Full Name: Solutions **ExamID: 000000**

EEL 4750 / EEE 5502 (Fall 2018) – Practice Exam #01 **Date: Sept. 25, 2018**

Question	# of Points Possible	# of Points Obtained	Grader
# 1	17		
# 2	16		
# 3	18		
# 4	18		
# 5	16		
# 6	14		
Total	100		

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,

- 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

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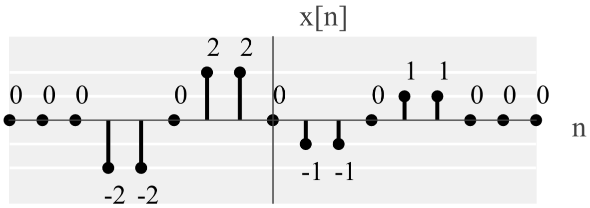
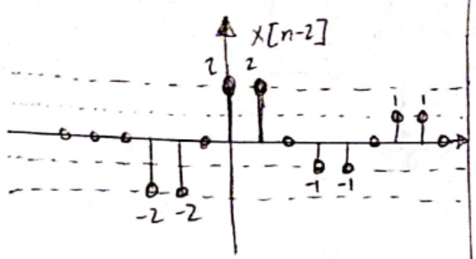
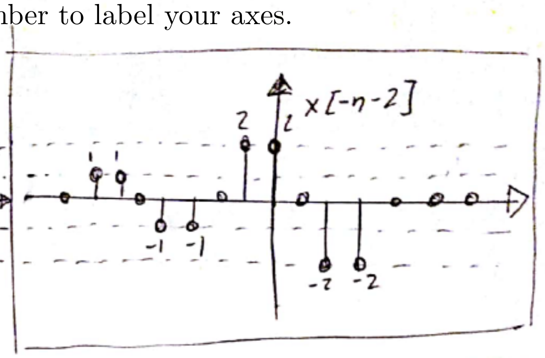
Student Date

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

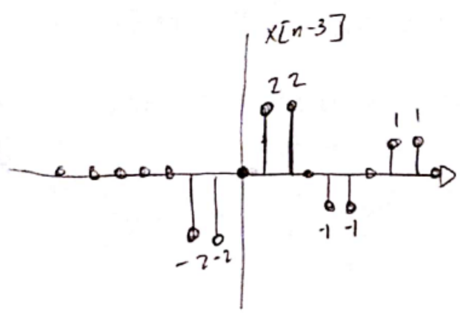


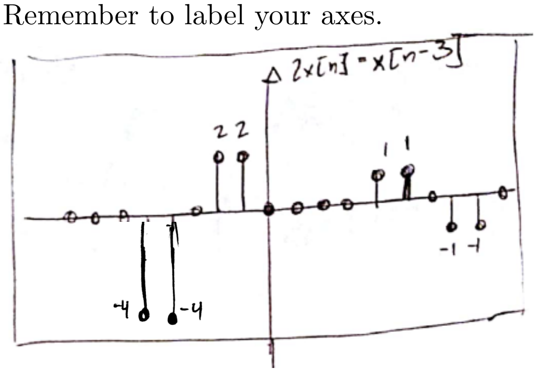
(a) *(4 pts)* Sketch $x[-2-n]$ Remember to label your axes.





(b) *(4 pts)* Sketch $2x[n] + x[n-3]$ Remember to label your axes.





(c) *(4 pts)* Is the signal $x[n]$ causal, anti-causal, or neither? **Briefly justify why.**

Neither since $x[n] = 0$ for $n < 0$ is not true.
and for $n \geq 0$ is not true.

(d) *(5 pts)* Is $x[n]$ an energy signal, a power signal, or neither? If $x[n]$ is an energy signal, compute its energy. If $x[n]$ is a power signal, compute its power. If $x[n]$ is neither, explain why.

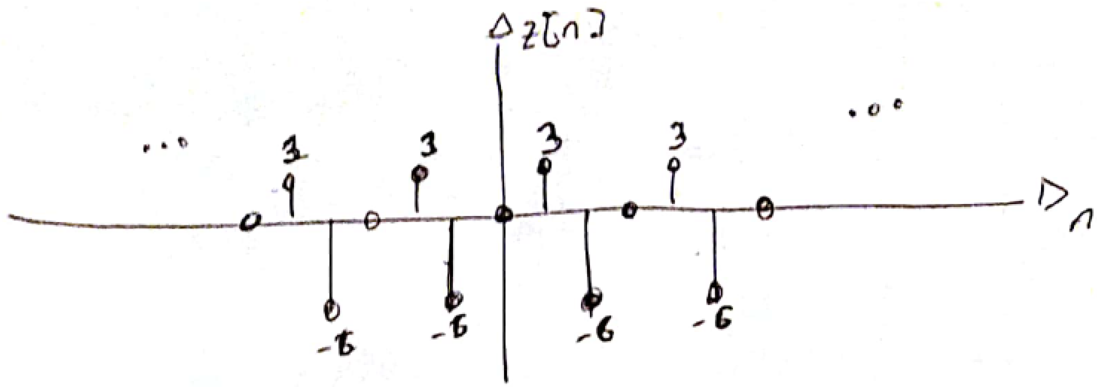
Energy Signal.

$$(-2)^2 + (-2)^2 + (2)^2 + (2)^2 + (-1)^2 + (-1)^2 + (1)^2 + (1)^2$$
$$= 4 + 4 + 4 + 4 + 1 + 1 + 1 + 1$$
$$= 16 + 4 = \boxed{20}$$

Question #2: Let the discrete-time signal $z[n]$ defined by

$$z[n] = 3\left[\sum_{m=-\infty}^{\infty} \delta[n-(3m+1)] - 2\delta[n-(3m+2)]\right]$$

(a) *(6 pts)* Sketch $z[n]$ for $-6 \le n \le 6$. Remember to label your axes.



(b) *(5 pts)* Is the signal $z[n] + z[-n]$ even, odd, or neither? **Briefly justify why.**

$z[n] + z[-n]$ is even.

The definition of even is $f[-n] = f[n]$. If I time reverse my signal, I get

$z[-n] + z[-(-n)] = \boxed{z[-n] + z[+n] = z[n] + z[-n]}$

even

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

$z[n]$ is a $\boxed{\text{power signal}}$

$$P_z = \frac{1}{3}\left[0^2 + (3)^2 + (-6)^2\right]$$
$$= \frac{1}{3}[9 + 36] = \frac{1}{3}45 = \boxed{15}$$

Question #3: Consider the discrete-time system expressed by the input-output relationship

$$y[n] = \sum_{m=-\infty}^{n} m\, e^{x[n]}$$

(a) *(5 pts)* Is this system linear? **Justify why.**

$a\mathcal{H}_1\{x_1[n]\} + b\mathcal{H}\{x_2[n]\}$

$= a\sum_{m=-\infty}^{n} m e^{x_1[n]} + b\sum_{m=-\infty}^{n} m e^{x_2[n]}$

$\mathcal{H}\{a x_1[n] + b x_2[n]\}$

$= \sum_{m=-\infty}^{n} m e^{a x_1[n] + b x_2[n]}$

Not Equal

$\boxed{\text{Not Linear}}$

(b) *(5 pts)* Is this system time-invariant? **Justify why.**

$y[n-N] = \sum_{m=-\infty}^{n-N} m e^{x[n-N]}$

$\mathcal{H}\{x[n-N]\} = \sum_{m=-\infty}^{n} m e^{x[n-N]}$

Not equal

$\boxed{\text{Not time-invariant}}$

(c) *(4 pts)* Is this system causal? **Justify why.**

$\boxed{\text{It is causal}}$

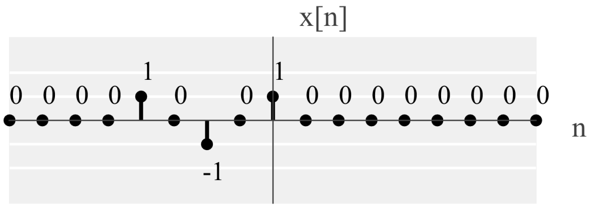
y[n] is only dependent on x[n] ← current inputs

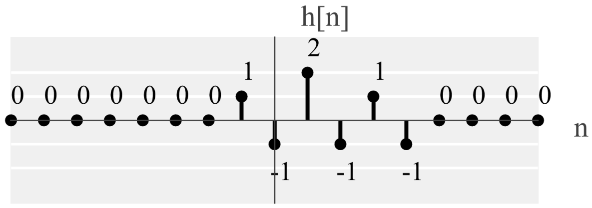
(d) *(4 pts)* Is this system memoryless? **Justify why.**

$\boxed{\text{It is memoryless}}$

y[n] is only dependent on x[n] ← current inputs

Question #4: Consider a discrete-time input $x[n]$ and impulse response $h[n]$.





(a) *(3 pts)* Express $h[n]$ as a sum of impulse signals.

$$h[n] = \delta[n+1] - \delta[n] + 2\delta[n-1] - \delta[n-2] + \delta[n-3] - \delta[n-4]$$

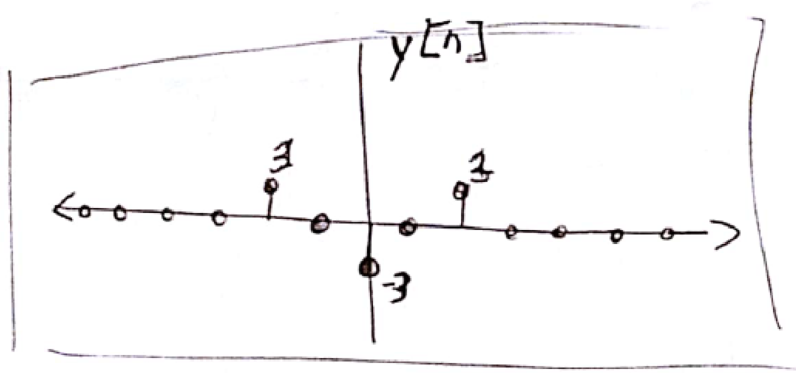
(b) *(3 pts)* Is the system with impulse response $h[n]$ causal?

$\boxed{\text{Not causal}}$

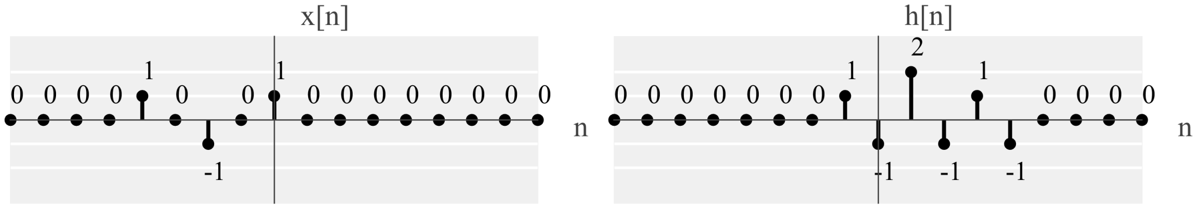
Because $h[n] \neq 0$ for $n < 0$

(c) *(5 pts)* Sketch the output $y[n]$ (for $n = -8$ to $n = 8$) of the discrete-time, LTI system

$$y[n] = x[n] * (3\delta[n-2])$$

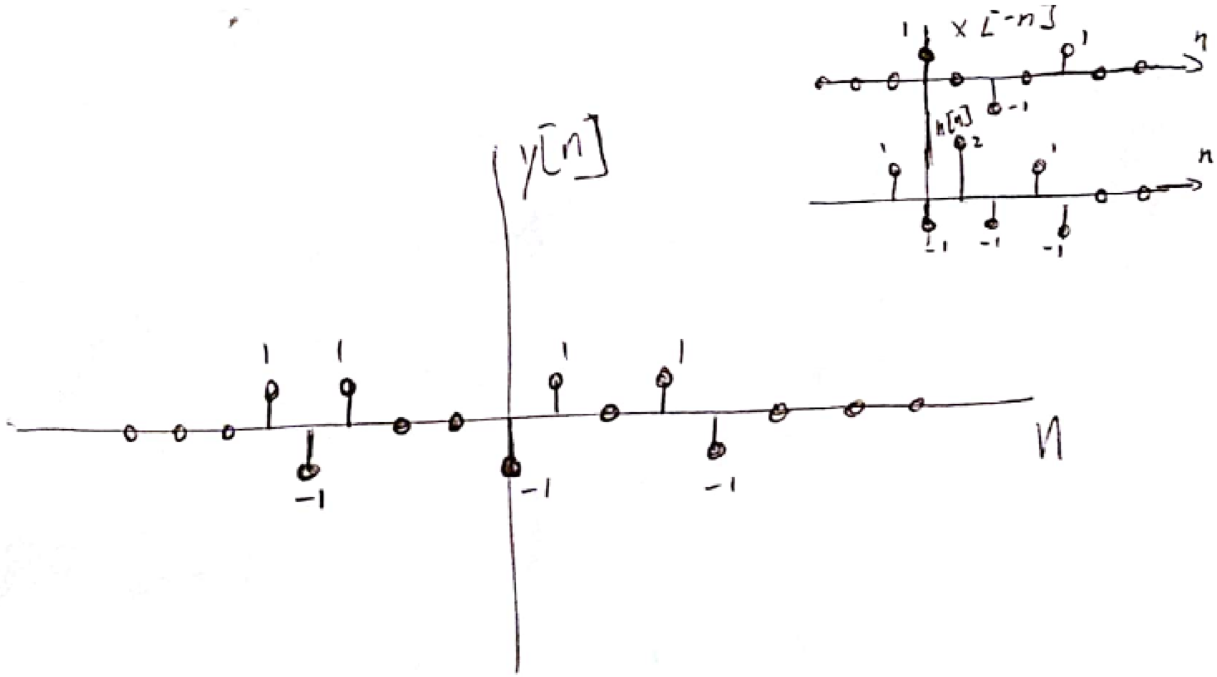


Consider a discrete-time input $x[n]$ and impulse response $h[n]$.



(d) *(7 pts)* Sketch the output $y[n]$ (for $n = -8$ to $n = 8$) of the discrete-time, LTI system

$$y[n] = x[n] * h[n]$$



Question #5: Answer the following questions.

(a) *(5 pts)* Determine the transfer function $H(z)$ for the given difference equation

$$0 = 4x[n-10] + 5x[n-15] - y[n] - 2y[n-10] - 3y[n-15]$$

$$Y(z)\left[1+2z^{-10}+3z^{-15}\right] = X(z)\left[4z^{-10}+5z^{-15}\right]$$

$$\boxed{\frac{Y(z)}{X(z)} = \frac{4z^{-10}+5z^{-15}}{1+2z^{-10}+3z^{-15}}}$$

(b) *(6 pts)* Compute the impulse response $h[n]$ for the given difference equation

$$y[n+10] = (1/4)y[n+9] + 2x[n+10]$$

$$y[n+10] - (1/4)y[n+9] = 2x[n+10]$$

$$Y(z)z^{+10} - (1/4)Y(z)z^{+9} = 2X(z)z^{+10}$$

$$Y(z) - (1/4)Y(z)z^{-1} = 2X(z)\cancel{z}$$

$$H(z) = \frac{2}{1-(1/4)z^{-1}} \qquad \boxed{h[n] = 2(1/4)^n u[n]}$$

(c) *(5 pts)* Determine the inverse discrete-time Fourier Transform (DTFT) of $H(\omega)$ such that

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

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

$$\boxed{h[n] = (-1/2)^n u[n] - (1/2)(-1/2)^{n-1}u[n-1]}$$

Question #6: Consider the z-transforms $H_1(z)$ and $H_2(z)$ below.

$$H_1(z) = \frac{4}{2 - z^{-1}} \quad , \quad H_2(z) = \frac{1 + 2z^{-1}}{1 + 4z^{-2}} + \frac{1}{1 - 2z^{-1}}$$

(a) *(5 pts)* Compute the inverse z-transform of the $H_1(z)$ such that the system is **causal**. Is the system **stable**?

$$H_1(z) = \frac{4}{2 - z^{-1}} = \frac{2}{1 - (1/2)z^{-1}}$$

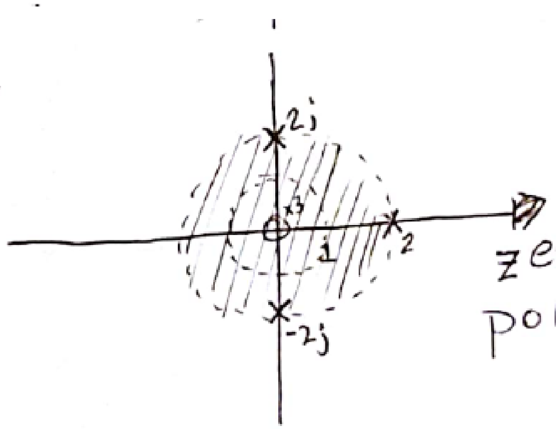
$$\boxed{h_1[n] = 2(1/2)^n u[n]}$$

The system is stable.

(b) *(9 pts)* Sketch the pole-zero plot and the region-of-convergence for $H_2(z)$. Assume $H_2(z)$ is **stable**. Is the system **causal**, **anti-causal**, or **neither**?

$$H_2(z) = \frac{(1+2z^{-1})(1-2z^{-1}) + (1+4z^{-2})}{(1+4z^{-2})(1-2z^{-1})} = \frac{1 - 4z^{-2} + 1 + 4z^{-2}}{(1+4z^{-2})(1-2z^{-1})} = \frac{2}{(1+4z^{-2})(1-2z^{-1})} = \frac{2z^3}{(z^2+4)(z-2)}$$

The system is anti-causal



zeros: 0, 0, 0
poles: 2, $\pm 2j$