Department of Electrical Engineering
Final – Term Assignment Spring 2020
Date: 22/06/2020

Course Details

Course Title: Computer Communication Network **Module:** 06
Instructor: **Total Marks:** 50

Student Details

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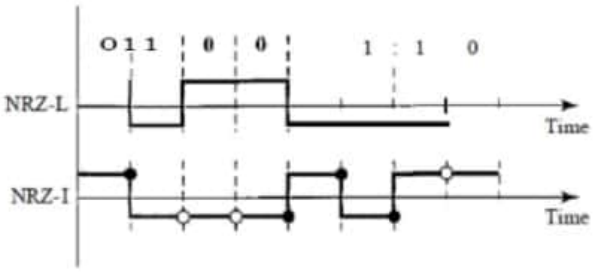
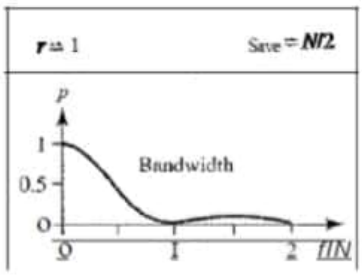
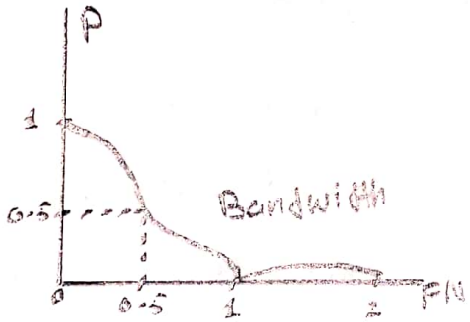
Q1.	(a)	1. An NRZ-I signal has a data rate of 100 Kbps. Using the following Figure, calculate the value of the normalized energy (P) for frequencies at 0 Hz, 50 KHz, and 100 KHz.   0 No inversion: Next bit is 0 • Inversion: Next bit is 1 2. What is the Nyquist sampling rate for each of the following signals? a. A low-pass signal with bandwidth of 200 KHz? b. A band-pass signal with bandwidth of 200 KHz if the lowest frequency is 100 KHz? 3. We have sampled a low-pass signal with a bandwidth of 200 KHz using 1024 levels of quantization. a. Calculate the bit rate of the digitized signal. b. Calculate the SNRdB for this signal. c. Calculate the PCM bandwidth of this signal. 4. What is the maximum data rate of a channel with a bandwidth of 200 KHz if we use four levels of digital signaling.	Marks 20 CLO 1
Q2.	(a)	Draw the graph of the NRZ-L, NRZ-I, Manchester and differential Manchester scheme using each of the following data streams a. 01010101 b. 00110011	Marks 16 CLO 1
Q3.	(a)	1. A TV channel has a bandwidth of 6 MHz. If we send a digital signal using one channel, what are the data rates if we use one harmonic, three harmonics, and five harmonics? 2. A signal travels from point A to point B. At point A, the signal power is 100 W. At point B, the power is 90 W. What is the attenuation in decibels? 3. The attenuation of a signal is -10 dB. What is the final signal power if it was originally 5 W? 4. A signal has passed through three cascaded amplifiers, each with a 4 dB gain. What is the total gain? How much is the signal amplified? 5. If the bandwidth of the channel is 5 Kbps, how long does it take to send a frame of 100,000 bits out of this device? 6. The light of the sun takes approximately eight minutes to reach the earth. What is the distance between the sun and the earth?	Marks 12 CLO 1
	(b)	A signal has eight data levels with a pulse duration of 2 ms. Calculate the pulse rate and bit rate.	Marks 02 CLO 1

Question # 1

Part(a): An NR2-I signal has a date rate of 100 Kbps. Using diagram, calculate the value of the normalized energy (P) for frequeixies at 0 Hz, 50 KHz, and 100 KHz.

Solution:

Data rate of Signal is 100 Kbps.



First we will calculate the valve of f/N.

For f = 0 Hz:

$$\frac{F}{N} = \frac{0}{100} = 0$$

at 0 the valve of energy per Hartz is = p = 1

For f = 50 Hz:

$$\frac{F}{N} = \frac{50}{100} = \frac{1}{2} = 0.5$$

at 0.5 the valve of energy per Hartz is p = 0.5

For $f = 100$ Hz:

$$\frac{f}{N} = \frac{100}{100} = 1$$

at "1" at value of $P = 0$.

Question # 01

Part (2):

What is the Nyquist Sampling rate for each of the following signals?

(a) Low-pass with bandwidth 200 KHz?

(b) band-pass with bandwidth 200 KHz if the lowest frequency is 100 KHz?

(a) Low-pass signal bandwidth = f_{max} = 200 KHz

Nyquist Sampling Rate = $2 \times f_{max}$

$= 2 \times 200 \times 10^3$

$= 400 \times 10^3$

= 400,000 Samples per Seconds

(b) Lowest frequency = 100KHz

band-pass signal = 200KHz

$f_{max} = 200 + 100$ KHz

$= 300$KHz

$f_{max} = 300 \times 10^3$ Hz

Nyquist Sampling rate = $2 \times f_{max}$

$= 2 \times 300 \times 10^3$

$= 600 \times 10^3$

$= 600,000$ Samples/Seconds.

Question #01

Part(3):

We have Sampled a low-pass signal with a bandwidth of 200KHz. using 1024 levels of quantization.

(a) Calculate bit of the digitized signal.

(b) Calculate the SNR dB for the Signal.

(c) Calcule the PCM bandwidth of this signal.

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(a). $f_{max} = 200\,KHz$

$f_s = 2 \times f_{max}$

$= 2 \times 200 \times 10^3\,Hz$

$= 400,000$ samples / Seconds

The number of bits per sample and the bit rate of digitized signal are:

$n_b = \log_2 1024$

$= 10$ bits / Sample

$N = 400,000 \times 10$

$= 4,000,000$

$= 4$ M bps.

(b) $SNR_{dB} = ?$

As $n_b = 10$

The value of $SNR_{dB} = 6.02 \times n_b + 1.76$

$= 6.02 \times 10 + 1.76$

$= 60.02 + 1.76$

$= 61.96$

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(c) PCM = ?

$n_b = 10$

PCM bandwidth = B_{PCM} = n_b x Bandwidth of analog

= 10 X 200 KHz

= 20000×10^3 Hz

= 2 MHz

(d)(4) What is the max data rate of channel with bandwidth 200KHz if we use four levels of digital signalling.

Sol: Bandwidth = B = 200 KHz

max data rate of channel will:

N_{max} = $2 \times B \times n_b$

= $2 \times 200 \times 10^3 \times \log_2 4$

= $400,000 \times \log_2 4$

= 8×10^5 bps

= 800 Kbps.

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Q2: Draw the graph of the NRZ-L, NRZ-I, manchester & differential Manchester Scheme using each of the following data streams

ⓐ 01010101 ⓑ 00110011

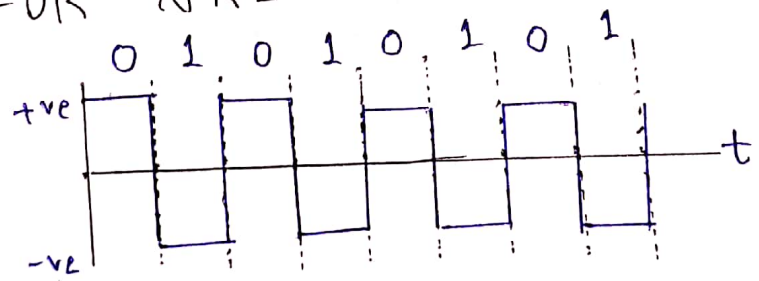
Solution:

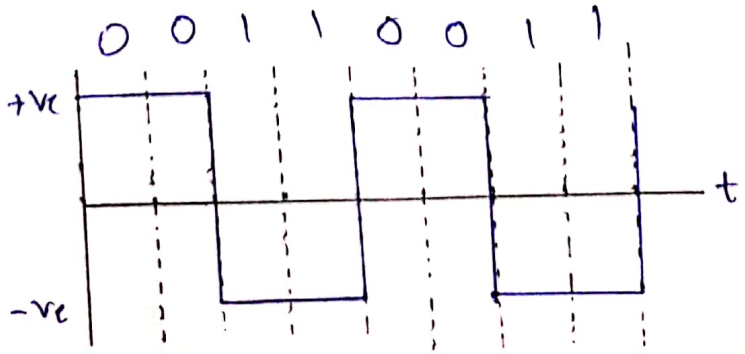
We need to find the graph for

ⓐ 01 010101 ⓑ 00110011

NRL-L, NRZ-I, manchester & differential manchester.

FOR NRZ-L:





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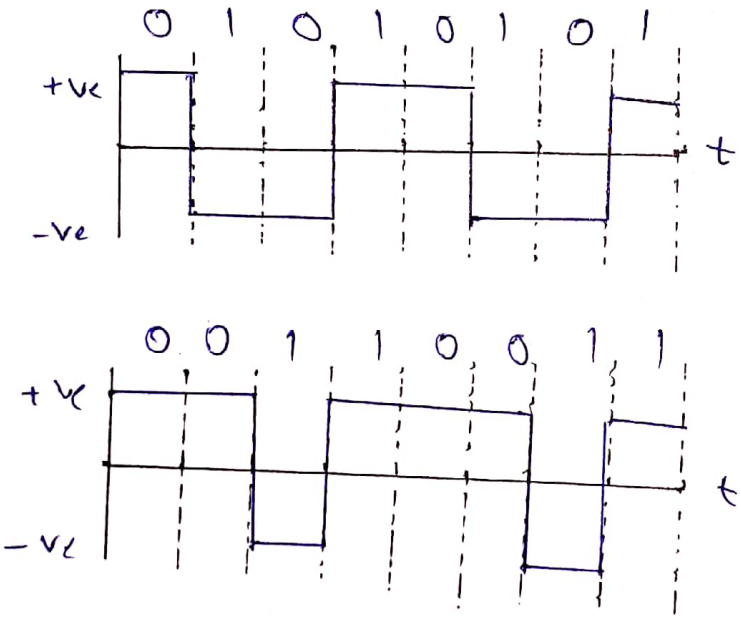
In NRZ-L the voltage levels are both sides of the time axis

Voltage level +ve = 0

Voltage level -ve = 1

In NRZ-I is same as NRZ-L. But inversion occurs when next bit is one otherwise no inversion.

NRZ-I graph:



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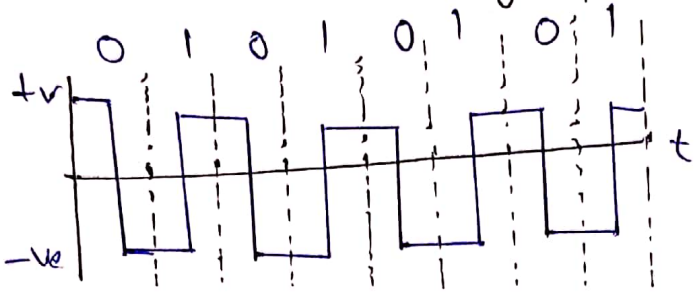
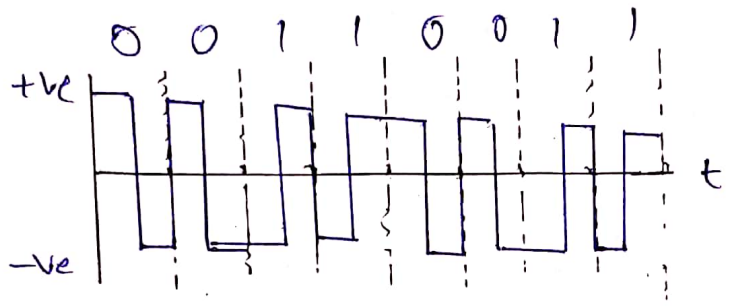
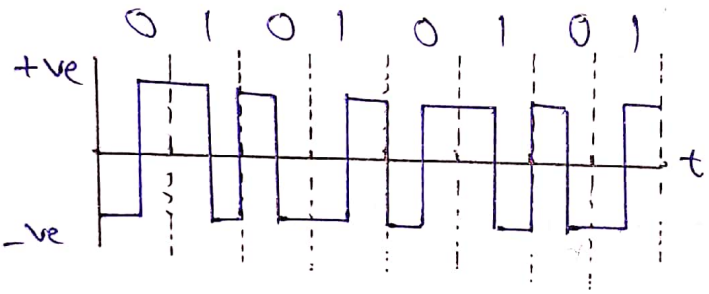
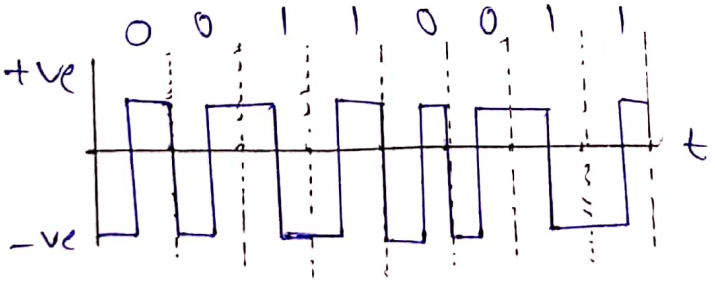
Manchester graph:





Differential Manchester graph:





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Question # 03

(a)

1.

Solution #1

TV channel Bandwidth = B = 6MHz

Using the first har harmonic.

$$\text{Bandwidth} = B = \frac{\text{Data rate}}{2}$$

$$\Rightarrow \text{Data rate} = B \times 2$$

$$= 6M \times 2$$

$$= 12M \text{ bps}$$

Using the first & three harmonics A better result can be achived by using the first and third harmonic with required bandwidth

$$B = 3 \times \frac{\text{data rate}}{2}$$

$$\text{Data rate} = \frac{2 \times B}{3}$$

$$= \frac{2 \times 6}{3}$$

$$= 4M \text{ bps.}$$

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Using the 1st & 5th harmonics

$$\text{Data rate} = \frac{2 \times B}{5}$$

$$= \frac{2 \times 6}{5}$$

$$= 2.4 \text{ Mbps.}$$

Question # 3

part(a)

2.

$$\text{attenuation in decibels} = 10 \log_{10} \frac{B}{A}$$

$$= 10 \log_{10} \left(\frac{90}{100}\right)$$

$$= 10 \log_{10} (0.9)$$

$$= 10(-0.046)$$

$$\text{attenuation (dB)} = -0.46 \text{ dB}$$

Question# 3

part a)

3- The value of attenuation is = -10 dB

Bandwidth = B = attenuation x B analog

$P_s = 5W$

attenuation = -10 dB

$P_d = 10 \log_{10} (P_d/P_s)$

$= 10^{-1} \times 5$

$P_d = 0.5 W$

4- The signal passed through 3 cascaded amplifier with each 4db gain

Total gain = $(P_{db}) = 3 \times 4$ dB

$P_{dB} = 12$ dB

$P_{dB} = 10 \log_{10} P$

$P = 10^{\frac{P_{dB}}{10}}$

$P = 10^{\frac{12}{10}}$

$P = 15.85$

Q3

(5) Bandwidth = 5 Kbps

= 5000 bps ∵ 1Kbps = 1000 bps

time takes to send a frame 100,000 bits out of this devices

$$T = \frac{100,000}{5000}$$

T = 20 Sec

(6) Time Taken by Sunlight to reach earth = 8min

8 mins = 8 x 60 sec

= 480 sec

Converting miles per Second to Kilometer per second

$$= 186000 \text{ m/s} \times \frac{1 \text{ Km}}{0.62}$$

= 300,000 Km/sec

the distance b/w Sun & earth is

= 480 x 300,000

= 144,000,000 Km/s.

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Question # 3

part (b)

Pulse rate $\frac{1}{2ms}$

$= 500$ pulse/sec

Bit rate = Pulse rate $\times \log_2 L$

$= 500 \times \log_2 8$

Bit rate = 1500