Exam 1

Tuesday, February 22, 2022 10:22 AM

midterm1

Need practice on time domain analysis. Don't get discouraged. Come to my office hour if you'd like to talk.

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ECE 466 Midterm 1

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- Don't forget to write your name.
- Open textbook.
- Read carefully and write legibly. For the problems with partial credit, show your work.
- For those of you who are remotely solving the exam:
  - You can solve your exam in a-4 sheets or on your tablet.
  - You need to send a scanned pdf or image until 11:45 AM, Tuesday 22nd, to sofuoglu@msu.edu. Otherwise, your exam will not be accepted.
  - Make sure your answers are legible from pdf or scanned image.

1. No partial points for the following.

(a) [15 Points] Check if the following systems fits the classifications on the columns.

System Equation	Linear	Time Invariant	Static	Causal	Stable
$y[n] = x[-n]$	✓	✓ -1	✓ -1		✓
$y[n] = 2n^2x[n] + nx[n+1]$	-1 ✓			✓ -1	✓
$y[n] = cos(2\pi x[n])$	✓ -1	-1	-1	-1	

(b) [5 Points] The sequence $x[n] = \cos\left(\frac{\pi}{2}n\right)$ was obtained by sampling an analog signal $x(t) = \cos(\Omega t)$ at a sampling rate of $F_s = 100$ Hz. What are two possible values of Ω?

Missing π

$2\pi \cdot \frac{2}{\pi} = 4K$ $\frac{100Hz}{4} = 25Hz$ $\Omega = \frac{\pi}{2}$ $N = \frac{2\pi}{\pi/2} = 4K$

$K = 1, 2, 3, 4, 5$

$4 \cdot 2 \rightarrow \frac{100Hz}{8} = 12.5Hz \rightarrow$ x -3

(c) [5 Points] What is the ideal sampling frequency of $x(t) = u(t)$?

$f_s = \frac{1}{T}$ not possible? ✓

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(d) [5 Points] The causal sequence $x[n] = \{\underline{3}, 1\}$ is input to a system with impulse response $h[n]$, producing the zero-state response $y[n] = \{\underline{6}, -1, 2, 1\}$. Determine $h[n]$.

$h[n] = \{2, 0,$

ran out of time

0	1	2	3
3	1	0	0
6	~~1~~	2	1

$n(0) = 2$
$n(1) = 0$
$n(2)$

Use convolution. -3

(e) The impulse response of a DT (Discrete Time)-LTI system is given by $h[n] = A(0.7)^n u[n]$. Suppose $x[n] = B\cos(0.2\pi n)u[n]$ is input to the system. Which of the following could be the output signal $y[n] = h[n] * x[n]$?

i. $K_1(0.7)^n \cos(0.2\pi n + \theta)u[n]$.
ii. $K_1(0.14)^n u[n] + K_1 \cos(0.14\pi n\theta)u[n]$.
iii. $K_1(0.7)^n u[n] + K_2 \cos(0.2\pi n + \theta)u[n]$.
iv. $K_1(0.7)^n u[-n] + K_2 \cos(0.2\pi n + \theta)u[n]$.

-6

Total = Homog. + Part.

2. [30 Points] Consider a causal LTI system described by the difference equation $y[n] = \frac{2}{15}y[n-1] + \frac{1}{15}y[n-2] + x[n]$ with $y[-1] = 1$, $y[-2] = -1$.

(a) [6] Find the impulse response $h[n]$.
(b) [4] Determine if the system is (1) FIR or IIR, and (2) stable.
(c) [8] Find the zero state response for $x[n] = u[n]$. (*Decide on particular response's K first.*)
(d) [8] Find the zero input response.
(e) [4] Find the total response for $x[n] = u[n]$. Identify the steady state and transient responses.

$\frac{Y(z)}{X(z)}$ Nope.

$\cancel{\frac{y[n]}{x[n]}} = h[n] = \frac{2}{15}^n u[n] + \frac{\left(\frac{2}{15}\right)^{-1}3}{1-(2^{-1}/15)}$

a)

b) FIR, IIR -3

-5

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Extra page for Question 2

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3. [30 points] A causal LTI system has a system function $H(z) = \frac{1+z^{-1}}{1-\frac{3}{5}z^{-1}+\frac{2}{25}z^{-2}}$.

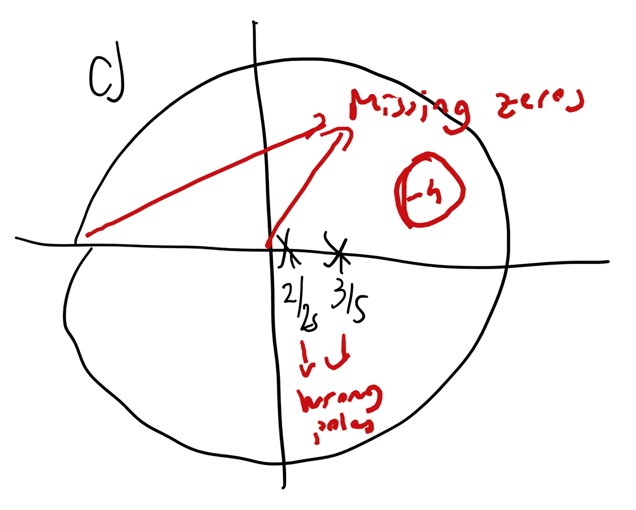
(a) [5] Determine the difference equation that this system function describes.
(b) [2] What is the gain of the system?
(c) [5] Plot the pole-zero map.
(d) [5] Determine the region of convergence (ROC).
(e) [5] Is the system stable? Why?
(f) [8] Find the input signal $x[n]$ that will produce the output $y[n] = 2\left(\frac{2}{5}\right)^n u[n] - \left(\frac{1}{5}\right)^n u[n]$.

b) gain is 2 1 -1

d) ROC $= z > 3/5$ $z > \frac{2}{5}$ -3

$|z| > 3/5$

c)



e) yes system is stable ✓

a) $n\ 2/5^n\ u[n]$ x -4

f) -6

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Extra page for Question 3

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