Cairo University - Faculty of Engineering
Computer Engineering Department

M-ARY AMPLITIUDE SHIFT MODULATION

Subject: Digital Communication

Submitted to:

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0.1 Part 1: Digital Communication

0.1.1 Problem 1

Figure 1 below showing the comparison between simulated BER and theoritical (analytical) BER VS the Eb/N0 in db.

Please notice, you'll have to input the no. of bits you wish to be transmitted, and it has to be divisible by 3.

0.1.2 Problem 2

The constellation of the 8-ary with decision region pf each symbol.

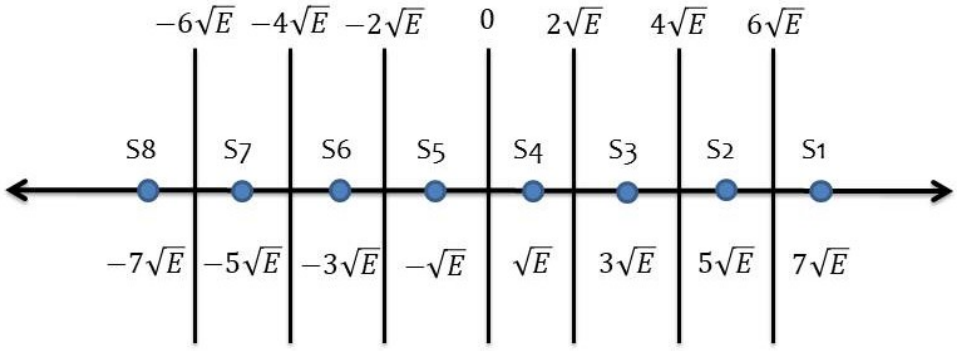

Figure 1: Symbols Boundary

0.1.3 Problem 3

The derivation of theoritical bit error rate.

$$Pe = \frac{1}{8}\sum_{i=0}^{7} P(e|Si) \tag{1}$$

$$Pe(e|S0) = Pe(e|S7) \tag{2}$$

$$Pe(e|S1) = Pe(e|S2) = Pe(e|S3) = Pe(e|S4) = Pe(e|S5) = Pe(e|S6) \tag{3}$$

Using Union bound S0, S7 only one neighbour and S1, S2,...S6 has two neighbours.

$$Pe(e|S0) = \frac{1}{2}erfc(\frac{\sqrt{E}}{\sqrt{N}}) \tag{4}$$

$$Pe(e|S1) = \frac{1}{2}erfc(\frac{\sqrt{E}}{\sqrt{N}}) + \frac{1}{2}erfc(\frac{\sqrt{E}}{\sqrt{N}}) \tag{5}$$

$$Pe(e|S1) = erfc(\frac{\sqrt{E}}{\sqrt{N}}) \tag{6}$$

$$Pe = \frac{1}{8*3}(2*\frac{1}{2}erfc(\frac{\sqrt{E}}{\sqrt{N}}) + 6*erfc(\frac{\sqrt{E}}{\sqrt{N}})) \tag{7}$$

$$Pe = \frac{7}{24}(erfc(\frac{\sqrt{E}}{\sqrt{N}})) \tag{8}$$

0.1.4 Probelm 4

Figure 1 below showing the comparison between simulated BER and theoritical (analytical) BER VS the Eb/N0 in db.

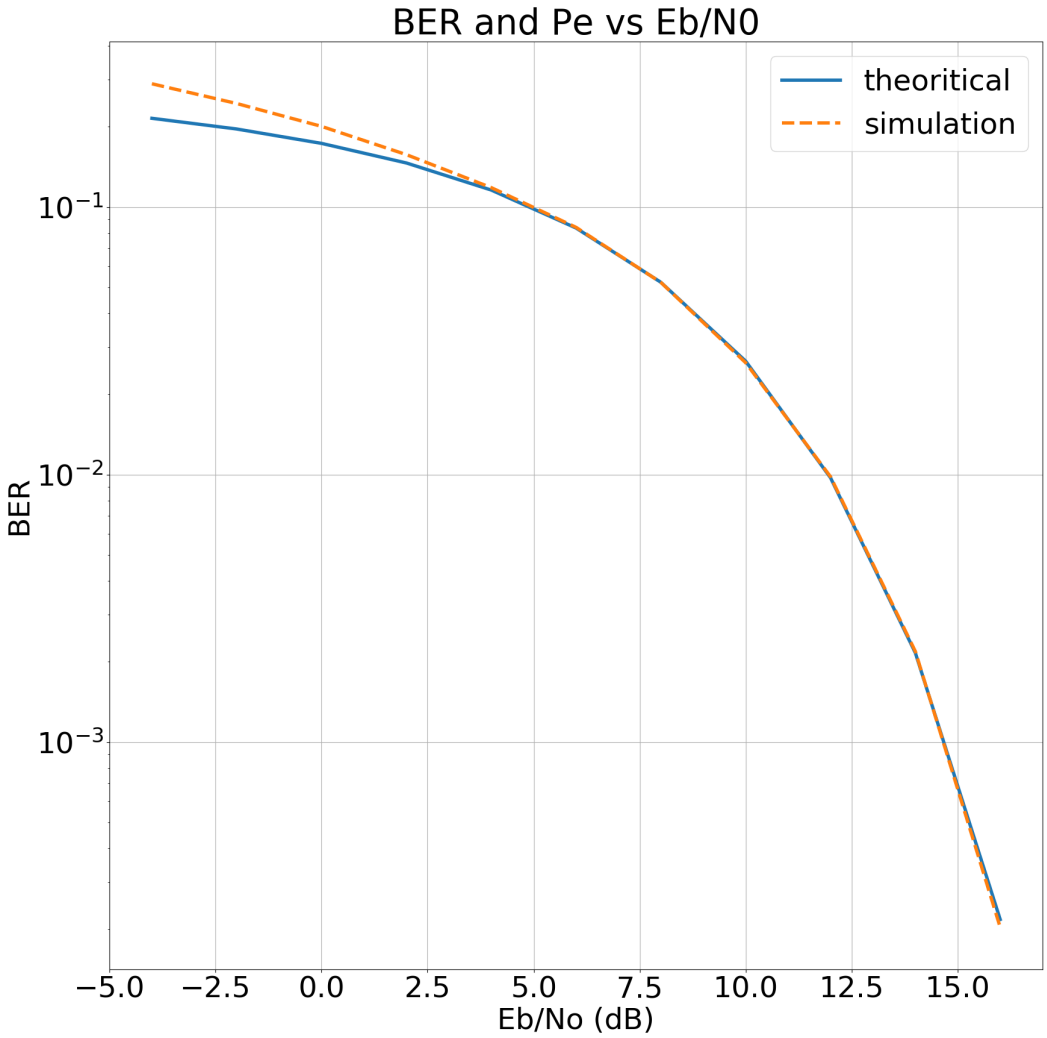

Figure 2: BER vs Eb/N0

0.1.5 Probelm 5

The answer is NO, We can't transmit at Rate 1 Mbps with bandwidth 0.5 MHz in passband transmition.

The minimum M required: 16 Only bit by bit transmittion is allowed.

GIVEN:

$$Bt = 2Rs$$

$$Rb = 1Mbps$$

$$BW = 0.5MHz$$

$$M = 3$$

REQUIRED:

$$BW = ?2 * Rs$$

$$BW =?2 * \frac{Rb}{\log_2 M}$$

$$BW =?1Mbps * \frac{2}{3}$$

The Answer is: NO it can not be transmitted

$$0.5MHz =?1Mbps * \frac{2}{\log_2 M}$$

$$4MHz =? \log_2 M$$

$$M = 16$$

0.1.6 Probelm 6

Both of them satisfy the Gray Encoding criterion.

Because at the two examples only one bit is changed in each transition from symbol to the next one.

0.2 Section 2

Hello World 2!

0.2.1 Subsection 2.1

Equations:

$$\frac{n!}{k!(n-k)!} = \binom{n}{k} \tag{9}$$

$$x^{\frac{1}{2}} \tag{10}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\big(kg(x)\big) \tag{11}$$

$$f(x) = x^2$$

0.3 Math

... This formula $f(x) = x^2$ is an example. ...

$$f(x) = x^2$$

$$g(x) = \frac{1}{x}$$

$$F(x) = \int_b^a \frac{1}{3}x^3$$

0.4 Figures

(a) Meme. (b) Same Meme.

Figure 3: The same meme, Two times.