Signal Processing (EC5.201)

Assignment – 02

Released – 19th August 2024

Due date – 29th August 2024 (11:59 pm IST)

- The handwritten assignments are to be submitted individually. Compile all your scans in the right order into a single pdf file. Moodle submission portal will be opened soon.

- Student discussions are allowed but copying and plagiarism will NOT be tolerated and will attract strict penalties.

- At the beginning of the assignment, each student must declare the honor code:

  "I affirm that I have neither given nor received help or used any means which would make this assignment unfair."

  - YOUR Signature

- Assignments submitted without an honor code and signature will have a 10% penalty.

- Late submission: 10% penalty per day (will be accepted up to at most 3 days after deadline).

- Solve and submit solutions to the following problems :

  - (**Book PM**) Chapter 3: 3.31 (Analyse this system for causality & stability), 3.46
  - (**Book OWN**) Chapter 10: 10.26, 10.47

  - **Q1**. Using Z-transform determine the explicit expression for the impulse response of a causal LTI system that develops an output $y[n] = 2(-0.2)^n \, \mathrm{u}[\mathrm{n}]$ for an input $x[n] = 3(0.5)^n \, \mathrm{u}[\mathrm{n}]$.

  - **Q2**. A causal LTI discrete-time system is described by the difference equation

$$y[n] = 0.4y[n-1] + 0.05y[n-2] + 3x[n],$$

    where $x[n]$ and $y[n]$ are, respectively, the input and output sequences of the system.

    a) Determine the transfer function $\mathrm{H}(\mathrm{z})$ of the system.

    b) Determine the impulse response $\mathrm{h}[\mathrm{n}]$ of the system.

    c) Determine the step response $\mathrm{s}[\mathrm{n}]$ of the system.

- Q3. Consider the FIR discrete-time system characterized by the difference equation

$$y[n] = x[n] + \alpha x[n - M]$$

a) Determine its impulse response $\mathrm{h[n]}$.

b) Determine the impulse response $\mathrm{g[n]}$ of its causal inverse system.

c) Check the stability of the inverse system.