New Mexico State University
Klipsch School of Electrical Engineering

EE312 - Signals and Systems I
Spring 2015
Exam #2

Name: _____

Prob. 1	/ 10 points
Prob. 2	/ 15 points
Prob. 3	/ 25 points
Prob. 4	/ 25 points
Prob. 5	/ 25 points
Total	/ 100 points

Prob. 1

Consider the impulse response

$$h(t) = \begin{cases} 0, & t < t_1 \\ e^{-t}, & t_1 \le t < t_2 \\ 0, & t \ge t_2. \end{cases}$$

(a) For the various parameters, indicate whether $h(t)$ is "Causal" or "Not Causal."

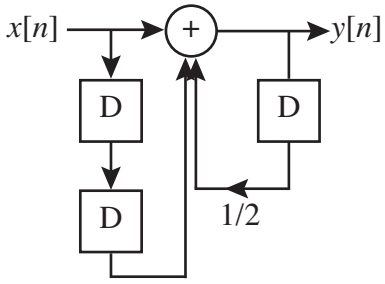
Parameters	$h(t)$
$t_1 < t_2 < 0$	
$t_1 < 0$ and $t_2 > 0$	
$0 < t_1 < t_2$	
$t_1 < 0$ and $t_2 = 0$	
$t_1 = 0$ and $t_2 > 0$	

(b) Let $0 < c < \infty$. For the various parameters, indicate whether $h(t)$ is "BIBO Stable" or "Not BIBO Stable."

Parameters	$h(t)$
$t_1 = -\infty$ and $t_2 = c$	
$t_1 = -\infty$ and $t_2 = \infty$	
$t_1 = -c$ and $t_2 = c$	
$t_1 = -c$ and $t_2 = \infty$	

Prob. 2

A system is described by the following block diagram.



Assume the system is initially at rest, i.e. $y[-1] = 0$.

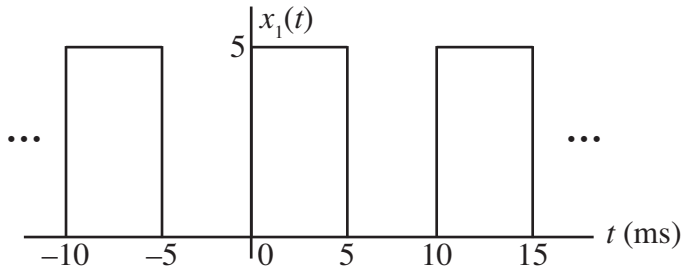
(a) Determine the equivalent linear, constant-coefficient difference equation (LCCDE).

(b) Use the LCCDE in (a) to determine the impulse response, $h[n]$ for $-\infty \leq n \leq \infty$. Please express $h[n]$ in a non-recursive, closed-form.

Hint: Let $x[n] = \delta[n]$ and compute a few values for $y[n] = h[n]$. Find a general expression for the values.

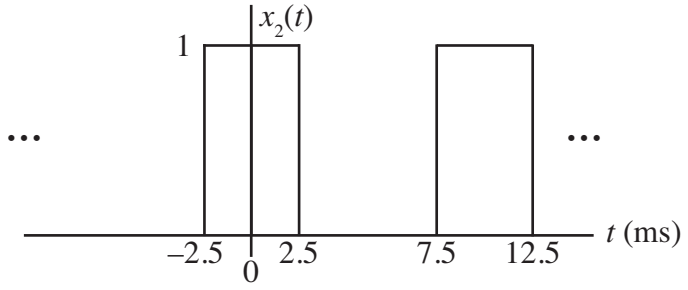
Prob. 3

(a) A periodic signal, $x_1(t)$ is shown below. Determine the Fourier Series (FS) coefficients, a_k. Note that 1 ms equals 0.001 s.



(b) A periodic signal, $x_2(t)$ is given below. Determine the FS coefficients, b_k by using your result in (a) together with the linearity and time-shifting properties of the FS.

Note: the continuous-time FS properties are given in Table 3.1 on p. 206.



Prob. 4

A discrete-time (DT) periodic signal, $x[n]$ is given by

$$x[n] = \cos\left(\frac{\pi}{2}n\right) + \cos(\pi n) + \sin\left(\frac{9\pi}{2}n\right)$$

(a) Determine the fundamental period, N and fundamental frequency, ω_0 of $x[n]$.

(b) Use a direct expansion into complex exponentials to determine the DTFS coefficients, a_k for $0 \leq k \leq N-1$.

(c) Graph the magnitude of the harmonic spectrum, i.e. $|a_k|$ vs. k for $0 \leq k \leq N-1$.

Prob. 5

In Example 3.5 on p. 193, the periodic square wave is defined over one period as

$$x(t) = \begin{cases} 1, & |t| < T_1 \\ 0, & T_1 < |t| < T/2 \end{cases}$$

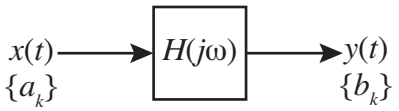
and the FS coefficients are given as

$$a_k = \begin{cases} 2T_1/T, & k = 0 \\ \dfrac{\sin(k\omega_0 T_1)}{k\pi}, & k \neq 0. \end{cases}$$

The periodic square wave is the input signal to a system with frequency response,

$$H(j\omega) = \frac{1}{(1 + j\omega)(1 + j10\omega)}$$

and the result is an periodic output signal, $y(t)$ with FS coefficients, b_k.



Assume $T = 1$ s and $T_1 = 0.1$ s. Determine the following values. Your answers should not have T, T_1, or k in them.

(a) b_0

(b) b_1

(c) b_2

(d) b_{10}

(e) b_{100}