Solve Mid 1

1. Five components of data communication system? [1]

given below:

1. Message
2. Sender
3. Receiver
4. Transmission Medium
5. Protocol

2. Given that,

time = 16 ns = 16×10^{-9} sec

$\therefore$ ~~bit rate = ?~~ Number of bit sent = 8

Note: Bit rate = The bit rate is the number of bits sent in 1s. noted as bits per second (bps)

$$\text{Bit rate} = \frac{8}{16 \times 10^{-9}} = \cancel{62.5\text{ Mbps}}\ 500\text{Mbps}.$$

3. Given that,

~~time = 4ms = 4×10^{-3} sec~~

$\therefore$ frequency = ?

$\cancel{f = \frac{1}{4\times10^{-3}} = 250\text{ Hz}}$.

Note: Frequency = It refers to the number of period in 1s.

~~Fr~~ Period: It refers to the amount of time, in seconds, a signal needs to complete 1 cycle

Time for 1 cycle, $T = \frac{4}{8} = 0.5$ms

$$\therefore \text{frequency} = \frac{1}{0.5\times10^{-3}} = 2000\text{Hz} = 2\text{kHz}.$$

9.

[Marks-3]

In a Data communication course, it's important ~~of~~ to understand terms like Baseline Wandering, DC components and self synchronization because the directly impact how signals are transmitted and interpreted. in digital communication system.

Here's a brief explanations of those terms:

Baseline Wandering:

Base line wandering refers to the shifting of the average voltage level (baseline) of a signal over time.

If the receiver uses the avg. voltage to decide between a 0 and 1, and the baseline shifts, bit errors can occur. This affects accurate decoding of signals.

Example: In NRZ (Non-Return-to-zero) encoding, a long stream of 1s or 0s can cause the baseline to drift, making it hard to find the next bits.

DC Components:

The DC components is the zero-frequency part of a signal basically the average voltage level. It is important in line coding schemes to ensure compatibility with physical transmission channels.

Example: Signals with no transitions contain a strong DC components (such as, NRZ encoding of long sequences).

self-synchronization:

Self-synchronization means the signal is encoded in such way that the receiver can maintain timing with the sender even without a separate clock signal.

~~Sy~~ Self-synchronization ensures the receiver stays alligned with the sender's timing, reducing bit errors during data transmission.

Example: In ~~en~~ line encoding like Manchester or Bipolar frequent signal transitions help the receiver synchronize with the sender's clock, ensuring accurate bit detection.

Q5. [Marks 6]

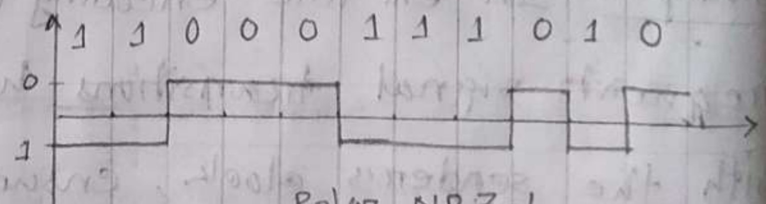
A line encoding scheme is a specific method ~~or~~ ~~code~~ used to represent digital data (0s and 1s) as a digital signal for transmission over a physical medium.

Data stream: 11000111010

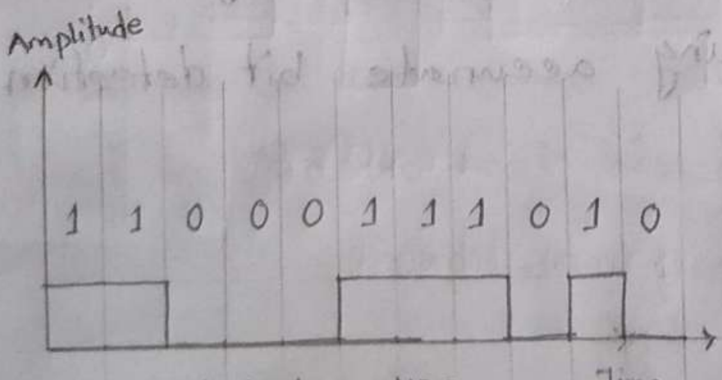
Unipolar NRZ: All signal levels are on one side of ~~there~~ the time axis. The signal level doesn't return to zero during ~~tran~~ transmission so its called Non Return to Zero.

Polar NRZ-L: The voltage or signal levels are on both side of the time axis. Voltage +V = 1 and voltage -V = 0.

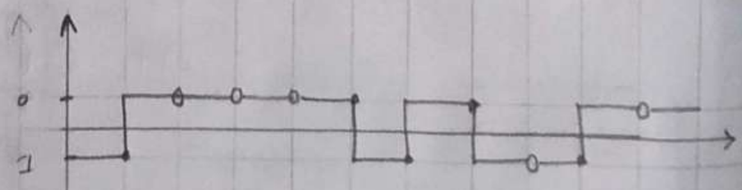
Polar NRZ-I: Inversion (NRI-I). "1" symbol inverts the polarity but "0" doesn't.



Polar NRZ-L



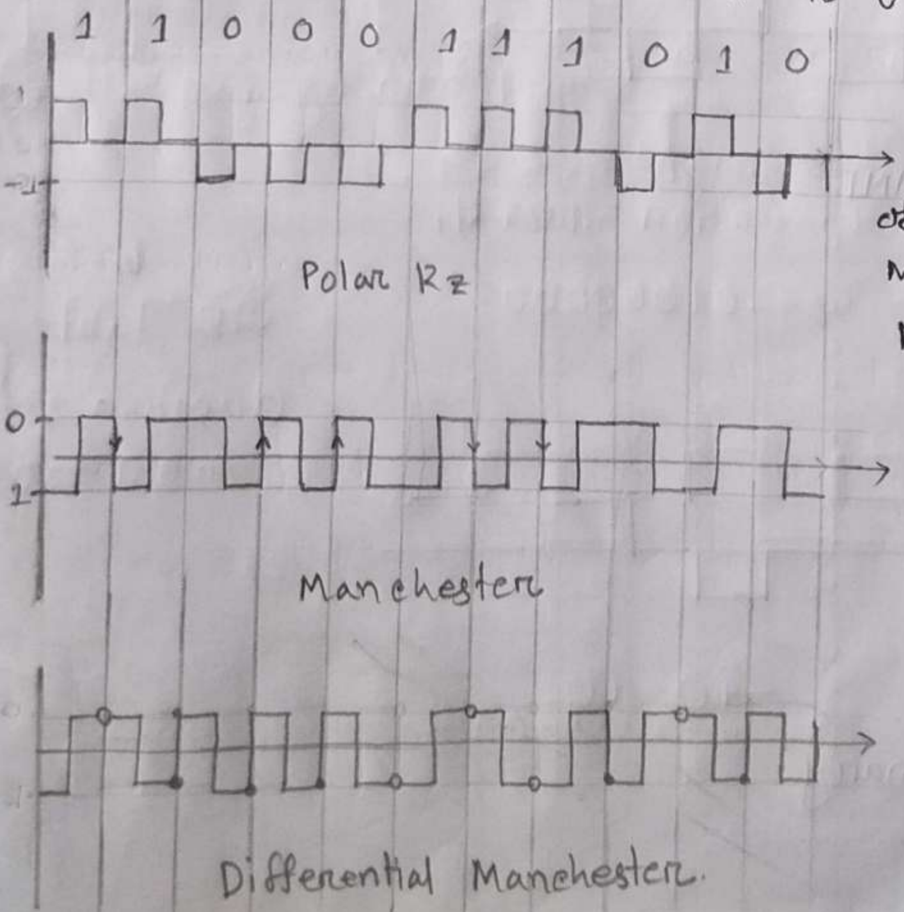
Unipolar NRZ.



Polar NRZ-I.

Polar RZ: Return to zero and uses three voltages +, 0, − or 1, 0, −1.
Always return to zero level, no matter where the signal ~~lev~~ level ~~starts~~ on end. Either high to zero or zero to high. two signals per one symbol.

Polar Biphase (Manchester and differential Manchester):
Manchester: It is the combine ~~form~~ form of NRZ-L and RZ schemes use only two voltage level 1 ~~oo~~ and 0. 0 is ⅂ and 1 is ⅃‾.
Diff. Manchester: It is the combine form of NRZ-I and RZ schemes. Use only two voltage level 1 and 0. But it is ~~inver~~ invertated ~~for~~ when next bit is 0. otherwise no inversion.



The minimum bandwidth of Manchester and diff. Manchester is 2 times of NRZ.

signal এ দেওয়া arrow চিহ্ন দেওয়ার দরকার নেই।

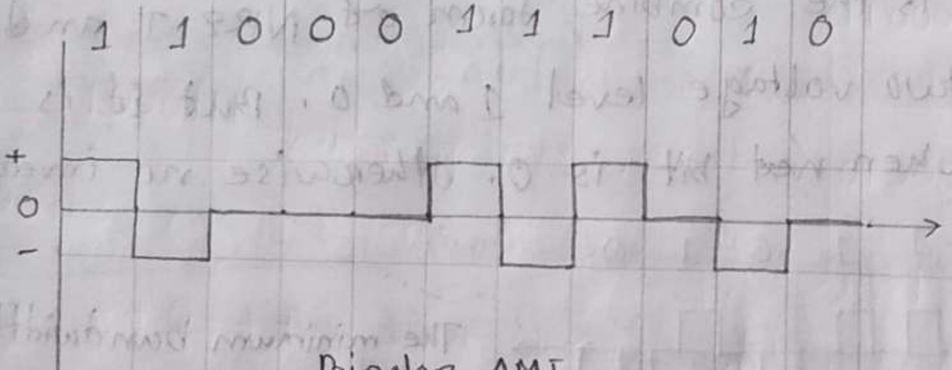
Diff Manchester
if 0 = ⊔⅃‾ start then ⊓⅂
1 = ⅃‾ or ⅂

Bipolar AMI: (Alternate Mark Inversion)

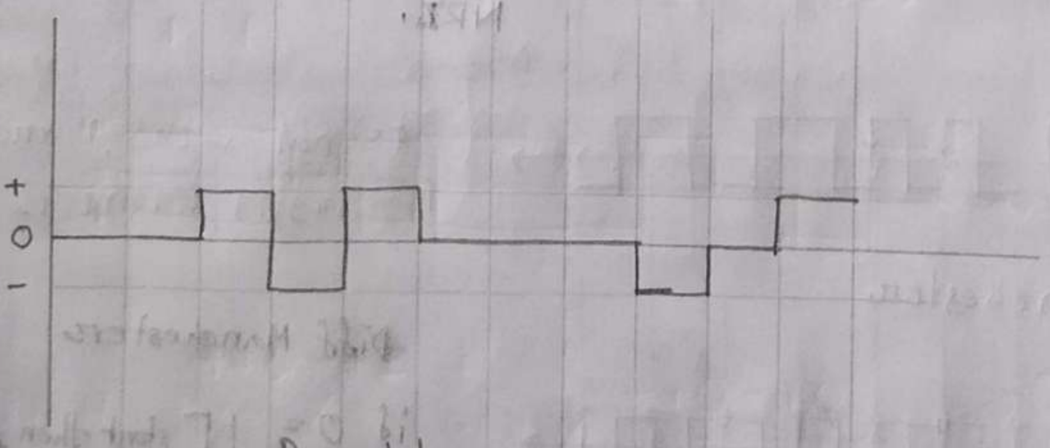
Code use 3 voltage level +, 0, - or +1, 0, -1. But it don't return to zero as like Polar RZ.

Symbol "0" when voltage level at 0, and the others symbol like 1 alternates between + & -.

~~Pos~~ Pseudoternary: It is the ~~opposite~~ reverse of AMI. In this 0 voltage represented by symbol "1" and "0" symbol alternates between +V and -V.



Bipolar AMI



Pseudoternary

Multilevel 2B1Q:

Encodes 2bit into 1 signal level. Uses 4 signal levels. (Quaternary, Q): ~~+3, +2, 0, -1, -3~~ +3, +1, -1, -3. volts

for 2B1Q: mBnL

$m = 2$, $n = 1$, $L = Q = 4$

$\therefore$ total number of symbols $= 2^m = 2^2 = 4$

$= L^n = 4^1 = 4$

$\therefore 2^m = L^n$, so Exact mapping possible.

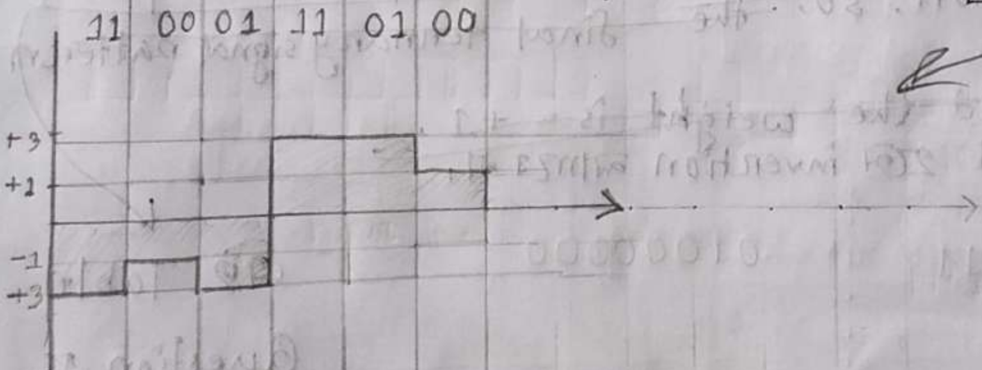
	Previous level Positive	Previous level negative
Next bit	Next level	Next level
00	+1	−1
01	+3	−3
10	−1	+1
11	−3	+3

given: Data stream as 11 bits, so pad a symbol '0' at the end of the stream.

Data stream:

$\underbrace{110001110100}$

এভাবে ধরিব



Data stream:

$\underbrace{011000111010}$

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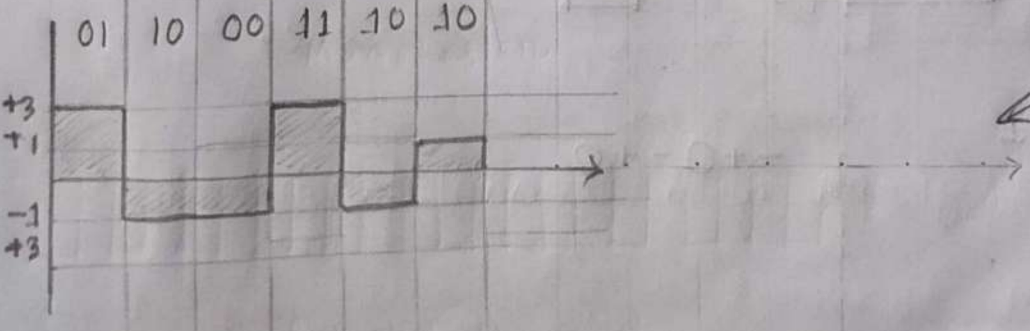


Multilevel 8B6T:

Used in 100 Base - 4T Ethernet; 8 binary bits - encoded into 6 ternary signal level. Ternary signal used 3 levels = +1, 0, -1.

Total data pattern = $2^8 = 256$, signal patterns $3^6 = 729$, but used only 478. So, 729 - 478 = 222 bits are remaining.

222 bits are used in, DC balance, Error detection, Synchronization

Given,

Data Stream = $\underbrace{11000111}_{8\text{ bit}}\underbrace{010}_{?}$, So we pad 5 extra '0',

= $\underbrace{11000111}_{8\text{ bit}}\underbrace{01000000}_{8\text{ bit}}$

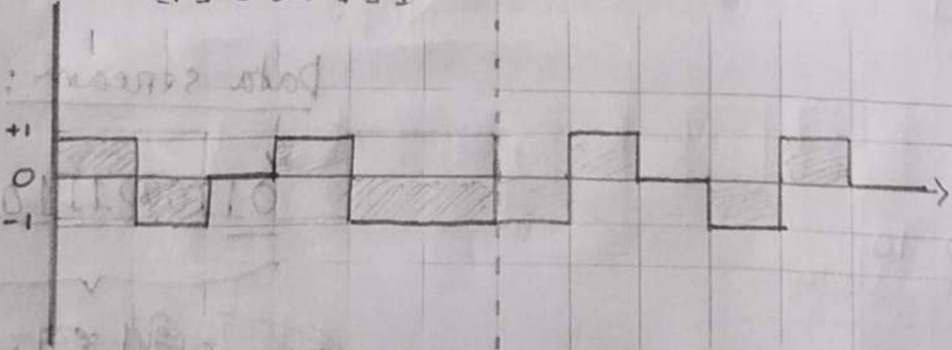
8-bit binary	Ternary signal pattern (6 symbol)	Weight
11000111	+ - 0 + - -	-1
01000000	- + 0 - + 0	0

~~As, 11000111 has negetive weight~~ so ~~its~~ need inversion, so, ~~the final ternary signal pattern is = - + 0 - + +, and the weight is = +1.~~

Weight = 0 and ±1 হলে inversion লাগবে না।

এই Table Question এ দেওয়া থাকবে

11000111   01000000

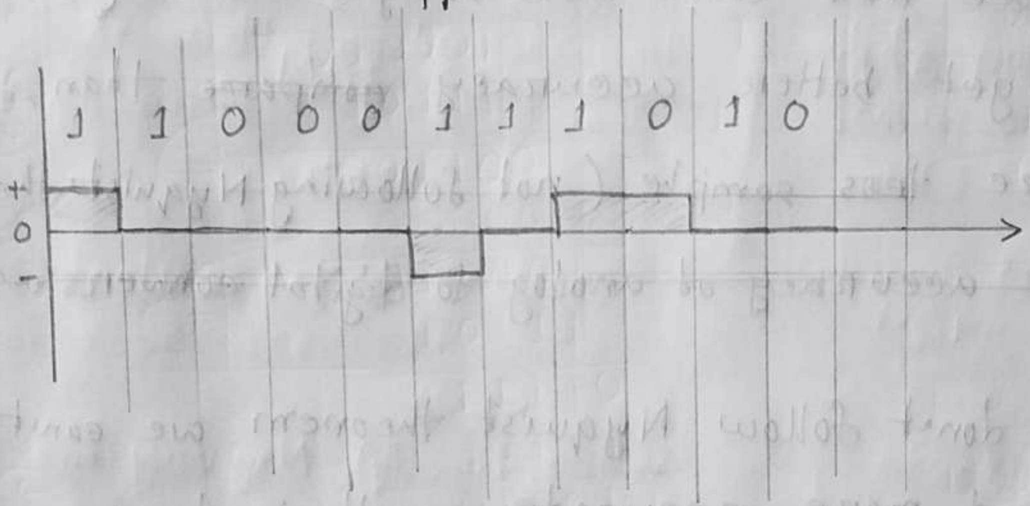


+ - 0 + - -   - + 0 - + 0

Multiline Transmission: MLT-3

If the next bit is 0, there is no transition
If the " " " 1, and current level is not 0 volt then the next level is 0 volt.

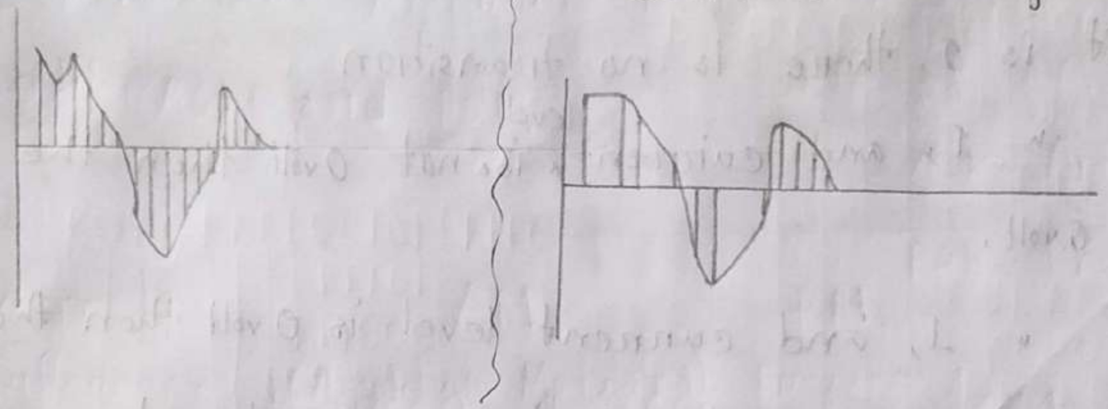
If the " " " 1, and current level is 0 volt then the next level is the opposite of the last nonzero level.



5. [Mark 1.5]

Nyquist theorem says that, the accuracy of analog to digital conversion depends on number of sample taken. So, if we don't follow Nyquist theorem and take less sample we don't get better accuracy in analog to digital conversion.
lets understand with an example:

With ~~M~~ More sample: with less sample.



We clearly see that with more sample (following Nyquist theorem) we get better accuracy ~~compare~~ than, when we take less sample (not following Nyquist theorem

~~the graph of accuracy of analog to digital conversion is~~

So, ~~we~~ if we don't follow Nyquist theorem we can't get better and more accurate result ~~in~~ during sampling an analog signal.

~~Ans~~

[[Marks 3.5]]

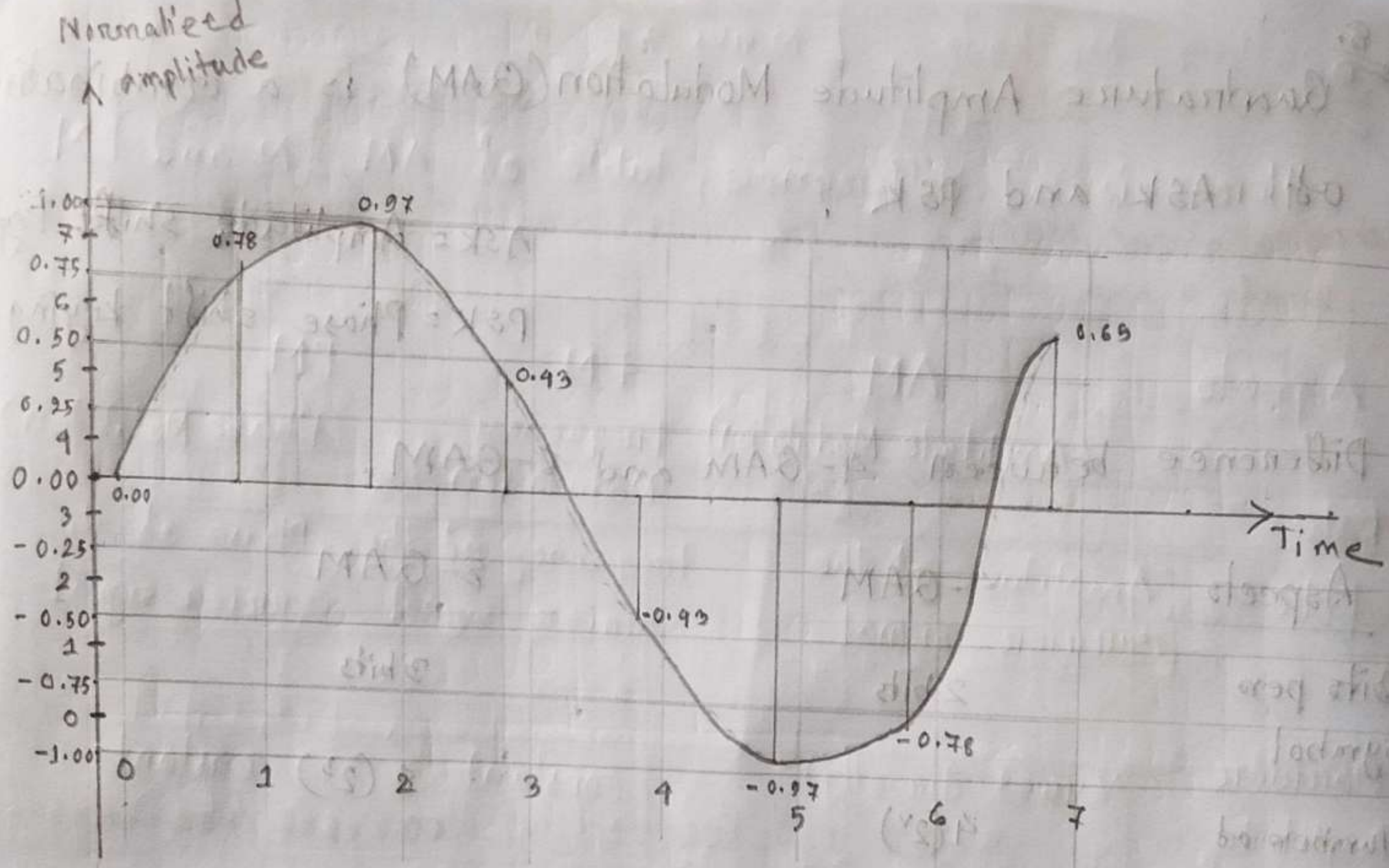
7.

Here, $V_{max} = 1$ and $V_{min} = -1$, $L = 8$

$$\therefore \Delta = \frac{V_{max} - V_{min}}{L} = \frac{1-(-1)}{8} = \frac{1+1}{8} = 0.25$$

Now draw the graph with Quantitilization code

and using PCM ~~to~~ we ~~f~~ will find out the digital ~~signal~~ data



Quantilization code 4 7 7 5 2 0 0 6

Encoded words 100 111 111 101 010 000 000 110

∴ The digital data is = 100 111 111 101 010 000 000 110 ;

8.

Quadrature Amplitude Modulation (QAM) is a combination of ASK and PSK.

ASK = Amplitude shift keying
PSK = Phase shift keying.

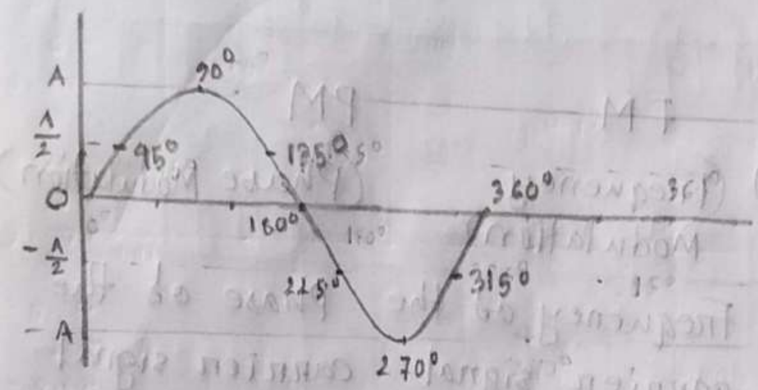
Difference between 4-QAM and 8-QAM.

Aspects	4-QAM	8-QAM
Bits per symbol	2 bits	3 bits
Number of symbol	$4 (2^2)$	$8 (2^3)$
Data rate	Lower	Higher
Complexity	simple	complex
Noise immunity	~~Higher Lower~~ Higher	~~Lower Higher~~ Lower
Constellation points	4 points, equal amplitude and phase difference	8 points, mix of different amplitude and phases.

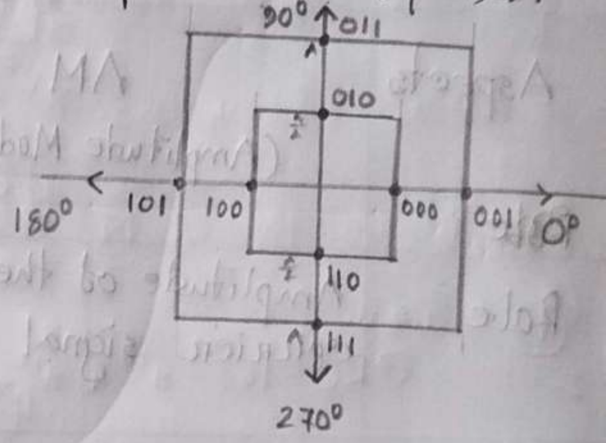
Draw 8-QAM signal using this ~~dibit~~ stream =

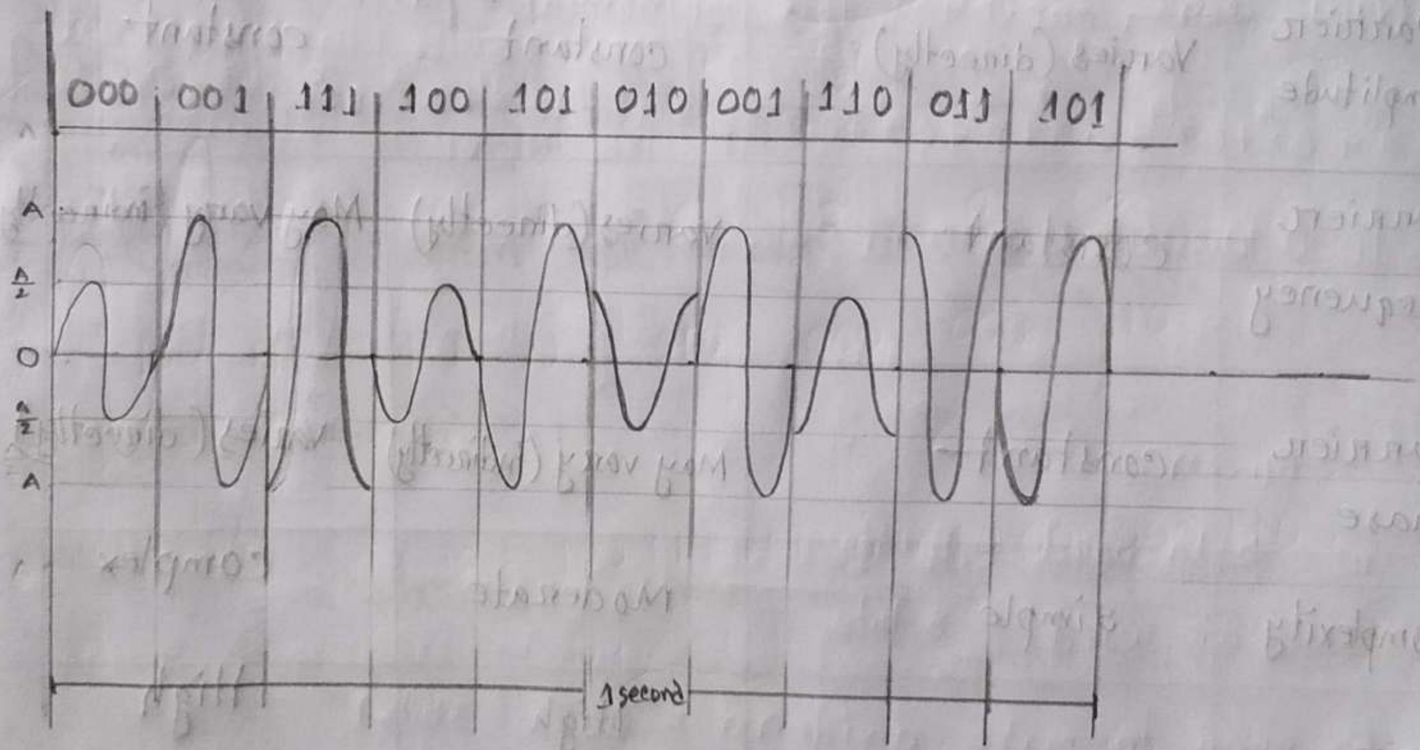
= 000 001 111 100 101 010 001 110 011 101

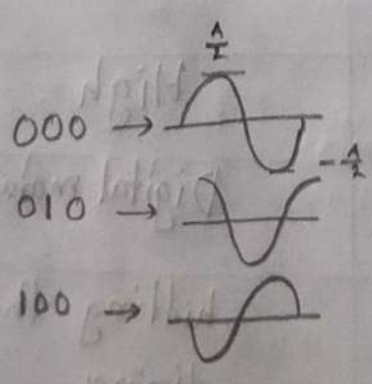
Now, ~~phase~~ graph of phase:

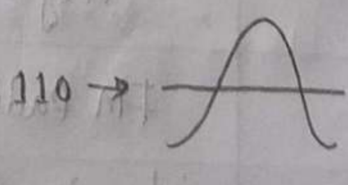


so, the 8-QAM constellation is 2 amplitude and 4 phases.









বাকি

001, 011, 101, 111 এর জন্য same graph হয় হবে শুধু ম্যাক্সি A/2 এর জায়গায় A হবে respectively

9. [Marks 3]

Here is a difference table of AM, FM and PM.

Aspects	AM (Amplitude Modulation)	FM (Frequency Modulation)	PM (Phase Modulation)
Role	Amplitude of the carrier signal	Frequency of the carrier signal	Phase of the carrier signal
Carrier Amplitude	Varies (directly)	constant	constant
Carrier Frequency	constant	Varies (directly)	May vary (indirectly)
Carrier Phase	constant	May vary (indirectly)	Varies (directly)
Complexity	simple	Moderate	complex
Noise immunity	Low	High	High
Bandwidth	Low	High	High
Application	AM Radio	FM Radio	Digital modulation
Example	changing the volume of a sound wave	changing the pitch	shifting the timing.