DA-IICT, CT 303, Autumn 2024-2025
Lab Exercise 9
Date: 18/10/2024, Expected by: 01/11/2024
Prepared by: Dr. Abhishek Jindal

References for perusal:

[1] *Manual, kit 2807:* ASK, FSK, BPSK, DBPSK Modulator & Demodulator, Scientech.

[2] *Manual, kit 2808:* QPSK, OQPSK and DQPSK Modulator & Demodulator, Scientech.

[3] *Contemporary Communication Systems Using MATLAB*, John G. Proakis, and Masoud Salehi, 2013, Cengage learning.

- **Before attempting the problems below, it is required for you to finish up with the pending problems from lab sheet 8.**
- In the exercise sheet, there are 3 lab problems.
- The first two problems need to be solved using the kit, while the remaining one needs to be done using MATLAB.
- The coding in MATLAB should be done in groups of 2.
- All the required soft copies of the texts referred to in the exercises are available in the lecture folder of the instructor for section A.

---

1. From [1], perform experiments 19 to 23 on Frequency Shift Keying (FSK). The page numbers for the same are given in the table of contents. You need to follow the procedures given in the manual and observe the output as suggested in the observations.
2. From [2], perform experiments 1 to 9 on Quadrature Phase Shift Keying (QPSK). The page numbers for the same are given in the table of contents. You need to follow the procedures given in the manual and observe the output as suggested in the observations.
3. The central limit theorem states that if random variables X_i, $1 \leq i \leq n$, are i.i.d. (independent and identically distributed), with finite mean and variance, and n is large, then their average (i.e., $Y = \frac{1}{n}\sum_{i=1}^{n} X_i$) has roughly a Gaussian distribution. This theorem explains why thermal noise generated in electric circuits has a Gaussian distribution. In this problem we verify this theorem using MATLAB.
   (a) Using MATLAB, generate a vector $\mathbf{x}$ of length 10^6 whose components are uniform random variables distributed between 0 and 1. The components of this vector are the $X_i's$ in the central limit theorem. (Use MATLAB command "rand" to generate the sequence.)
   (b) Find the average of every 100 consecutive elements of $\mathbf{x}$ and generate the sequence $\mathbf{y}$ of length $10,000$. So, Y_1 is the average of X_1 through X_{100} , Y_2 is the average of X_{101} through X_{200}, and so on.
   (c) Plot the histogram of the sequence $\mathbf{y}$ using the "hist" command. Use 50 bins to generate your plot. Include the listing of your program and the plot. Note that the histogram is very close to a Gaussian distribution.

Instructions for Preparing Lab Report:

- For experiments done on kit, you need to take a snap shot of each output on the oscilloscope. This can be done either by connecting a USB stick to the oscilloscope, or connecting the oscilloscope to the PC. Your lab report must contain these snapshots.
- You need to verify and subsequently mention in the report that the outputs given in the manual corresponding to the experiments are indeed correct.
- For MATLAB based experiments, your lab report must contain the code and all the figures. Further, you need to explain the results in the graphs.
- For tutorial problems, you need to put up the solution in the lab report.

General Instructions:

- The lab is intentionally made from the references given above so that you have ample resources to refer to and learn.
- For the final evaluation, we may have a quiz/lab test which will test if you have gone through the codes and tweaked them in Matlab.
- For learning Matlab functions used in the codes, refer to the help section which pops up as you press F1 in Matlab.