

University of Kentucky
Department of Electrical and Computer Engineering

EE421G: Signals and Systems I – Fall 2007

Problem Set 2

Issued: September 2, 2007

Due: September 10, 2008 (In class)

Reading Assignments:

Read Chapter 1.7-1.9 and 2.1-2.3 of Chen

Computer Assignments:

- 1) Try out different demos on the webpage “*Listen to Fourier Series*” at <http://www.jhu.edu/~signals/listen-new/listen-newindex.htm> and answer the following questions:
 - a. “Introduction”: Compute the logarithmic difference of successive notes. **Take the base-10 logarithm of each frequency before computing their differences.**
 - b. “Additional Tones”: This section shows the amplitude responses of playing the note F using different instruments. What do you think the amplitude response for each instrument would be if the note G is played?
 - c. “Harmonic Contribution”: Is there a difference in pitch between the low-passed signal and the high-passed signal? Explain such difference.
- 2) Read “*Discrete-Time Frequency*” at <http://www.jhu.edu/~signals/dtphasor/index.htm> and use the applet to answer problem 4 below for the cases when $N = 4, 8$ and 16 .

If the Java applets in the above webpages are not running properly, install the latest Java Runtime Environment (JRE) from <http://java.sun.com/javase/downloads/index.jsp>

Paper and Pencil Assignments:

- 1) Problem 1.22: Consider the CT signal

$$x(t) = 2 + \sin 1.4t - 4 \cos 2.1t$$

Is it periodic? If yes, find its fundamental period. (a) Express it using exclusively sine functions. What are their frequencies, corresponding magnitudes, and phases? (b) Express it using exclusively cosine functions. What are their frequencies, corresponding magnitudes, and phases?

- 2) Problem 1.24: Is the signal

$$x(t) = 2 + \sin 2 - 3 \cos \pi$$

periodic? Can it be expressed using complex exponentials?

3) Problem 1.27: Are the sequences $\sin(6.9\pi n)$, $\sin(4.9\pi n)$, $\sin(2.9\pi n)$, $\sin(0.9\pi n)$, $\sin(-1.1\pi n)$ and $\sin(-3.1\pi n)$, for $T=1$ the same (DT) sequence? If not, how many different sequences are there? Find their frequencies **periods**.

4) ~~Problem 1.31: Consider $\cos \omega_k n$ with $T=1$ and~~

$$\omega_k = \frac{2\pi k}{N}$$

~~where N is a given positive integer and k is an integer ranging from $-\infty$ to ∞ . How many different $\cos \omega_k n$ are there (in terms of N)? What are their frequencies (in terms of N)?~~

5) ~~Problem 1.35: What are the sample sequences of $x(t) = \cos 50t + 2\sin 70t$ for $T = \pi/45$, $\pi/30$ and $\pi/180$. Under what condition on T will all frequencies of $x(t)$ be retained in $x(nT)$?~~

6) ~~Are the following systems with or without memory, causal or non-causal?~~

a. ~~$y(t) = 5u(t)$~~

b. ~~$y(t) = \sin u(t) + \sin u(t+1)$~~

c. ~~$y(t) = (\sin t)u(t-1)$~~

d. ~~$\frac{d^2 y(t)}{dt^2} = u(t)$~~

e. ~~$y(t) = \int_0^t 3t^2 u(\tau) d\tau$~~