# ECL332 - Communication Lab

Department of Electronics and Communication
College of Engineering Trivandrum

21 February 2023 and 22 February 2023

## 1 Instructions

1. The programs should be written in Python language only. You can use any of the available python tools for coding.
2. Each section of this document (after the instruction section) shall be written in a separate file.
3. There should be a file header for each program. The file header is a comment section at the start of the file before you write the program. The file header consists of `Description of the program`, `Author` and `Date of program`.
4. The program should be properly commented and meaningful names shall be given to variables and functions.
5. All the programs should be made as modular as possible by implementing necessary functions. There should be function header for each function. Function header is similar to file header except that there will not be Author and Date instead there will be `Description of the function` and `Explanation of the parameters`.
6. The student should print the *Student Name*, *Student Roll No* and *Student Department* at the start of the program.

## 2 Probability and Random Variables

1. Generate two random variables $X \sim \mathcal{N}(r, \sigma^2)$ and $Y \sim \mathcal{N}(r, \sigma^2)$ where the mean $r$ is your roll number and the variance $\sigma^2 = 1$.
   (a) Plot the histogram of $X$ and $Y$ and show that the plot of probability density function is Gaussian in nature.
   (b) Plot the probability mass function of both the random variables.
   (c) Generate a new random variable $Z = X + Y$. Plot the histogram for pdf. What is the mean and variance of $Z$?.

## 3 Pulse Coded Modulation

1. Generate the following raised sine wave by sampling it at four times the Nyquist rate

$$s(t) = (\text{mod}(r, 5) + 1)\left(\frac{1 + \cos(8\pi t)}{2}\right)$$

   where $mod(r, 5)$ is the reminder when your roll number $r$ is divided by 5. Quantize the samples of $s(t)$ with $L = 4, 8, 16, 32, 64$ where $L$ is the number of quantization levels.
   (a) Compute the signal to quantization noise ratio and plot it against $N$, where $N = \log_2(L)$ is the number of bits used for quantization.
   (b) Generate the PCM modulated output for $L = 32$ using binary encoding.