

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL of ELECTRICAL & COMPUTER ENGINEERING
QUIZ #3

DATE: 5-April-02

COURSE: ECE 2025

NAME: _____
 LAST, First

GT #:gt. _____

Recitation Section: **CIRCLE THE DAY & TIME** when your Recitation Section meets:

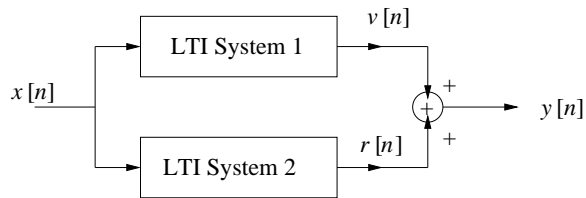
L02:Tues-9:30am (Bordelon) L04:Tues-12:00pm (Yezzi) L05:Thurs-1:30pm (Williams)
L06:Tues-1:30pm (Bordelon) L07:Thur-3:00pm (Williams) L08:Tues-3:00pm (Smith)
L11:Mon-3:00pm (Glytsis) L14:Mon-4:00pm (McClellan) RPK: (Abler) Vald: (Fares)

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- Write your name on the front page **ONLY**. **DO NOT** unstaple the test.
 - This exam is closed book. However, one page ($8\frac{1}{2} \times 11''$) of **HAND-WRITTEN** notes (front and back) and a calculator are permitted.
 - Justify your reasoning clearly to receive partial credit.
Explanations are also required to receive full credit for any answer.
 - You must write your answer in the space provided on the exam paper itself. Only these answers will be graded. **CIRCLE** your answers, or write them in the boxes provided. If space is needed for scratch work, use the backs of previous pages.

<i>Problem</i>	<i>Value</i>	<i>Score</i>
1	20	
2	20	
3	20	
4	20	
5	20	

Problem 1: (20%)

Consider the parallel form LTI system depicted below.

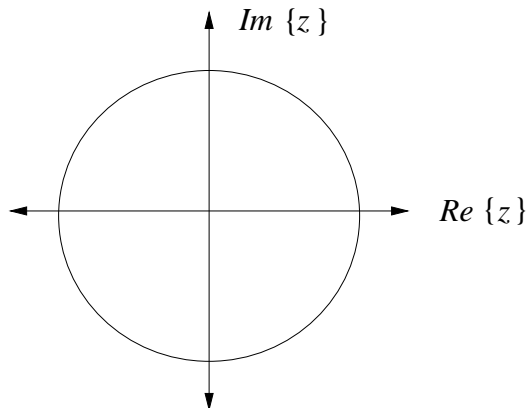


System 1 is defined by the difference equation $v[n] = x[n] - x[n - 6]$

System 2 is defined by the system function $H_2(z) = z^{-2} + \frac{1}{3}z^{-3} + z^{-6}$.

- (a) Determine the system function $H_1(z)$ associated with System 1 and plot the zeros of $H_1(z)$.

$H_1(z) =$



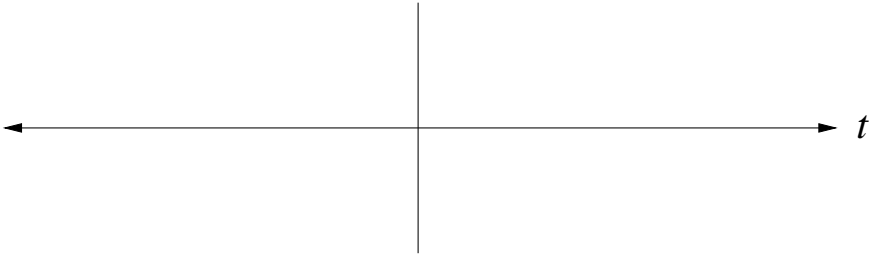
- (b) Determine the impulse response of the overall parallel form system. That is, find $h[n]$ such that $y[n] = x[n] * h[n]$.

$h[n] =$

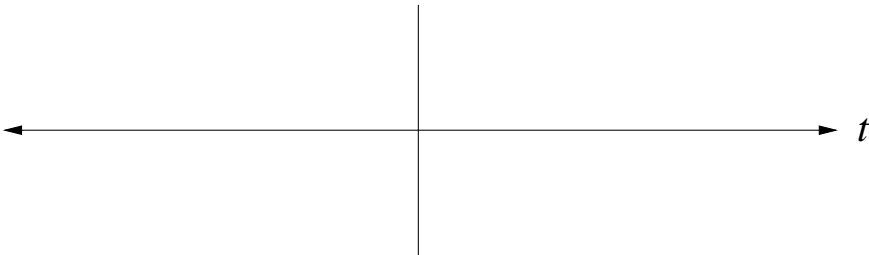
Problem 2: (20%)

Let $x(t) = -u(t) + u(t - 3)$.

(a) Sketch $\frac{d}{dt}x(t)$. Carefully label your plot.



(b) Sketch $x(-3 - t)$. Carefully label your plot.



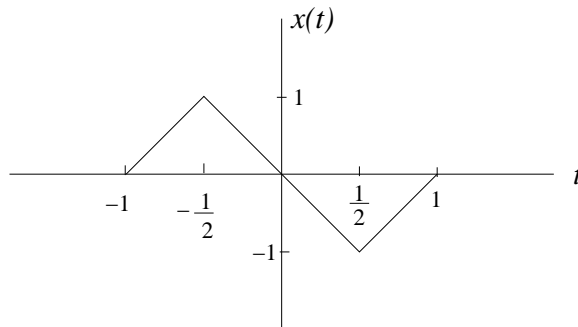
(c) If $x(t) * x(t - 2) * \delta(t - T) = x(t - 4) * x(t - 7)$, determine the numerical value of T .

$T =$

Problem 3: (20%)

Consider the LTI System whose output is $y(t) = x(t) * h(t)$, where $h(t) = u(t)$

and $x(t)$ is given by



- (a) Determine $y(0)$, the value of $y(t)$ at $t = 0$.

$y(0) =$

- (b) You should be able to see that $y(t) = 0$ in two regions: $T_1 \leq t \leq T_2$ and $T_3 \leq t \leq T_4$. Determine T_1, T_2, T_3 , and T_4 . **Explain carefully to receive full credit.**

$T_1 =$ _____, $T_2 =$ _____, $T_3 =$ _____, $T_4 =$ _____
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- (c) Is this system stable? yes or no (Circle one)

Problem 4: (20%)

Let $h(t) = \delta(t + 4) + 3\delta(t) + \delta(t - 4)$.

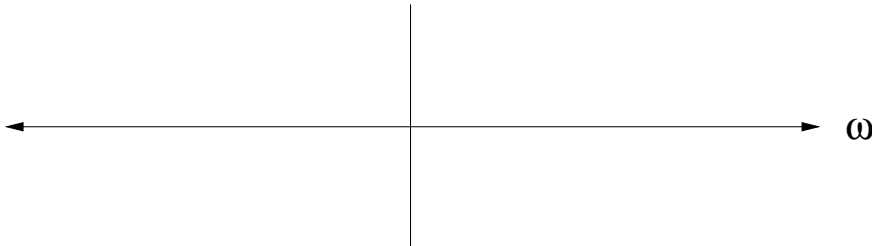
(a) Find $H(j\omega)$.

$H(j\omega) =$

(b) Let $y(t) = h(t - 5)$. Find the phase of $Y(j\omega)$, the Fourier transform of $y(t)$.

$\angle Y(j\omega) =$

(c) If $x(t) = \frac{\sin 80\pi t}{\pi t} + \frac{\sin 40\pi t}{\pi t}$, plot $X(j\omega)$. Carefully label your plot.



Problem 5: (20%)

Assume that $x(t)$ is the periodic function given by

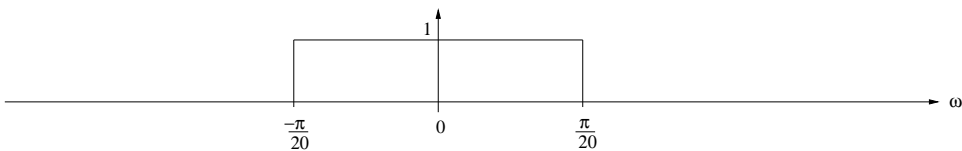
$$x(t) = \sum_{k=-\infty}^{\infty} \delta(t - 45k) = \sum_{k=-\infty}^{\infty} \frac{1}{45} e^{j\omega_0 kt}.$$

- (a) Determine the value of the fundamental frequency ω_0 .

$\omega_0 =$

- (b) Suppose that $x(t)$ is the input to an LTI system with the frequency response illustrated below.

$$H(j\omega) = \begin{cases} 1 & |\omega| \leq \frac{\pi}{20} \\ 0 & |\omega| > \frac{\pi}{20} \end{cases}$$



Give an equation for the output of the system, $y(t)$, that is valid for $-\infty < t < \infty$. Your answer should be expressed in terms of only real quantities. (Hint: Plot the spectrum of $x(t)$ on the plot of the frequency response.)

$y(t) =$