Full Name: Zexi Liu. 55314399. **ExamID: 010001**

EEL 4750 / EEE 5502 (Fall 2019) – Exam 01 **Date: Sept. 23, 2019**

Question	# of Points Possible	# of Points Obtained	Grader
# 1	20	20	IDK
# 2	20	15.5	JBH
# 3	20	14	Y.B
# 4	20	16	Y.B
# 5	20	19	MS
Total	100	84.5	

For full credit when sketching: remember to label axes and make locations and amplitudes clear.

Before starting the exam, read and sign the following agreement.

By signing this agreement, I agree to solve the problems of this exam while adhering to the policies and guidelines of the University of Florida and EEL 4750 / EEE 5502 and without additional external help. The guidelines include, but are not limited to,

- The University of Florida honor pledge: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."
- Only one 8.5 by 11 inch cheat sheet (double-sided) may be used
- No calculators or computers may be used
- No textbooks or additional notes may be used
- No collaboration is allowed
- No cheating is allowed

Zexi Liu.
Student

Sept. 23. 2019
Date

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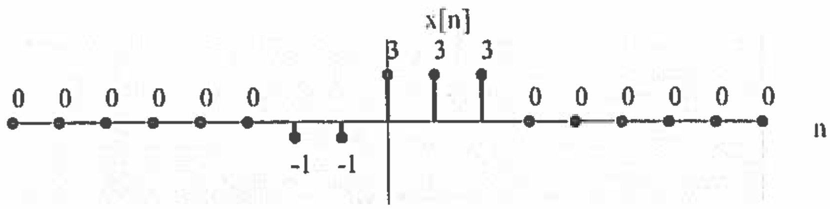
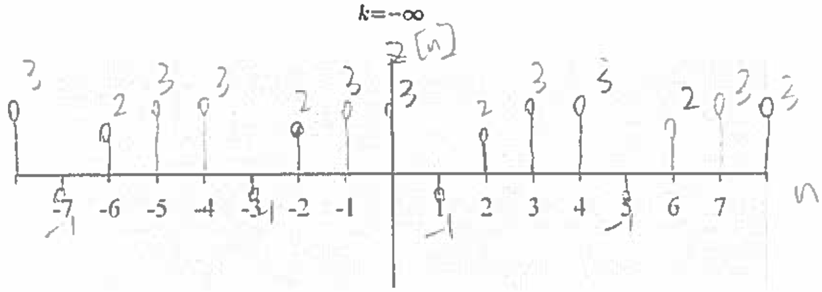
Question #1: Consider discrete-time signal $x[n]$ below.



(a) *(7 pts)* Sketch $z[n] = \sum_{k=-\infty}^{\infty} x[-n+4k]$ for $-8 \leq n \leq 8$.



(b) *(7 pts)* Express $x[n]$ as a sum of shifted and amplified step functions (i.e., $u[n]$).

$x[n] = -u[n+2] + 4u[n] - 3u[n-3]$

(c) *(6 pts)* Is $x[n]$ an energy signal, a power signal, or neither? If $z[n]$ is an energy signal, compute its energy. If $x[n]$ is a power signal, compute its power. If $x[n]$ is neither, explain why.

Energy Signal.

$E_x = (-1)^2 + (-1)^2 + 3^2 + 3^2 + 3^2 = 29$

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Question #2: Consider the discrete-time system expressed by the input-output relationship (* represents discrete-time convolution)

$$y[n] = \begin{cases} x[n] & \text{if } x[n] < 10 \\ 10 & \text{if } x[n] \geq 10 \end{cases}$$

(a) *(7 pts)* Is this system linear? **Justify why.**

Yes. it's not linear.

when $x[n] < 10$.

$a y_1[n] + b y_2[n] = a x_1[n] + b x_2[n]$.

$H\{a x_1[n] + b x_2[n]\}$ $a x_1[n] + b x_2[n] = a y_1[n] + b y_2[n]$.

when $x[n] \geq 10$.

$a y_1[n] + b y_2[n] \neq H\{a x_1[n] + b x_2[n]\}$.

$\therefore$ not Linear.

which one?

4.5

(b) *(7 pts)* Is this system time-invariant? **Justify why.**

~~Yes. it's time invariant~~. Yes, it's not time-invariant.

because $y[n+N] = \begin{cases} x[n+N] & \text{if } x[n+N] < 10. \\ 10 & \text{if } x[n+N] \geq 10. \end{cases}$

$y[n+N] \neq H\{x[n+N]\}$.

(c) *(6 pts)* Is this system memoryless? **Justify why.**

Yes. memoryless.

Because $y[n]$ is just a function about n.

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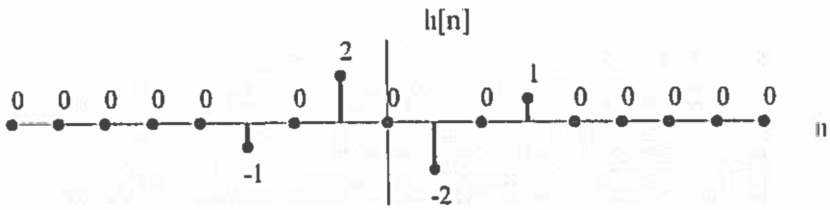
Question #3: Consider a discrete-time input $x[n]$ and impulse response $h[n]$.



(a) *(6 pts)* Is a system defined by the impulse response $h[n]$ BIBO stable? **Justify why.**

Yes. It's BIBO stable.

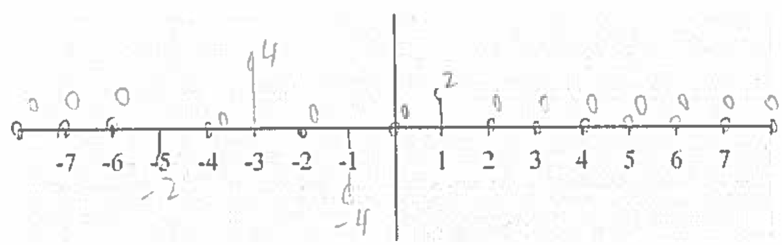
−3

Because $x[n] \to \infty$. $h[n] < \infty$. ✗

(b) *(7 pts)* Sketch the output $y[n]$ (for $n = -8$ to $n = 8$) for

$$y[n] = h[n] * (\delta[n+2] + 1)$$

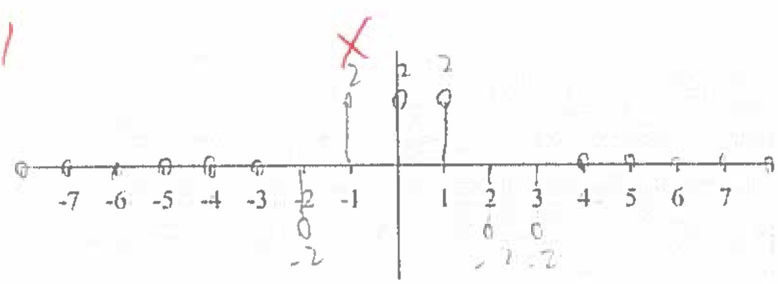
−2



(c) *(7 pts)* Sketch the output $y[n]$ (for $n = -8$ to $n = 8$) for

$$y[n] = h[n] * (2u[n-1])$$

−1



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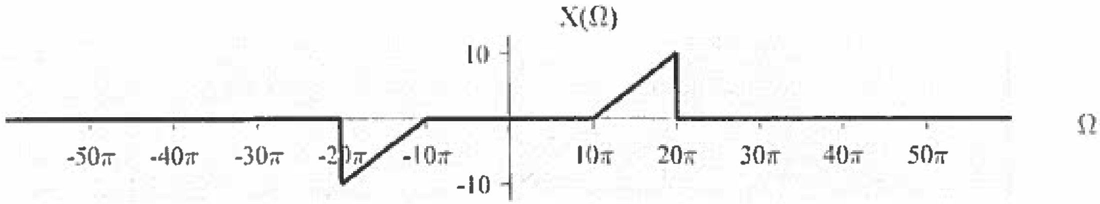
Question #4: Consider the Fourier Transform of a continuous-time signal $x(t)$, shown below.

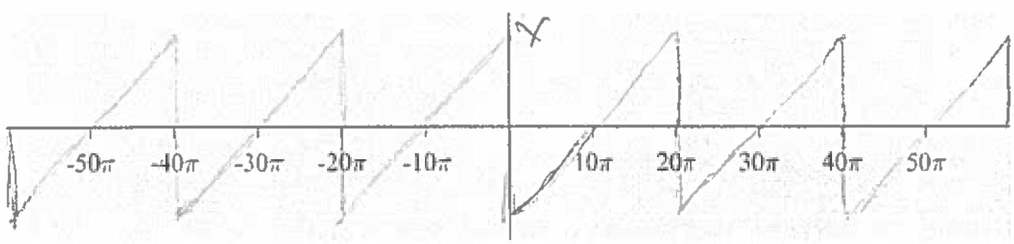


(a) *(6 pts)* Determine the Nyquist sampling rate for $z(t) = x(t) * x(t) + 1$.

$\Omega_{max} = 20\pi$. $\Omega_s = 2\Omega_{max} = 40\pi$.

(b) *(7 pts)* Sketch (for $\Omega = -60\pi$ to $\Omega = +60\pi$) the Fourier transform $X_s(\Omega)$ of the sampled signal $x_s(t)$ with a sampling rate of $\Omega_s = 20\pi$. **Do we experience aliasing?**

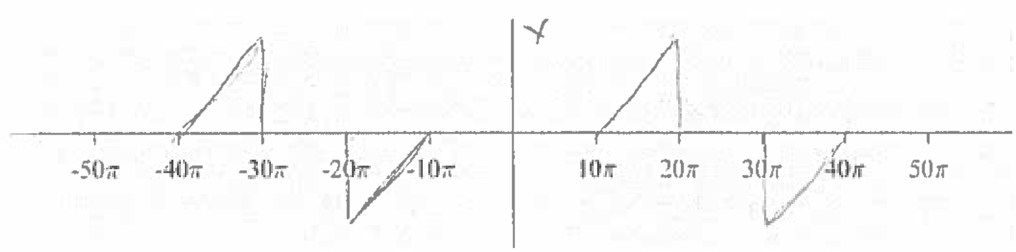
-2



aliasing.

(c) *(7 pts)* Sketch (for $\Omega = -60\pi$ to $\Omega = +60\pi$) the Fourier transform $X_s(\Omega)$ of the sampled signal $x_s(t)$ with a sampling rate of $\Omega_s = 50\pi$. **Do we experience aliasing?**

-2



not aliasing.

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Question #5: Consider the following

$$h_1[n] = 4(1/2)^{n-3}u[n-3] \qquad , \qquad H_2(z) = \frac{1 - z^{-2}}{(1 + 4z^{-2})(2 - z^{-1})}$$

(a) *(5 pts)* (True / False) The DTFT any signal is periodic with a period of π. **Briefly justify why.**

$$X(\omega) = \sum_{n=-\infty}^{\infty} x[n] e^{-j\omega n} .$$

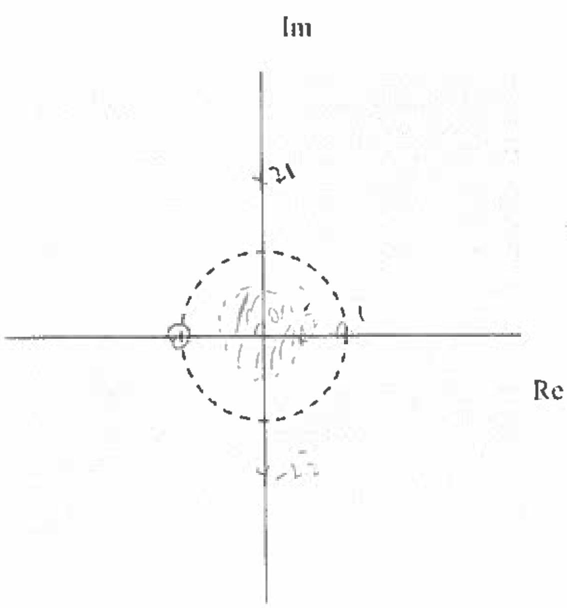
Such as $x[n] = \frac{\sin(Wn)}{\pi n}$. $X(\omega) = \begin{cases} 1 & 0 \le |\omega| \le W. \\ 0 & W < |\omega| \le \pi. \end{cases}$

$X(\omega)$ is periodic with period 2π.

(b) *(7 pts)* Compute the DTFT of $h_1[n]$.

$$X(\omega) = \frac{4}{1 - (\frac{1}{2})e^{-j\omega}} e^{-j\omega 3}$$

(c) *(8 pts)* Sketch the pole-zero plot and the region-of-convergence for $H_2(z)$. Assume $H_2(z)$ is an **anti-causal** system. Is the system **stable**?



$$\frac{z^3(1 - z^{-2})}{(z^2+4)(2z-1)} .$$

-1

zeros: $z = 0$. 1. -1

poles: $z = \pm 2i$. $\frac{1}{2}$.

unstable.