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

Course Details

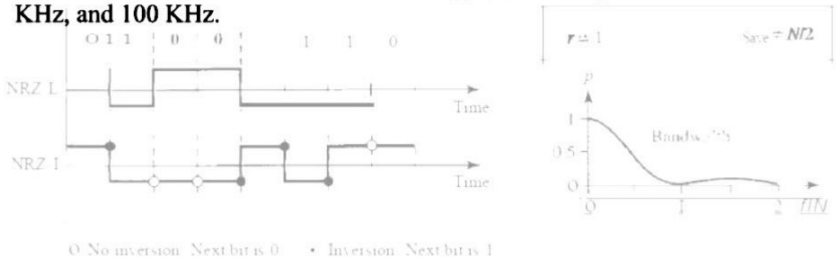
Course Title: Computer Communication Network **Module:** 06

Instructor: _____ **Total Marks:** 50

Student Details

Name: _____ **Student ID:** _____

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. Marks 20



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.

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 Marks 16
   a. 01010101
   b. 00110011

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? Marks 12
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?

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

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Final Paper

Question 1

Part (a)

1): NRZ-I signal has data rate = 100 Kbps

Normalized energy (P) = ?

at $f = 0$ Hz

$P = \frac{f}{N} = \frac{0}{100} = 0$ ∵ 0, so the next bit will 1

$\boxed{P = 1.0}$

at $f =$ 50 KHz

$P = \frac{f}{N} = \frac{50}{100} = \frac{1}{2}$

$\boxed{P = 0.5}$

at $f = 100$ KHz

$P = \frac{f}{N} = \frac{100}{100} = 1$ ∴ 1, so the next bit will 0

$\boxed{P = 0}$

2): Nyquist sampling.

(a): bandwidth = 200 KHz

$F_s = 2 \times F_m$

$= 2 \times 200$

F_s = 400K samples / sec

(b):

$f_{max} = 100 + 200$

$= 300$ KHz

$f_s = 2 \times 300,000$

f_s = 600,000 samples / sec

3):

(a): Bit rate of ~~the~~ digitized signal

In low pass signal minimum frequency = 0

$f_{max} = 0 + 200$

$= 200$ KHz

$f_s = 2 \times 200$ K samples / sec

The number of bits per sample and bit rate.

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

$N = 400\,KHz \times 10$ **$= 4$ Mbs**

b):

The value of $n_b = 10$

we can easily calculate the value of SNR_{dB}

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

$SNR_{dB} = 61.96$

c):

The value of $n_b = 10$

The minimum bandwidth can be calculated as,

$B_{PCM} = n_b \times B_{analog} = 10 \times 200\,KHz$

$B_{PCM} = 2$ MHz

4): Bandwidth = 200 KHz
= 200,000 Hz

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

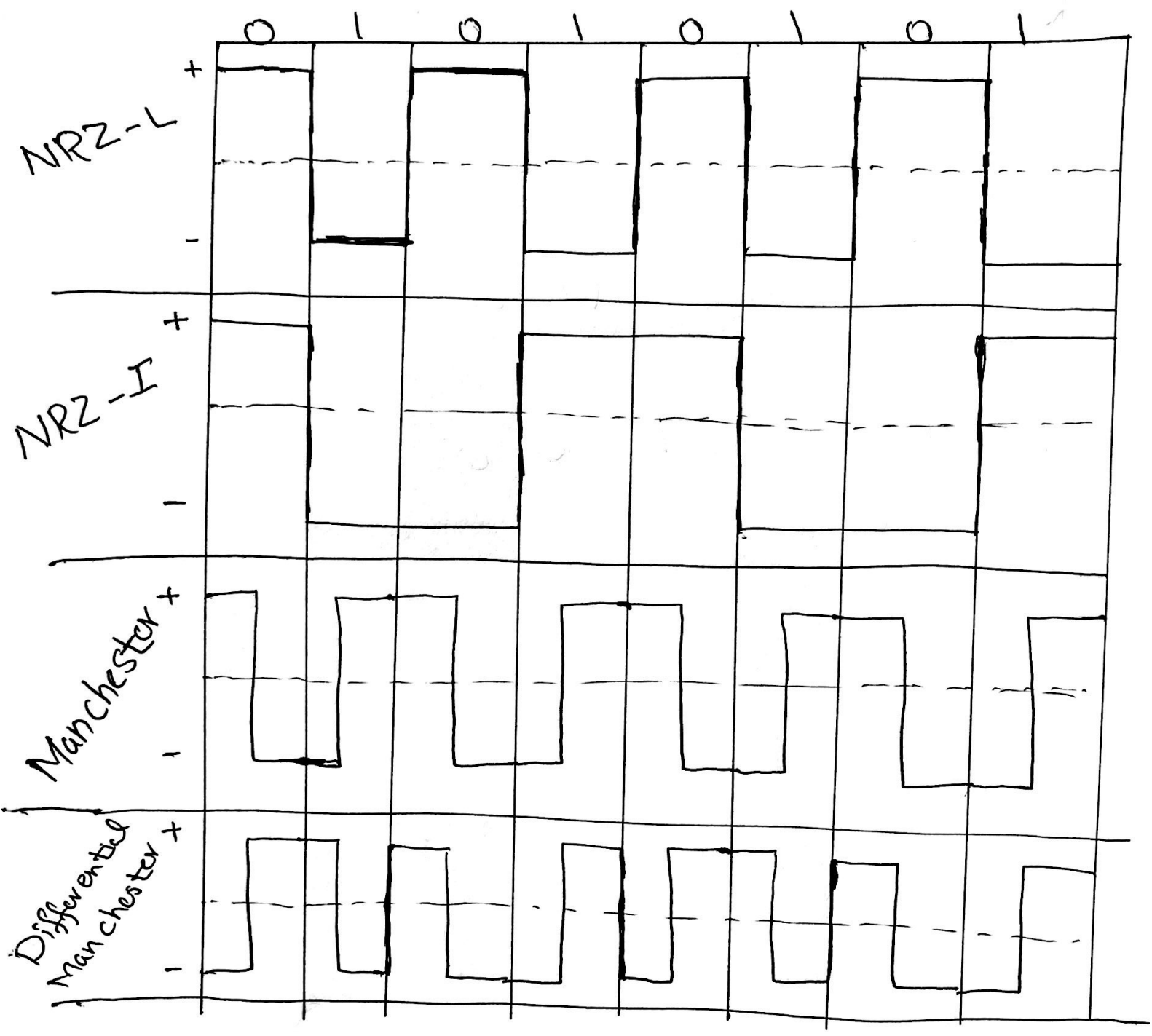
$N_{max} = 800$ Kbps

Question 2

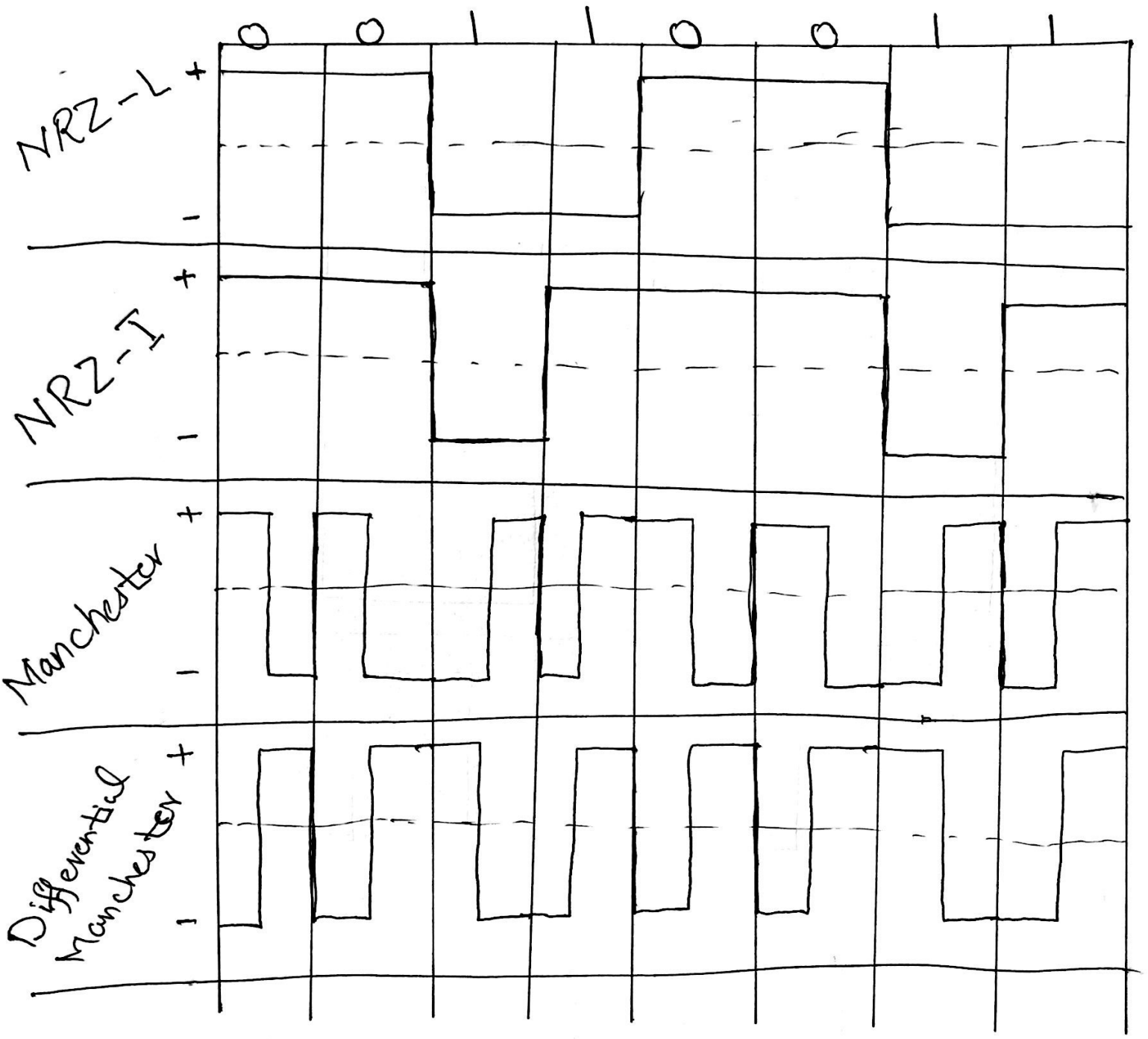
Part (a)

(5)

(a): (01010101)



(b): (0 0 1 1 0 0 1 1)



Question 3

Part (a)

1): Bandwidth = 6 MHz

BW from 0 Hz to 1st hormonic = 6MHz

Bit rate = 2 x 1st hormonic

= 2 x 6

= 12 Mbps

BW from 0 Hz 3rd hormonic = 6MHz

3rd harmonic = 3x 1st harmonic

1st hormonic = 6MHz / 3 = 2MHz

Bit rate = 2 x 1st harmonic

= 2 x 2 = 4 Mbps 3

BW from 0 Hz to 5th harmonic

= 6 MHz

1st harmonic = 6MHz / 5 = 1.2 MHz

Bit rate = 2 x first harmonic

= 2 x 1.2 = 2.4 Mbps

2): Attenuation of a signal (8)

$= 10 \times \log$ (Input power / output power)

Note: Logarithm is to the base 10

Here, Power at point (A) is the input power

Power at point (B) is the output power

Therefore,

Attenuation in dB $= 10 \times \log\left(\frac{100}{90}\right)$

$= 0.457575\,dB$

3):

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

$$\Rightarrow 10 = 10 \log_{10} \frac{P_2}{5}$$

$$\log_{10} \frac{P_2}{5} = -1$$

$$\frac{P_2}{5} = 10^{-1}$$

$$P_2 = 0.5\,W$$

4): An amplifier is used to improve the power of a signal moving from one point to another.

Total gain = 4dB + 4dB + 4dB + 4dB

$$= 12\ dB$$

For power gain of the 1st stage,

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

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

for power gain of three stages

$$12dB = \log_{10} \frac{P_4}{P_1}$$

$$\frac{P_4}{P_1} = \left(10\left(\frac{12}{10}\right)\right) = 15.85$$

5): Given:

Bandwidth = 5000 bps

Frame = 100,000 bit

$$= \frac{100000\ b}{5000\ bps} = \boxed{20\ sec}$$

6):

$z = c \times t$

z = distance to the object

t = time to reach

c = speed of light which is 300,000 km/sec

Time takes by light to reach us = 8 minutes

$z = 8 \times 300,000$

speed of light is in sec, so we will convert minuts to seconds

1 minute = 60 seconds

8 minutes = 8×60

8 minutes = 480 seconds

$z = 480 \times 300,000$

$\boxed{z = 144000000\ km}$

Part (b)

Data levels of signal = 8

Pulse duration = 2 ms

Pulse rate = ?

bit rate = ?

$$\text{Pulse rate} = \frac{1}{2 \times 10^{-3}}$$

$$= 500 \text{ pulses / sec}$$

$$\text{Bit rate} = \text{Pulse rate} \times \log_2 L$$

$$= 500 \times \log_2 8$$

$$= 1500 \text{ bps}$$