EE 120 SIGNALS AND SYSTEMS, Spring 2012

Midterm # 1, October 3, Wednesday, 10:10-11:50 am

Name _____

Closed book. Two letter-size cheatsheets are allowed. Show all your work. Credit will be given for partial answers.

Problem	Points	Score
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

1. For each of the following impulse responses of LTI systems, determine whether or not the system is causal and/or stable:

a) (5 points) $h[n] = u[n] - u[n-10]$

b) (5 points) $h[n] = (1/2)^{|n|}$

c) (5 points) $h[n] = \sin\left(\frac{\pi n}{3}\right) u[n]$

d) (5 points) $h[n] = (1/2)^n u[-n-1]$

Additional workspace for Problem 1

2. (20 points) Find a periodic continuous-time signal $x(t)$ that satisfies all of the following properties:

i) $x(t)$ is real and even-symmetric: $x(-t) = x(t)$

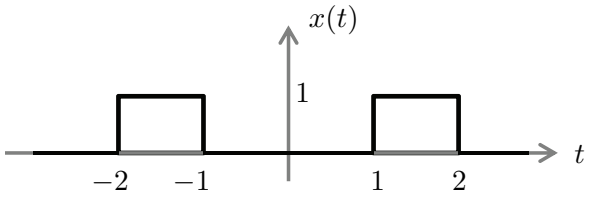
ii) $x(t)$ has period $T = 6$ and Fourier coefficients $a_k = 0$ for $k \geq 3$

iii) $x(t) = -x(t-3)$

iv) $\frac{1}{6}\int_0^6 |x(t)|^2 dt = 1$

Additional workspace for Problem 2

3. a) (15 points) Determine the Fourier transform of the continuous-time signal $x(t)$ depicted below:



b) (5 points) Sketch the phase plot for $X(j\omega)$.

Additional workspace for Problem 3.

4. An ideal lowpass filter has impulse response $h_{lp}[n]$ and frequency response:

$$H_{lp}(e^{j\omega}) = \begin{cases} 1, & |\omega| < 0.2\pi \\ 0, & 0.2\pi \leq |\omega| \leq \pi. \end{cases}$$

a) (10 points) A new filter is defined by the equation:

$$h_1[n] = 2h_{lp}[n]\cos(0.5\pi n).$$

Plot the frequency response $H_1(e^{j\omega})$ and determine whether the filter is lowpass, bandpass, bandstop, or highpass.

b) (10 points) A second filter is defined by the equation:

$$h_2[n] = \frac{\sin(0.1\pi n)}{\pi n} h_{lp}[n].$$

Determine and plot the frequency response $H_2(e^{j\omega})$.

Additional workspace for Problem 4.

5. Consider an LTI system with frequency response:

$$H(e^{j\omega}) = \frac{1 - e^{-2j\omega}}{1 + \frac{1}{2}e^{-4j\omega}}.$$

a) (5 points) Write a difference equation that characterizes a system with this frequency response.

b) (15 points) Determine the output $y[n]$ if the input is:

$$x[n] = \sin\left(\frac{\pi n}{4}\right).$$

Additional workspace for Problem 5.