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

Course Details

Course Title: Computer Communication Network **Module:** 06

Instructor: Muhammad Waqas. **Total Marks:** 50

Student Details

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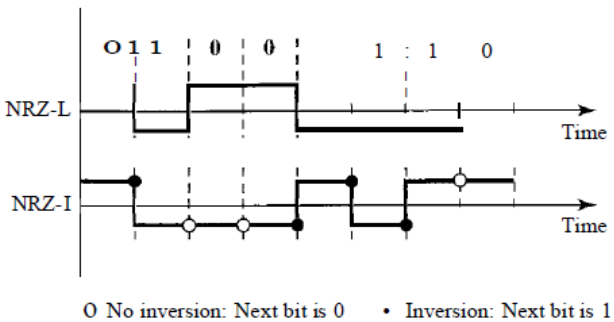
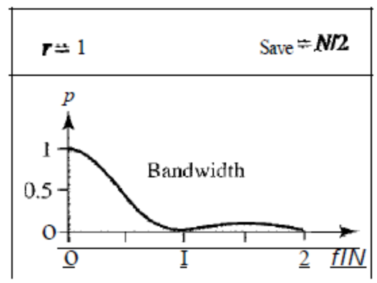
Q1. (a) — Marks 20, CLO 1

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.





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.

Q2. (a) — Marks 16, CLO 1

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

Q3. (a) — Marks 12, CLO 1

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?

(b) — Marks 02, CLO 1

A signal has eight data levels with a pulse duration of 2 ms. Calculate the pulse rate and bit rate.

(1)

Q(1) a; An NRZ-I signal has a data rate of 100 kbps.

Sol:- The data rate is 100 kbps. For each case, we calculate first the value of f/N the use the given figure to find P (energy per Hz). All calculations are approximations.

a. $F/N = 0/100 = 0 \rightarrow P = 1.0$

b. $F/N = 50/100 = 1/2 \rightarrow P = 0.5$

c. $F/N = 100/100 = 1 \rightarrow P = 0.0$

Q1 (2) What is the Nyquist sampling rate for each of the following signals?

Sol:-

(a) A low-pass signal

$B = f_{max} = 200$ KHz

Nyquist ~~Samples per second~~ Rate = 2×200 KHz = 400000 samples per second.

(b) $f_{max} = 100 + 200$ kHz = 300 kHz

Nyquist Sampling Rate = 2×300 KHz

= 600000 samples per second.

Q(1) :-

(3) We have sampled a low-pass Signal with a bandwidth of 200kHz using 1024 levels of Quantization

Sol :- (a) Here, Bandwidth = 200 kHz = 200000Hz

We know that, in a low-pass signal, the minimum frequency = 0

∴ $f_{max} = 0 + 200000 = 200000 Hz$

$f_s = 2 \times 200000 = 400000$ Samples/s

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

$n_b = \log_2 1024 = 10$ bits / sample

$N = 400000 \times 10 = 4 \times 10^6$ bps $= 4$ mbps

(b) we get, the value of $n_b = 10$.

$\therefore SNR_{dB} = 6.02 \times n_b + 1.76 = 61.96$

(c) calculate the PCM ~~da~~ Bandwidth of this signal.

we get, the value of $n_b = 10$.

The minimum bandwidth can be calculated as,

$B_{PCM} = n_b \times B_{analog} = 10 \times 200000 = 2\,MHz$

Q(1)

(4) What is the maximum data rate of a channel with a bandwidth of 200 KHz if we use four levels of digital signaling.

Sol:-

Bandwidth = 200 kHz

Here, bandwidth = 200kHz = 200000Hz

∴ The maximum data rate can be calculated as

$N_{max} = 2 \times B \times n_b = 2 \times 200000 \times \log_2 4$

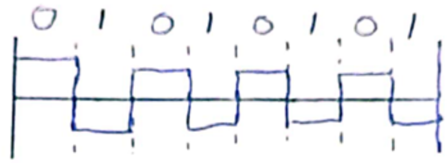
$= 8 \times 10^8$ bps = 800 kbps

Q(2) (a)

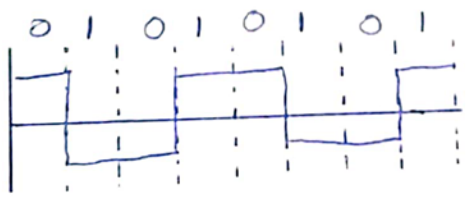
a. 01010101

Sol :- NRZ-L scheme:-

(1)

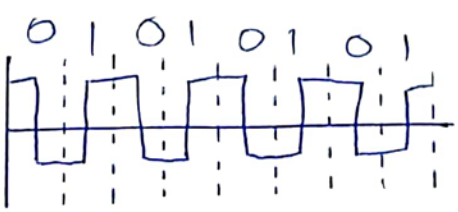


(2) NRZ-I Scheme:-

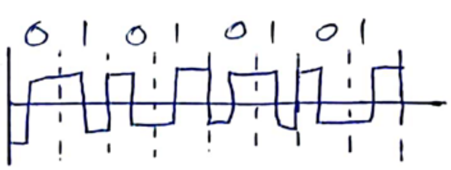


Manchester scheme:-

(1)



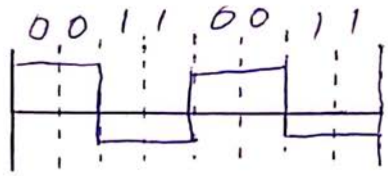
Differential Manchester scheme:-



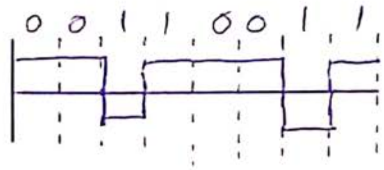
Q(2) (a)

b. 00110011

(1) NRZ-L

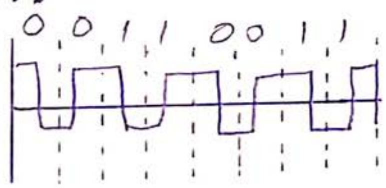


(2) NRZ-I

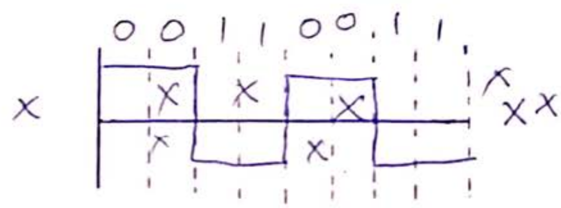


Manchester.

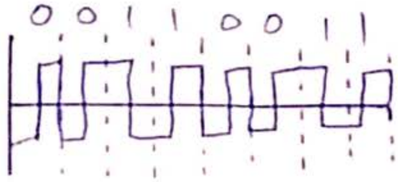
(1)



Differential Manchester.



(1)



Q(3) (a)

(1) $(2*3=6M)$

First harmonic $B = \frac{N}{2}$

$N = 2*B = 2*6\ M = 12M\ bps$

Third harmonic $B = 3*\frac{N}{2}$

$N = \frac{2*B}{3} = \frac{2*6M}{3} = 4M\ bps$

Fifth harmonics $B = 5 \times \frac{N}{2}$

$N = \frac{2 \times B}{5} = \frac{2 \times 6M}{5} = 2.4M\ bps$

Q(3) (a)

(2). Attenuation in decibels $= 10 \log_{10} \frac{P_t}{P_r}$

wher P_t is the transmitted power

and P_r is the received power.

In the given case attenuation in

$dB = 10 \log \frac{100}{90} = 10 (\log(10) - \log(9))$

$= 0.46\, dB \simeq 0.5\, dB$

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(3) Sol:-

$dB = 10 \log_{10} \frac{P2}{P1} \rightarrow -10 = 10 \log_{10} \frac{P2}{5}$

$\log_{10} \frac{P2}{5} = -1 \Rightarrow \frac{P2}{5} = 10^{-1}$

$P2 = 0.5 W$

Q 3 (a)

(4) <u>Sol</u>:- Total gain $= 4dB + 4dB + 4dB$
$= 12 dB$

For power gain of the first stage

$$4dB = 10 \times \log_{10} \frac{P_2}{P_1}$$

$$\frac{P_2}{P_1} = \left(10^{(4/10)}\right) = 2.512$$

for gain of three stages:

$$2.512 \times 2.512 \times 2.512 = 15.85$$

or $12dB = \log_{10} \frac{P_4}{P_1} \rightarrow \frac{P_4}{P_1} = \left(10^{(12/10)}\right)$

$= 15.85$

Q(2) a:-

(5) Sol:- Given, bandwidth 5000 bps,
Frame 100,000 bit
1Kbps = (1000 bps)

$$T \Rightarrow \frac{100000}{5000bps} = 20 \text{ sec}$$

$$\boxed{T = 20s}$$

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(6) Sol 8 mins = 8 × 60s
= 480s.

convert miles per second to km/s

$$= \frac{186000 \text{ miles}}{\text{sec}} \times \frac{1 \text{ km}}{0.62 / \text{miles}}$$

$$= 3,00,000 \text{ Km/s}$$

Therefore the distance b/w sun and earth is = 480×300000

distance = 144,000,000 Kms

Q(3) (b)

Sol:- 8 levels

2 ms

Pulse rate = $\frac{2}{10^{-3}}$ = 2000

Bit rate = $2000 \times \log_2 8$

= 6000
