

EC5.201 – Signal Processing – Quiz 1

Date: 26th August, 2024
Exam duration: 45 minutes

Maximum marks: 20

Instructions:

- There are 3 questions for a total of 20 marks.
 - Mention any additional assumptions you make that is not given in the question.
 - Clearly show the steps used to arrive at the solutions.
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1. [6 marks] A discrete-time LTI system has impulse response given by $h[n] = u[n] - u[n - 3]$. A signal $x[n] = \sin(\frac{\pi}{2}n)u[n]$ is given as input to this system.

- Sketch the input signal for $n = -2$ to 12.
- Using time domain analysis, find the output of this system and sketch it for $n = -2$ to 12.
- If the input is instead $\sin(\frac{\pi}{2}n)$, find the simplified form of the output signal.

2. [6 marks] We have seen that complex exponential signals act as eigensignals for any LTI system. What are eigensignals?

For each of the following systems, give an example of non-complex exponential signals which act as eigensignals.

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

3. [7 marks] Shiva and Madhuri are performing analysis of causal systems described by linear constant coefficient difference equation. Their system descriptions are as follows:

Shiva: $y[n] = \frac{1}{2}y[n - 1] + x[n]$

Madhuri: $y[n] = \frac{5}{6}y[n - 1] - \frac{1}{6}y[n - 2] + x[n] - \frac{1}{3}x[n - 1]$

- Show using Z-transform analysis that both of them are working with same system.
- Find the impulse response of this system.
- Is this system stable?