Final Project

Part 1

1.1 Description of Part 1

The purpose of this part is the simulation and analysis of the Amplitude shift keying and its Bit Error Rate (BER)

M-ary Amplitude Shift Keying (M-ary ASK) is a modulation technique where the input symbol modulates the amplitude of the carrier as follows

$$S_i(t) = a_i\sqrt{E_o} \times \sqrt{\frac{2}{T}}\cos(2\pi f_c t) \quad , 0 \le t \le T,$$

$$i = 1,2, \dots M, \qquad a_i = \pm 1, \pm 3, \pm 5, \dots$$

The Modulation- Demodulation of an M-ary ASK is shown in Figure 1

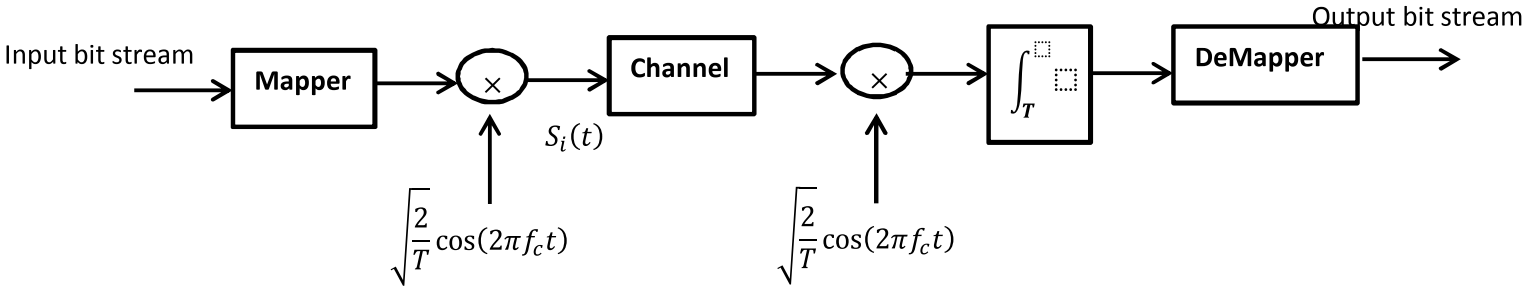


Figure 1: Modulation/Demodulation

The Mapper

The mapper takes the I/P data bits "for example, 100,000 randomly generated bits" and produces the amplitudes of the corresponding symbols

The Channel

The channel is an AWGN channel. In this model, the channel just adds noise to the transmitted signal (i.e. no distortion). In MATLAB, the command "randn" should be used to generate the AWGN

The DeMapper

The simple demapper in the model under consideration will decide on the symbol transmitted. The output bit stream of the receiver is compared to the input bit stream and the Bit Error Rate (BER) is calculated.

The modulation under consideration is the 8-ASK. Figure 2 shows the signal constellation of the modulation schemes

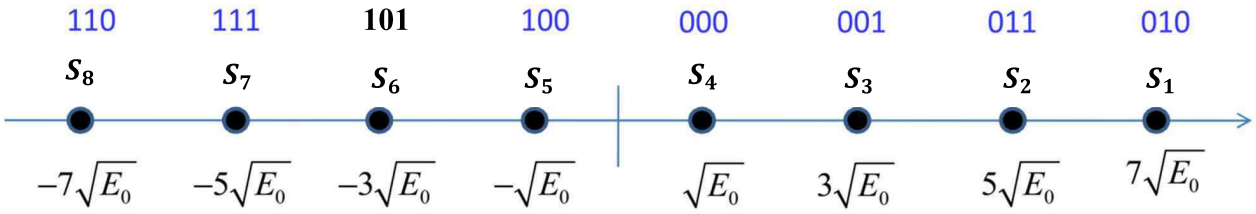


Figure 2: 8-ASK Modulation

1.2 Requirements of Part 1

1- Use **Matlab** to simulate and calculate the BER of the 8-ary ASK in Figure 2. **All simulations are done on the baseband equivalent system, with no carriers**.

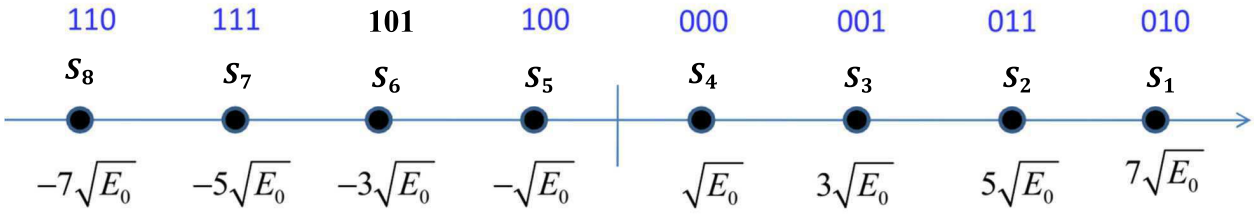
2- Sketch the constellation of the 8-ASK in Figure 2 with the decision regions of each symbol marked.

3- Derive the theoretical Bit Error Rate

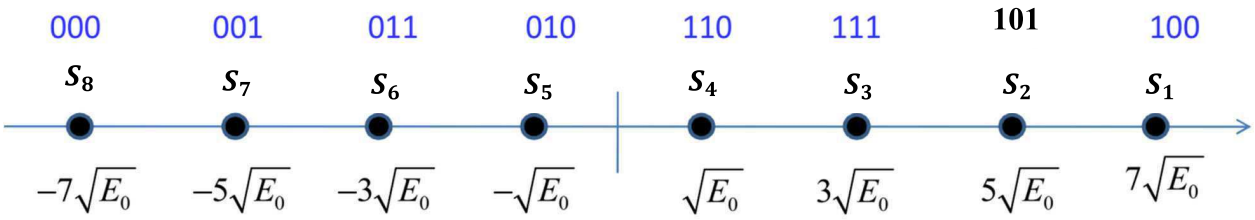
4- Plot the **simulated BER** and **the theoretical BER** versus E_b/N_0 for the 8- ASK in Figure 2. The BER should be on the vertical axis (in log scale). E_b/N_0 should be on the horizontal axis in dB (from -4 to 16 dB with step 2 dB). Use "semilogy" in Matlab to plot the BER on y-axis with log scale. ***Please note that we're asking for the Bit error rate NOT the symbol error rate.***

5- You are designing a system that uses M-ary ASK. The required bit rate is 1Mbps and the available BW is 0.5 MHz centered at a carrier frequency 5 MHz. Knowing that the bandwidth of a passband modulation is twice the symbol rate (i.e. $2R_s$), Can you use a 8-ary ASK? Why? What is the minimum M (in M-ary ASK) that satisfies the bit rate and bandwidth requirement?

6- Which of the following bit to symbol assignment satisfies the Gray Encoding criterion? And Why?



Bit to symbol assignment 1



Bit to symbol assignment 2

1.3 your submission on Part 1:

- You should submit a report that fulfils all the requirements in section 1.2 **in the same order.** The report should include:
  - All the required results, comments, and answers to questions
  - All the required figures
  - All the required sketches and theoretical analysis
  - All codes as appendices (with comments that clearly explain the code and variables).
- The figure in your report should be **clear**. **Use solid line (with line width '2') for your simulated BER and dashed line (with line width '2') for the theoretical BER**. The figure should have **a legend and the axes should be properly labelled with proper font size.**
- The theoretical analysis along with the decision regions (whether you scan your hand analysis or use word/latex for the equations features) should be **clear, neat, and easily readable. Do NOT write equations on word or any text editor as text, you should use a proper equation editor or feature. DO NOT use pale pencil/pen and do not scratch**
- Your comments should be **"concise"** and do not exceed 3 lines**.**
- Please keep your report **neat, clean, and organized**.
- You are responsible for **the clarity and visibility of your figures, analysis, comments, code, etc**.

Part 2

Write notes on cyclic codes showing:

1) Definition of binary cyclic codes and why are they attractive?
2) Description of cyclic codes and systematic Cyclic codes.
3) Relation between the generator polynomial and the generator matrix (in linear block codes)
4) Cyclic code generation (encoding procedure)

Project Submission Policy:

This project is Individual.

Submission:

- Submit a single uncompressed .pdf file on the Google classroom of the course **(Digital Communications ELC325b with code "upj4jha").**
- You .pdf report should fulfil all the requirements of part 1 and part 2.
- The report should use the provided template
- The front page of the PDF file should have your full name **in "Arabic",** your section, and Bench number on the front page**.**

Plagiarism: Students must not copy any material from any reference (without proper citation) or any another project. Plagiarism check shall be carried and the project will be considered invalid (fail) in case of plagiarism.

Deadline: May, 31, 2020 at 11:59 PM

Late submission is not allowed