Signal Processing (EC5.201)

Assignment – 07
Released – 9th November 2024
Due date – 16th November 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:

- **(OWN) Chapter 7:**
    a) 7.31
    b) Repeat 7.31 when the difference equation is $y[n] = x[n-1]$. What is relation between $x_c(t)$ and $y_c(t)$?

- **(PM) Chapter 10:** 10.5

o **Q1.** If $H(z)$ is a low pass filter, analyze what happens when
    (a) z is replaced by $-z$
    (b) z is replaced by z^{-1}
    (c) z is replaced by z^2

○ Q2.

[**Marks**] Consider the setup below which is used to process continuous-time signals using a digital filter $H(z)$.

$$x_a(t) \longrightarrow \boxed{\text{A/D}} \longrightarrow \boxed{H(z)} \longrightarrow \boxed{\text{D/A}} \longrightarrow y_a(t)$$
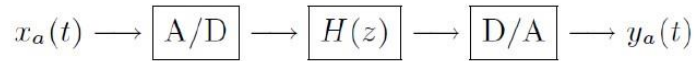
(a) If $x_a(t)$ is a speech signal containing maximum frequency of 8 kHz, what can be the maximum spacing of samples in the A/D system to avoid aliasing?

(b) We wish to design a causal, linear-phase, symmetric, FIR digital filter $h[n]$ of length-4 with following requirements: frequency response $H(e^{j\omega})|_{\omega=0} = 2$ and the filter has one of its zeros located at $z = j$. Find the filter $h[n]$.