AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

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Assignment Title:	**Mid Term Assignment**		
Assignment No:	**01**	**Date of Submission:**	**MARCH 08, 2024**
Course Title:	**DATA COMMUNICATION**		
Course Code:	**COE3201**	**Section:**	**E**
Semester:	**SPRING 2023-24**	**Course Teacher:**	**NOWSHIN ALAM**

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	Total Marks	

American International University - Bangladesh
Faculty of Engineering
COE 3201: Data Communication
Assignment #1
Spring 2023-24
Instructor: Nowshin Alam

Due Date: March 08, 2024.

INSTRUCTIONS:

Consider, your ID = AB-CDEFG-H.

Note: Copied/identical submissions will be graded as 0 for all parties concerned.

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1. A signal is carrying data in which 16 data elements are encoded as **(A+E)** signal elements. What is the value of r? If the bit rate is **(C+H)** kbps, what is the average value of the baud rate if c is assumed to vary between 0 and 1? [5]

2. A communication channel has a signal power S = **(A+D)** x 5 milliwatts with an average noise power, N = **H** milliwatts. The channel capacity is **(50+B)** Mbps. Calculate the bandwidth of channel's transmission medium, and then find the signal levels needed to achieve a Nyquist data rate equal to 70% of the channel capacity. [5]

3. For the following line coding schemes, draw the signal for **ABGH** where each digit is expressed with a bit pattern of 4 bits. For example, 1234 would be a stream of 0001 0010 00110100. [10]

   i) NRZ-I

   ii) Manchester

   iii) Differential Manchester

   iv) 8B6T

   v) Pseudoternary

4. An ethernet cable performs properly above an SNR_{dB} above 27. What is the minimum number of bits per sample? What is the data rate through the cable if digital signal to be sent has been sampled at that number of bits per sample and the sampling frequency is **(B+G)** kHz? [5]

5. A signal has passed through three cascaded amplifiers, first one with a **(4+B)** dB gain, second one with a **(5+H)** dB gain and the third one with a **(2+D)** dB gain. What is the total gain in decibels and absolute number? If the output power is 20 mW, how much was the original input power? How much would the output power be if the input power is changed to 55mW? [5]

Solution: 1

My ID,

A	B	-	C	D	E	F	G	-	H
2	2	-	4	6	0	1	3	-	1

Data Elements = 16

Signal Elements = A+E = 2+0 = 2

Bit rate, N = C+H = 4+1 = 5 Kbps = 5000 bps

we know,

$$r = \frac{16}{2} = 8$$

$$S = C \times N \times \frac{1}{r} = \frac{1}{2} \times 5000 \times \frac{1}{8} = 312.5 \approx 313 \text{ bauds}$$

Solution: 2

My ID,

A	B	-	C	D	E	F	G	-	H
2	2	-	4	6	0	1	3	-	1

Bandwith,

$$BW = \frac{C}{\log_2(SNR+1)}$$

$$= \frac{52}{\log_2(40+1)}$$

$$= 9.705 \text{ Mbps}$$

Signal power, S = (A D) X 5 mW

= (2+6) X 5 = 40 mW

Noise power, N = H mW

= 1 mW

Capacity, C = (50 + B) Mbps

= 50 + 2

= 52 Mbps

we know,

$$\therefore SNR = \frac{S}{N}$$

$$= \frac{40}{1} = 40$$

According the question,

$$BR = 0.7 \times C$$
$$= 0.7 \times 52$$
$$= 36.4 \text{ Mbps}$$

We know that,

$$BR = 2 \times BW \times \log_2^L$$

$$\log_2^L = \frac{36.4}{2 \times 9.705}$$

$$L = 3.66 \approx 4$$

Solution: 3

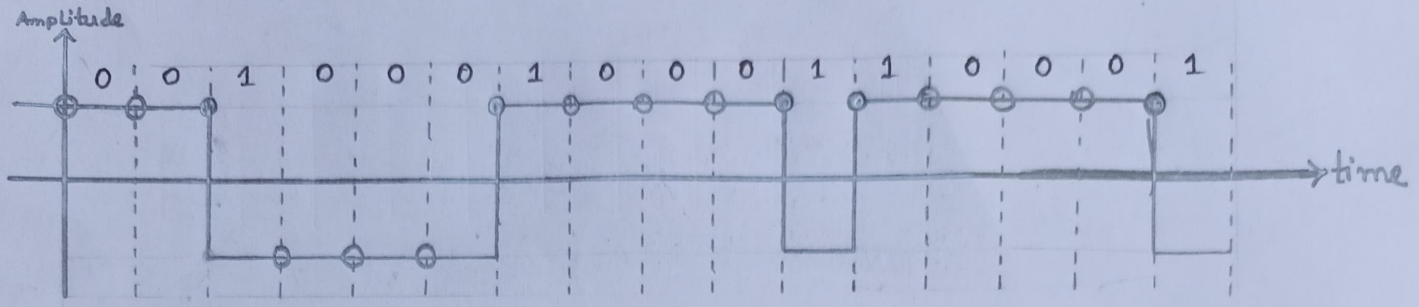
My ID

A	B	-	C	D	E	F	G	-	H
2	2	-	4	6	0	1	3	-	1

A	B	G	H
2	2	3	1
0010	0010	0011	0001

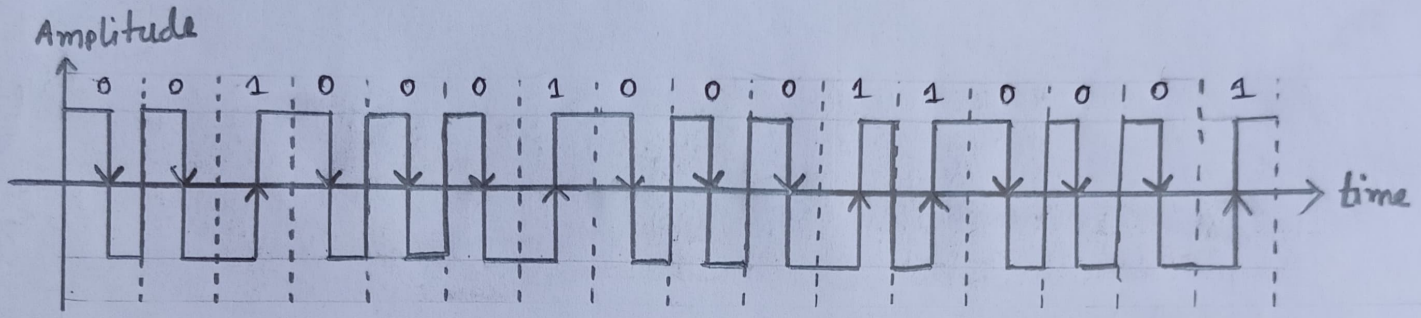
(i) NRZ-I

Let, 0: No inversion [initially +ve]
1: Inversion



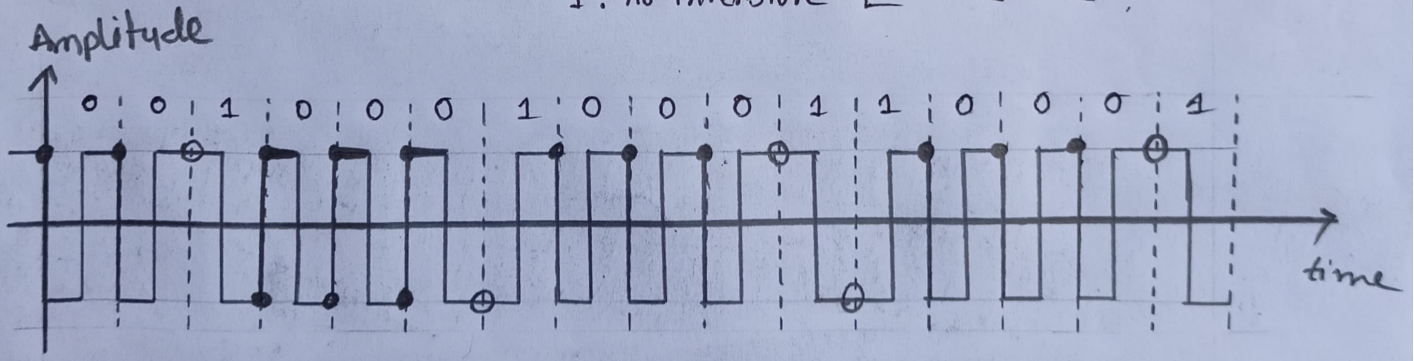
(ii) Manchester

0: ⊼ 1: ⊻

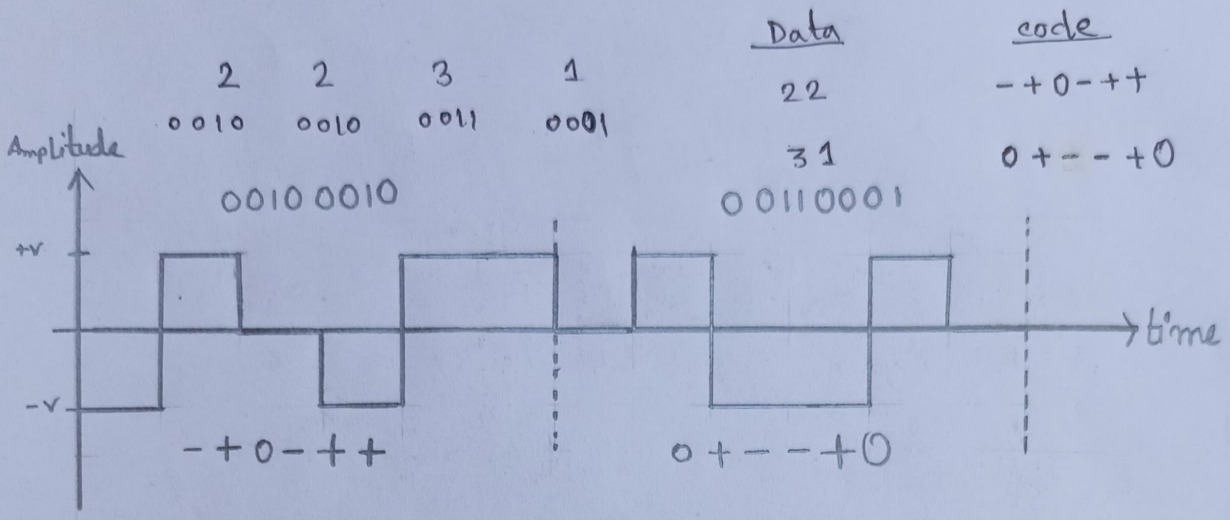


(iii) Differential Manchester

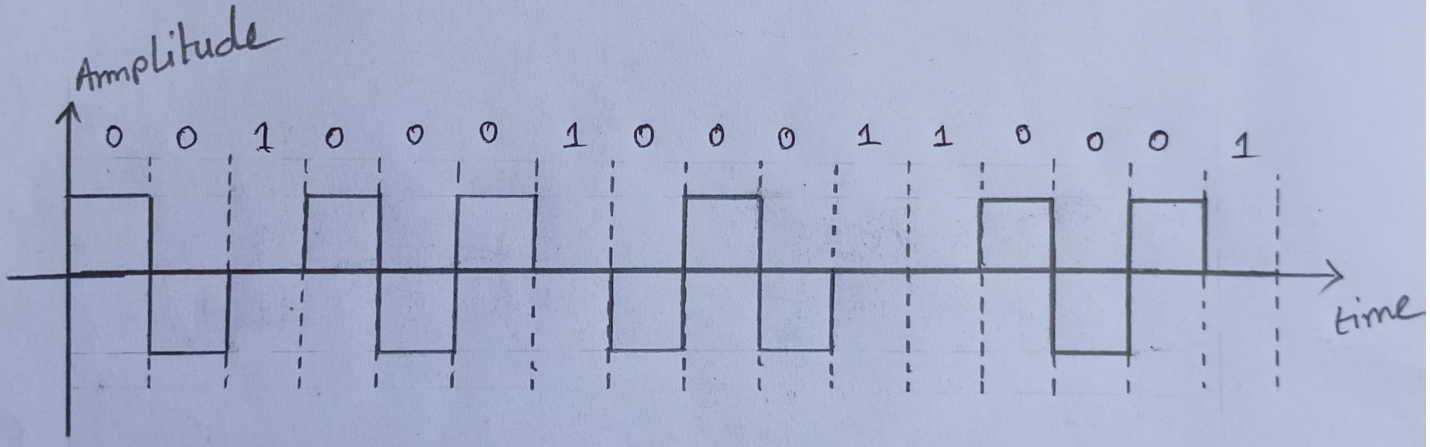
Let, 0: inversion
1: no inversion [initially +ve]



(iv) 8B6T



(v) Pseudoternary



Solution: 4

My ID,

A	B	-	C	D	E	F	Gr	-	H
2	2	-	4	6	0	1	3	-	1

$SNR_{dB} = 27$

we know that,

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

$$\therefore n_b = \frac{SNR_{dB} - 1.76 dB}{6.02}$$

$$n_b = \frac{27 - 1.76}{6.02}$$

$$n_b = 4.19 \approx 5$$

$\therefore$ bit per sample $= 5$

$f_s = (B+G)\ KHz$

$= 2 + 3$

$= 5\ kHz$

Data Rate,

$$BR = f_s \times n_b$$

$$= 5 \times 5$$

$$= 25\ kbps$$

Solution: 5

My ID,

A	B	-	C	D	E	F	G	-	H
2	2	-	4	6	0	1	3	-	1

Total gain in decibles,

$= 6+6+8 = 20\,dB$

Absolute gain

$= 10^{\frac{20}{10}}$

$= 100$

first one = (4+B) dB gain
= 4+2 = 6 dB gain

second one = (5+H) dB gain
= 5+1 = 6 dB gain

Third one = (2+D) dB gain
= 2+6 = 8 dB gain

If output power is 20 mW,

$$\text{input power} = \frac{\text{output power}}{\text{gain}} = \frac{20}{100} = 0.2\,mW$$

If input power is 55 mW,

output power = input power × gain

$= 55 \times 100$

$= 5500\ mW$