

ECE130B: Home Work 8

Due on March 13, 2009.

Problems marked **reading assignment** don't have to be turned in. Remember to prepare the following **cheat sheets** for your final exam:

1. table of convolution formulas
2. table of z -transform pairs (Table 10.2 from the text book)
3. table of z -transform properties (Table 10.1 from the text book)
4. table of discrete-time Fourier transform pairs (Table 5.2 from the text book)
5. table of discrete-time Fourier transform properties (Table 5.1 from the text book)
6. table of discrete-time Fourier series pairs
7. table of discrete-time Fourier series properties (Table 3.2 of the text book).

You can augment these tables with additional entries, but they must belong to the table.

1. **Reading assignment:** Sections 3.6, 3.7 and 7.5.
2. A discrete-time periodic signal $x[n]$ is real-valued and periodic with period 5 (that is, $x[n + 5] = x[n]$ for all n). Some of the Fourier series coefficients (based on a period of 5) for $x[n]$ are

$$a_0 = 1, a_1 = 2e^{j\pi/3}, a_2 = e^{j\pi/4}.$$

Express $x[n]$ in the form

$$x[n] = A_0 + \sum_{k=1}^4 A_k \sin\left(k\frac{2\pi}{5}n + \phi_k\right),$$

where A_i and ϕ_i are real numbers. *Hint:* What is the value of a_{-1} and a_{-2} ? Then use the Fourier synthesis formula

$$x[n] = \sum_{k=-2}^2 a_k e^{jk\frac{2\pi}{5}n}.$$

3. Find the Fourier series coefficients of the periodic function

$$x[n] = \sum_{m=-\infty}^{\infty} (4\delta[n - 5m] - 4\delta[n - 1 - 5m]).$$

4. When the impulse train

$$x[n] = \sum_{k=-\infty}^{\infty} \delta[n - 4k]$$

is input to a particular LTI system with frequency response $\mathcal{H}(\omega)$, the output of the system is found to be

$$y[n] = \cos\left(\frac{\pi}{4} - \frac{3\pi}{2}n\right).$$

Find $\mathcal{H}(0)$, $\mathcal{H}(\pi/2)$, $\mathcal{H}(\pi)$ and $\mathcal{H}(3\pi/2)$. Is it possible to find the value of $\mathcal{H}(\omega)$ for any other values of ω from the given information ($0 \leq \omega \leq 2\pi$)?

5. **Reading assignment.** Problems 3.11, 3.12, 3.16, 3.18, 3.27, 3.28, 3.29, 3.30.(a), 3.30.(b), 3.31, 3.36–3.39.