



New Mexico State University
Klipsch School of Electrical Engineering

EE312 - Signals and Systems I
Spring 2010
Exam #1

Name: _____

Prob. 1	/	25 points
Prob. 2	/	25 points
Prob. 3	/	25 points
Prob. 4	/	25 points
Total	/	100 points

Prob. 1

For the following problems, determine if $x(t)$ or $x[n]$ is periodic. Check the appropriate box and fill in other information as required. Determine the energy or power as directed.

(a) Let $x[n] = 1.2e^{j1.5\pi n}$. Is $x[n]$ periodic?

Yes, it is periodic and the period, $N = \underline{\hspace{2cm}}$.

No, it is not periodic.

Compute the total energy over the time interval $0 \leq n \leq 7$ and average power over the time interval $0 \leq n \leq 7$.

(b) Let $x(t) = \begin{cases} t, & -1 \leq t \leq 1 \\ 0, & \text{otherwise} \end{cases}$. Is $x(t)$ periodic?

Yes, it is periodic and the period, $T = \underline{\hspace{2cm}}$.

No, it is not periodic.

Compute the total energy over the infinite time interval and average power over the infinite time interval.

Prob. 2

For each of the following systems, check which system properties are *true*. For the properties of memoryless and causality, *justify* your answer with a short statement. For the properties of linearity, time invariance, and BIBO stability, provide a mathematical *proof or counter-example*. No credit will be given without the justification, proof, or counter-example.

(a) Let $y[n] = x[n + 1] - 2x[n] + x[n - 1]$.

MEMORYLESS

CAUSAL

BIBO STABLE

TIME INVARIANT

LINEAR

Prob. 2 (cont.)

(b) Let $y(t) = x(2t)$.

MEMORYLESS

CAUSAL

BIBO STABLE

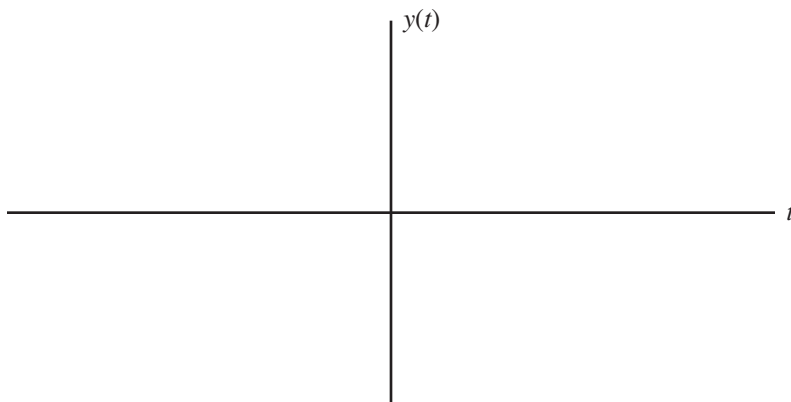
TIME INVARIANT

LINEAR

Prob. 3

For the following systems characterized by their impulse response $h(t)$, $h[n]$ determine the output signal $y(t)$, $y[n]$ for the given input signal $x(t)$, $x[n]$ respectively. *Carefully* graph the output (be sure to label critical x - and y -values) and answer the causality/stability questions.

(a) Let $x(t) = \begin{cases} t, & 0 \leq t \leq 1 \\ 0, & \text{otherwise} \end{cases}$ and $h(t) = \delta(t + 1) - \delta(t)$. $y(t) = ?$

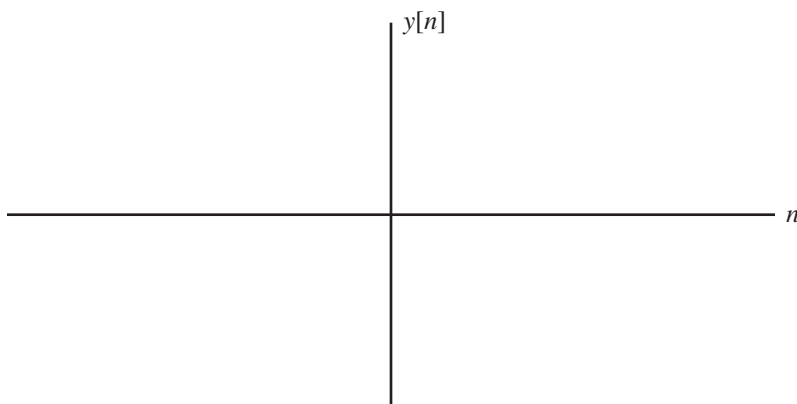


Is the above system causal (YES / NO)? Why?

Is the above BIBO stable (YES / NO)? Why?

Prob. 3 (cont.)

(b) Let $h[n] = \left(\frac{1}{2}\right)^n u[n]$ and $x[n] = u[n+2]$. $y[n] = ?$



Is the above system causal (YES / NO)? Why?

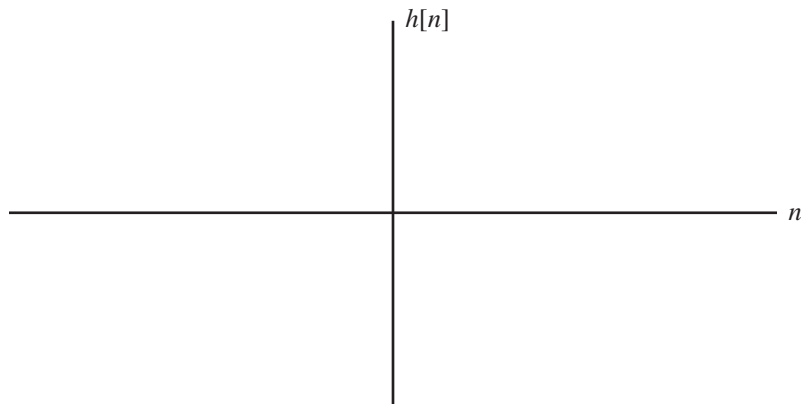
Is the above BIBO stable (YES / NO)? Why?

Prob. 4

(a) A causal LTI system is described by the LCCDE

$$y[n] = y[n - 1] + y[n - 2] + x[n - 1]$$

with initial rest conditions, i.e. $y[-2] = y[-1] = 0$. Determine and graph the impulse response, $h[n]$ for $0 \leq n \leq 10$.



Is the system BIBO stable (YES / NO)? Why?

Prob. 4 (cont.)

(b) A causal LTI system is described by the LCCDE

$$\frac{dy(t)}{dt} + 4y(t) = x(t).$$

together with initial rest conditions. Suppose the input signal is given by

$$x(t) = e^{j\omega_0 t} u(t).$$

Determine the output $y(t) = y_p(t) + y_h(t)$ where $y_h(t)$ is the homogeneous solution and y_p is the particular solution with the assumed form

$$y_p(t) = Y e^{j\omega_0 t}.$$

If $\omega_0 = 0$, $x(t) = u(t)$. Use this substitution and your answer from above to determine and graph the step response $s(t)$ of the system.

