DA-IICT, CT 303, Autumn 2024-2025
Lab Exercise 3 and Tutorial
Date: 20/08/2024, Expected by: 30/08/2024
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References for perusal:

[1] *Manual, kit 2804:* 4-Channel TDM-PCM Modulator and Demodulator, Scientech.

[2] *Modern Digital and Analog Communication Systems*, B. P. Lathi, and Zhi Ding, International 4th edition, Oxford University press.

[3] *Communication Systems*, Simon Haykin, 4th edition, Wiley Student Edition.

- In the exercise sheet, there are 2 lab problems and 1 tutorial problem.
- Among the two lab problems, one needs to be done on hardware, while the other one in MATLAB.
- The hardware experiment is to be done in groups of 4, while the coding in MATLAB should be done in groups of 2.
- **It is required for a group of 4 to occupy two consecutive desks and share the kit among themselves. Once the hardware-based experiments are done, they should split in groups of 2 and occupy the adjacent PCs on the desks.**
- 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.

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1. **(Tutorial Exercise)** A signal $m(t)$ of bandwidth $B = 4$ kHz is transmitted using a binary companded PCM with $\mu = 100$. Compare the case of $L = 64$ with the case of $L = 256$ from the point of view of transmission bandwidth and the output SNR. Show that SNR for $L = 256$ is 16 times the SNR for $L = 64$ and the former requires just about 33% more bandwidth compared to latter. (***Note:*** *You can refer to lecture notes for solving the problem.*)

2. From [1], perform experiments 8 to 14, which pertain to TDM. 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.
(***Note:*** *Time-division multiplexing (TDM) is one very useful application of PCM which allows multiple users to use a common channel. For section A, it will be soon covered in the lectures.*)

3. Go through section 7.6 and subsequently, section 7.10 from [2]. Thereafter, implement the files "pnrz.m", "prz.m", "psine.m", "prcos.m", "binary eye.m", and "Mary eye.m". Subsequently, with the understanding developed, solve problem 4.38 from [3]. The function "eyediagram" is a built-in M-function in MATLAB.
(***Note:*** *The concept of eye-diagram is well explained in section 7.6. However, it will be covered in the lectures on "communication over band-limited channels, scheduled for the second week after In-sem 1.*)

Instructions for Preparing Lab Report:

- The tutorial problem needs to be solved during the lab and no submission is required for the same.
- 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.

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.