the number of filter coefficients and the filter order for your design. Evaluate the computational complexity of your design by indicating the number of multiplications per second required for the filter. Assume a filter structure which minimizes the number of multiplications required (and indicate the filter structure that you assumed).

2. A discrete-time system uses sampling frequency $F_s = 48$ ksps. Use the window method to design a linear phase FIR filter to approximate an integrator (with gain) over the band of frequencies 2 kHz $< |F| <$ 5 kHz. Over this band, the designed filter should approximate the integrator transfer function $10^3/(jF)$ (with an appropriate constant delay phase shift). Keep the magnitude of the error between this desired transfer function and the FIR transfer function less than 0.05 over this band.

   In addition, the FIR filter is to attenuate frequencies below 1 kHz and above 8 kHz by at least 50 dB.

   (Caution: Be careful in evaluating $10^3/(jF)$ at $F = 0$!)

   Submit your design for grading using the MATLAB command

   ```
   ece486_submit('lastname_test2_2',h);
   ```

   where "h" is the name of the vector containing your filter coefficients.

3. The course www site provides a link to a data file containing 256 samples of a distorted periodic signal, samples using a sampling frequency of 48 ksps. Assume that the data provided is in units of volts.

   The link to the data file is:
   http://www.eece.maine.edu/~hummels/classes/ece486/test2data.txt

   (a) Identify frequencies corresponding to the dominant tones of the signal. Give your answer in the space below.

   (b) Find the amplitude (in volts) of the largest tone present. Describe below how you obtained your answer.