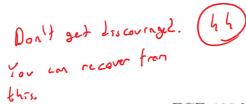


## zeb miles



## 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]	V	✓ <del>(-1)</del>		1-1	
$y[n] = 2n^2x[n] + nx[n+1]$	/				16
$y[n] = cos(2\pi x[n])$	VE-1		/	/	/

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

sampled since this would require infinite bandwidth.
However, an approximation can be produced by using the
lighest sampling rate allowed by the ADC being used.

1

## ECE 466 Page 2

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

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

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

- 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.

$$y[n] = \frac{2}{15}y[n-1] + \frac{1}{15}y[n-2] + \times (n)$$

$$y[-2] = -1$$

$$x[-2] = -1$$

$$x[-2]$$

4) 
$$h[N] = C_1(\frac{2}{15})^n u[N] + C_2(\frac{1}{15})^n 2 u[N] +$$

$$= \frac{2}{15} R + \frac{1}{15} (R) + \frac{1}$$

ECE 466 Page 3

Extra page for Question 2

C.) 
$$Z \leq Z \times [n] = u[n] \rightarrow [n] \times [n]$$

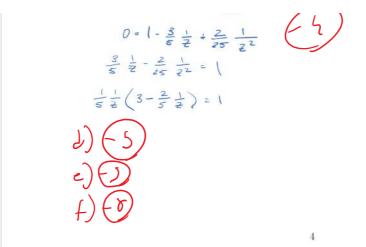
3. [30 points] A causal LTI system has a system function 
$$H(z) = \frac{1+z^{-1}}{1-\frac{3}{5}z^{-1}+\frac{2}{25}z^{-2}}$$
.

- (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  $y[n] = 2\left(\frac{2}{5}\right)^n u[n] \left(\frac{1}{5}\right)^n u[n]$ .

(A) 
$$\frac{Y(z)}{X(z)} = \frac{1+z^{-1}}{1-\frac{3}{5}z^{-1}+\frac{2}{25}z^{-2}}$$
  
 $\frac{Y(z)}{(1-\frac{3}{5}z^{-1}+\frac{2}{25}z^{-2})} = X(z)(1+z^{-1})$ 

$$0 = 1 - \frac{3}{5} \frac{1}{2} + \frac{2}{25} \frac{1}{2^2}$$

$$0 = 1 - \frac{3}{5} \frac{1}{2} + \frac{2}{25} \frac{1}{2^2}$$



ECE 466 Page 5