LE/EECS 3213 E Communication Networks Fall 2014

Quiz #4, Thurs. Nov. 27, 2014 Name: ____________________

1. (*5 points*)

1.) [1] In (only) 1 word: What important function in the receiver does a Manchester code assist?

synchronization

2.) [1] What is the drawback of a Manchester code?

increased bandwidth

3.) [1] In digital receivers when adjacent data symbols start to interfere with each other we call that ...

ISI

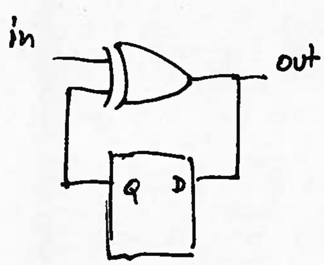
4.) [1] What is the maximum number of symbols/s/Hz that I can send in a binary bandpass scheme.

2

5.) [1] What is the maximum number of symbols/s/Hz that I can send in a binary passband scheme using a single carrier.

1

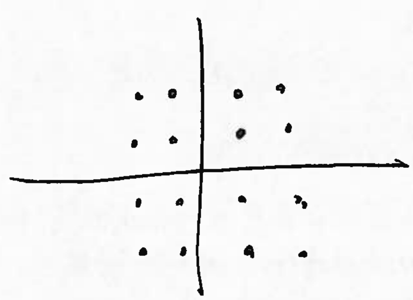
2. (*3 points*) You are to send 10111000 using a differential line code. What is the sequence of bits that comes out of your differential line coder?



in : 1 0 1 1 1 0 0 0

out : 1 1 0 1 0 0 0 0

3. (*3 points*) Sketch a 16-QAM constellation.



4. (*4 points*) A 256 point constellation is to achieve a data rate of 15-Mbps. What is the minimum channel bandwidth needed to support this requirement?

$M = 256$ # of bits per symbol $= m = \log_2(M) = 8$ bits

$\frac{15 \text{ Mbps}}{8 \text{ bits}} = 1.875$ MHz ← bandpass channel bw needed

$L = \lceil \sqrt{256} \rceil = 16$ ← # of levels per carrier

$c = 3 \times 10^8$ m/s (in free space), $c = 2 \times 10^8$ m/s (in media), 1 nm $= 10^{-9}$ m, 1 ms $= 10^{-3}$ s, 1 GHz $= 10^9$ Hz

$$\log_x y = \frac{\log_a y}{\log_a x}$$
$$C = W_c \log_2(1 + \text{SNR})$$
$$y = \int_a^b x \mathrm{d}x = \frac{x^2}{2}\Big|_a^b = (b^2 - a^2)/2, y = \int_a^b x^2 \mathrm{d}x = \frac{x^3}{3}\Big|_a^b = (b^3 - a^3)/3$$
$$y(t) = a_0 + \sum_{k=1}^{\infty} a_k \cos(2\pi f_0 \cdot k \cdot t) + \sum_{k=1}^{\infty} b_k \sin(2\pi f_0 \cdot k \cdot t)$$
$$f_0 = \frac{1}{T}, a_0 = \frac{1}{T}\int_0^T y(t)\mathrm{d}t, a_k = \frac{2}{T}\int_0^T y(t) \cdot \cos(2\pi f_0 \cdot k \cdot t)\mathrm{d}t, b_k = \frac{2}{T}\int_0^T y(t) \cdot \sin(2\pi f_0 \cdot k \cdot t)\mathrm{d}t$$
$$\text{SNR [dB]} = 10\log(\text{SNR}), \text{SNR [dB]} = 6m - 10\log(3\sigma_x^2/V^2), \sigma_q^2 = \Delta^2/12$$
$$\mathcal{F}\{\text{rect}(t/T)\} = T\text{sinc}(fT) = T\sin(\pi fT)/\pi fT$$
$$\mathcal{F}\{\text{sinc}(t/T)\} = T\text{rect}(fT)$$
$$B = v\Delta\lambda/\lambda^2$$