

EE112/PPV/Winter'09: Digital Signal Processing

HW SET #7

Due On **Thursday Feb. 26** in class.

1. (60 points) PPV's book Problem 3.10.
2. (120 points) PPV's book Problem 3.12.
3. (120 points) PPV's book Problem 3.14 (assume $\Omega_S \gg \Omega_p$.)
4. (200 points) **Matlab assignment.** Suppose we wish to design a digital IIR lowpass filter with the following specifications:

$$\omega_p = 0.1\pi, \quad \omega_s = 0.22\pi, \quad \delta_1 = 0.01, \quad \delta_2 = 0.001$$

We would like to satisfy these specifications using elliptic filters described in class. Perform the design and include the following in the report. All plots should be shown for $0 \leq \omega \leq \pi$.

- a) Matlab codes
- b) The filter-order.
- c) Plots of impulse response $h(n)$ for $0 \leq n \leq 50$.
- d) Magnitude response plot.
- e) Pass-band blowup of the magnitude response, in the range $0.97 \leq |H(e^{j\omega})| \leq 1$ (normalize the plot to maximum of unity if necessary).
- f) dB plot showing the range 10 dB to -100 dB (e.g., the stopband bumps of the elliptic filters will be about -60 dB).
- g) Phase response plot.
- h) Group delay response plot (negative derivative of phase response; matlab command *grpdelay* will do it).

From the plot be sure to verify that the specifications are indeed satisfied, otherwise read the command descriptions carefully again. Since order estimates are typically rounded to nearest integers, the specifications are usually slightly over-satisfied. This is OK. Helpful matlab commands: *help* command (e.g., *help ellipord*), *ellip*, *ellipord*, *freqz*, *grpdelay*, *plot*, etc.

- *5. (180 points) PPV's book Problem 3.6.

Reading assignments.

1. PPV's book, Sec. 3.2.2 and 3.3. AVO's book, Sec. 7.1.

Reminders:

Late homework policy for EE112. Late homeworks will not be accepted. No exceptions other than institute-established emergency reasons, in which case a signed letter is required from authorized official.

NCT Problems. Remember that problems with an asterik, such as *6 are no-collaboration (NCT) problems.

Books. AVO's book means "Discrete time signal processing" by Oppenheim et al. PPV's book means "Multirate systems and filter banks" by PPV. Most homework problems come from these books.
