Birla Institute of Technology & Science, Pilani, Rajasthan
First Semester 2025-2026
<u>**Lab-1 Time and Frequency Analysis**</u>

Course: EEE F311 Communication Systems
Instructor-in-Charge: Prof. Syed Mohammad Zafaruddin

Week 1: 04-08-2025

Objectives

In this task, the objective is to study signals in time and frequency representation.

Time and Frequency Analysis

- Sinc pulses $sinc(x) = \frac{sinx}{x}$ require minimum bandwidth for signal transmission. Plot sinc pulse $m(t) = 2Bsinc(2\pi Bt)$ and $|M(f)|$, where B is the bandwidth. Pass the signal $m(t) = 2B_1sinc(2\pi B_1t)$ to a transmitter $g(t) = 2B_2sinc(2\pi B_2t)$ and observe the output for different B_1 and B_2. Use convolution operation.

- Using $f_0 = 110$ Hz, pass the signal

$$m(t) = \sum_{k=1}^{5} \frac{1}{k}\cos(2\pi k f_0 t).$$

  to a transmitter block $g(t) = 2B_2sinc(2\pi B_2t)$ for different values of B_2.

Project Task

Topic: *Introduction to Information Source Modeling: Analog and Digital Signals*
Objective: Design and implement a modular class to model diverse information sources and analyze their behavior.

- Implement a Python class named `InfSourceID` that serves as a data structure for the **information source** block in the end-to-end simulator.

- The class should support generation of:

  - **Analog waveforms:** sine, rectangular, sinc, and square signals
  - **Digital signals:** bitstreams from user-defined text input
  - **Real-world signals:** audio from `.wav` files (e.g., speech)

Analysis Goals

- Plot signals in the **time domain** (amplitude vs. time)

- Apply the **Fast Fourier Transform (FFT)** to analyze signals in the **frequency domain** (spectrum and bandwidth)

Deliverables

- Python implementation of the `InfSource` class (`inf_source.py`)

- Plots for analog, digital, and audio signals (time and frequency domain)