

# Birla Institute of Technology & Science, Pilani, Rajasthan

**First Semester 2021-2022**

## **Lab-8 (PYTHON): FM**

**Course: EEE F311 Communication Systems**

**Instructor-in-Charge: S M Zafaruddin**

**14-10-2021 THURSDAY (P1, P3): FM**

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### **Instructions**

- Create a folder named Lab in your shared folder.
- Create a Lab8 Sub-folder in the Lab folder. This folder will be your working directory.
- Develop .py file corresponding to each task.
- You can start the tasks in any order.
- Once all tasks are done, paste your codes and plots/results/observations/conclusions in a word doc and upload through a Dropbox file request link. The link will be shared through Slack.
- Best of Luck

### **Objectives**

In this task, the objective is to study real time transmissions of modulated signals over a channel with additive noise.

### **PYTHON Task 1**

- Plot  $m_1(t) = 2N \sin(2N\pi t)$  and FM signal (time domain) with  $\beta_{\text{FM}} = 10$  in two subplots to show the variation in the frequency of FM with amplitude of signal. Take  $c(t) = 10 \cos(2\pi f_c t)$ . Also, plot in a separate figure frequency domain of the FM signal by choosing appropriately carrier frequency.
- Repeat the above for PM signal with  $\beta_{\text{PM}} = 20$ .

Take  $N$  as the **sum** of the last two digits of your BITS ID.

## PYTHON Task 2

The message signal  $m(t) = 2U\text{sinc}(2U\pi t)$ , where  $U \sim (1, 10)$  is a uniform random variable frequency modulates a carrier signal  $c(t) = A\cos(2\pi f_c t)$  with  $\beta = 20$ . The modulated signal is passed through a channel  $h(t) = 0.1\delta(t)$  with AWGN  $\sim N(0, 0.01)$ . Plot the message signal, carrier signal, modulated signal before channel, modulated signal after the channel with AWGN, and demodulated signal using the frequency discriminator. Use real-time code for 10 seconds.

## Project Task

We have started individual tasks with a bigger picture: to design an end-to-end simulator for a digital communication system. In this task, we have transmitted modulated signal over band-limited channel with additive noise in real time.