GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

EE2201A
Homework Assignment No. 0

Date Assigned: March 31, 1999
Date Due: April 2, 1999

Reading Assignment: Read pp. 30-56 and 90-103 in Oppenheim and Willsky (henceforth referred to as O&W).

Homework Assignment: You should work all of these problems by next Friday to review things that were learned in EE2200 and EE2250.

Problem 0.1:
A signal composed of sinusoids is given by the equation

$$x(t) = 10\cos(200\pi t + \pi/3) + 6\cos(400\pi t) - 3\cos(600\pi t - \pi/6) \tag{1}$$

(a) Sketch the spectrum of this signal indicating the complex size of each frequency component. Make separate plots for real/imaginary or magnitude/phase. You may make either a one-sided or two-sided plot.

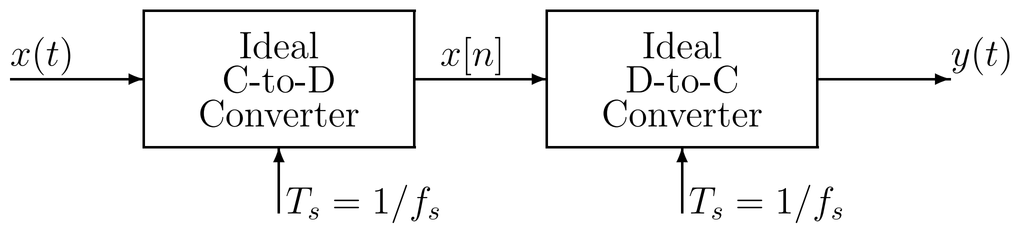
(b) Is $x(t)$ periodic? If so, what is the period? What is the fundamental frequency?

(c) Now consider the signal $y(t) = x(t) + 8\cos(300\pi t - \pi/2)$ where $x(t)$ is defined in Equation (1) above. How is the spectrum changed? Is $y(t)$ periodic? If so, what is the period?

(d) Now consider the signal $y(t) = x(t) + 4\cos(900t + \pi/5)$ where $x(t)$ is defined in Equation (1) above. How is the spectrum changed? Is $y(t)$ periodic? If so, what is the period?

Problem 0.2:

Consider the following system.



Suppose that the output of the D-to-C converter is

$$y(t) = 10 + 6\cos(400\pi t + \pi/3)$$

when the sampling rate is $f_s = 1/T_s = 1000$ samples/second. Determine three *different* input signals $x(t) = x_1(t)$, $x(t) = x_2(t)$ and $x(t) = x_3(t)$ that could have been the input to the C-to-D converter. Give equations for all three inputs. The frequencies of these signals should all be less than 1500 Hz.

Problem 0.3:

Consider the discrete-time system defined by the z-transform system function

$$H(z) = -1 + 2z^{-1} - z^{-2}$$

(a) Determine the difference equation that is satisfied by the input $x[n]$ and the output $y[n]$.

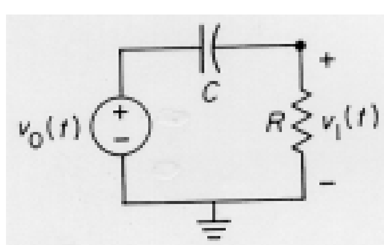
(b) Find the frequency response, $H(e^{j\hat{\omega}})$, of this system, and plot its magnitude and phase as a function of $\hat{\omega}$ for $-\pi < \hat{\omega} < \pi$.

(c) Use the frequency response determined in (a) to find the output if the input is

$$x[n] = 5 + 2\cos(0.5\pi n)$$

Problem 0.4:

Consider the following circuit:



Determine the steady-state output voltage $v_1(t)$ of this network (with $R = 2$ ohm and $C = 1/2$ farad) to the input signal

$$v_0(t) = 10 + 5\sin(t)$$