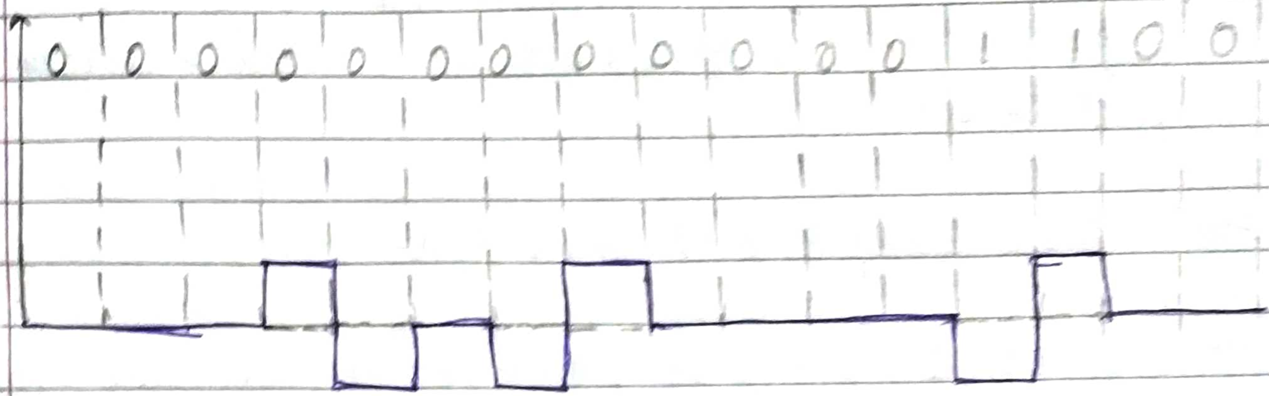
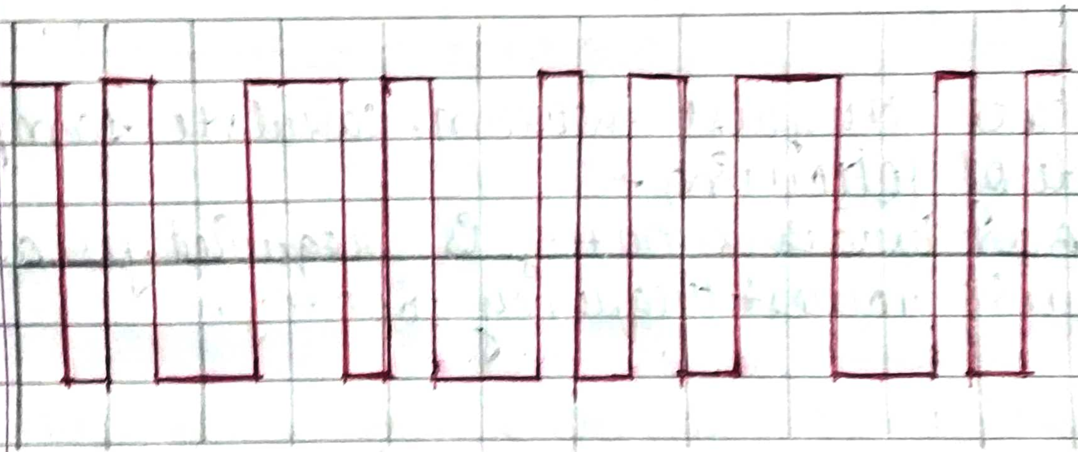
Computer Networks

Q1 a) For the bit stream D000000000001100, encode using B8ZS. Assume polarity of previous bit is 1.



b) In the below figure, the Differential Manchester encoding of data stream is given. What is data stream?



101101001110 → Data stream

1) What are the weaknesses of NRZ-L & NRZ-I encoding schemes, how they can be removed by RZ encoding scheme.

-> ~~Sender's & Receiver's clocks are not synchron~~

-> The problem occurs when sender's & receiver's clock are not synchronized. The receiver does not know when one bit is ended & when next bit is starting

-> DC component problem.

-> Sudden change of polarity causes problem.

Solution for this is RZ scheme which uses 3 values : positive, negative & zero. In RZ signal changes not between bits but during the bit.

Q2 State Nyquist theorem. Calculate sampling rate of following -

(i) Bandwidth 6000 Hz is required for a signal having lowest frequency 1000 Hz.

Nyquist Theorem states that "a signal can be exactly reproduced if it is sampled at the rate of fs, which is greater than twice the maximum frequency."

Bandwidth = Highest frequency - lowest frequency

6000 Hz = Highest - 1000 Hz

fs = 7000 Hz (fs)

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thus, sampling rate = $2f_s$
$= 2 \times 7000$
$= 14000 Hz.$

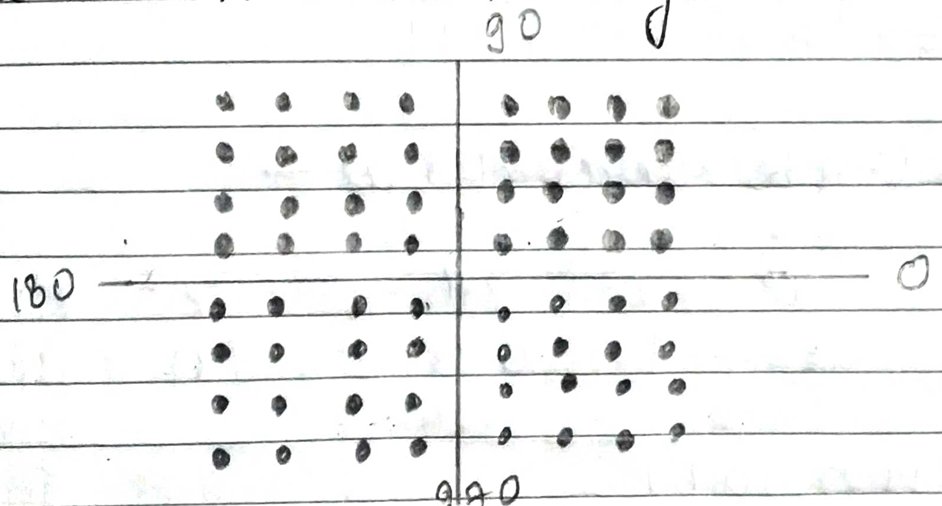
(iii) Bit Rate of signal is B bits per second & N bits are needed to represent each sample.

Bit rate = sampling rate x No of bits per signal

Sampling rate = $\frac{\text{Bit Rate}}{\text{No of bits per signal}}$

$= \frac{B}{N}.$

Q3 See the constellation diagram below:



Does this constellation represent ASK, PSK or QAM. Consider bit rate is B bits per seconds. How many bauds per second be send with this constellation?

This constellation represents QAM (Quadrature Amplitude Modulation) because in this, both amplitude & phase is modified.
It is 64 bit QAM => 6 bits in each signal will be transmitted.

i.e $2^6 = 64$.

Bit Rate = B.

Baud Rate = $\frac{\text{bit rate}}{\text{no of bits per baud}}$

$$\boxed{\text{Baud Rate} = \frac{B}{6}}$$

Q4 suppose we want to transmit 8 bit message $M = x^7 + x^6 + x^5 + x + 1$ & protect it from errors using generator polynomial $p(x) = x^5 + x^4 + x + 1$

(i) Encode the message M using generator polynomials give code word.

$M(x) = x^7 + x^6 + x^5 + x + 1$

M(x) can be represented as —

x^7	x^6	x^5	x^4	x^3	x^2	x^1	x^0
1	1	1	0	0	0	1	1

= 11100011

Generator polynomial $P(x) = x^5 + x^4 + x + 1$

x^5	x^4	x^3	x^2	x^1	x^0
1	1	0	0	1	1

= 110011

Divide message by generator polynomial.

after adding 00000 (5 zeros because degree of P(X) is 5).

```
110011 ) 1 1 1 0 0 0 1 1 0 0 0 0 0 ( 1 0 1 1 0 1 1
         1 1 0 0 1 1
         0 0 1 0 1 1 1 1
             1 1 0 0 1 1
             0 1 1 1 1 0 0 0
               1 1 0 0 1 1
               0 0 1 0 1 1 0 0
                   1 1 0 0 1 1
                   0 1 1 1 1 1 0
                     1 0 0 0 1 1
                     0 0 1 1 0 1 0
```

$T(x)$ = Transmitted Polynomial

$= 1110001101010$

$= \underbrace{x^{12} + x^{11} + x^{10} + x^6 + x^5}_{x^5 M(x)} + \underbrace{x^4 + x^3 + x}_{+ R(x)}$

(ii) Suppose channel introduces error pattern $E(x) = x^9 + x^6 + x^3$ during transmission. What is received at receiver? Can error be detectable at receiver?

$E(x) = x^9 + x^6 + x^3$

$Tr = E(X) \oplus T$

Tr = frame received

T = frame sent.

$Tr = (x^9 + x^6 + x^3) \oplus (x^{12} + x^{11} + x^{10} + x^6 + x^5 + x^4 + x^3 + x)$

Tr = 0001001001000.
1110001111010
1111000110010

$Tr = x^{12} + x^{11} + x^{10} + x^9 + x^5 + x^4 + x$

Q6 The sender window for system uses 4 bits n-ARQ as given

0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 0 | 1 | 2 | 3 | 4 | 5

(i) show the window after the sender has sent packet 0 to 12 & has received ACK 7.

0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 0 | 1 | 2 | 3 | 4 | 5 | 6

(ii) sent packet 0 to 14 & has received NAK6.

0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 0 | 1 | 2 | 3 | 4 | 5

(iii) 0 to 14 no ack has received & timeout expired

0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 0 | 1 | 2 | 3 | 4 | 5 | 6

(iv) sent ACK6 & AC9 but ACK6 is lost & no timeout upto AC9.

0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

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Q5 (i) Suppose X sends to Z. which bridges learn where X is? Does Y's Network interface in this frame?

B1

Destination	LAN
X	LAN1

B2

Destination	LAN
X	LAN2

B3

Destination	LAN
X	LAN3

B4

Destination	LAN
X	LAN3.

When X sends to Z, all the bridges have empty hash table so frame will go out from all the ports & it will flood the network. Due to flooding all the bridges will know where X is. Y'S interface will also see this frame.

(ii) U sends to X. which bridges learn where U is Does Y'S interface see this frame?.
when source & destination are on the same LAN then that frame is discarded so B4 will discard the frame since X is on LAN3 & B4 is also on LAN3. Since B4 has discarded the frame so Y'S interface can't see this frame.

B1

Destination	LAN
X	LAN1
U	LAN2

B2

Destination	LAN
X	LAN1
U	LAN2

B3

Destination	LAN
X	LAN3
U	LAN5

B4

Destination	LAN
X	LAN3
U	LAN3.

6 7 8

) T sends to V. which bridge will learn where T is? Does X's interface see this frame.

B1

Destination	LAN
X	LAN1
U	LAN2
T	LAN2

B2

Destination	LAN
X	LAN2
U	LAN3
T	LAN3

B3

Destination	LAN
X	LAN3
U	LAN5
T	LAN4

B4

Destination	LAN
X	LAN3
U	LAN3
T	LAN3

Since V's address is unknown, ~~to all the bridges~~ i.e no entry for V in hash table so frame will be flooded & hence all the bridge will learn T's address.

Since B1 does not know the address of V so & frame is flooded in the network so it will also ~~interface~~ see the frame.

iv) U ~~sends~~ moves to LAN6, which bridge will learn where U is? And then U sends to T which bridge will learn where U is?. Does W's interface see this frame?

~~U will send data & U is on LAN6. So B4 will the.~~

U wants send data to T & T's entry is there in hash table so, B4 will learn the address

of U & T's entry is there in hash table so it will forward frame to LAN3. B2 will discard the frame because in B2's hash table both U & T are on same LAN & frame is discarded if ~~source~~ source destination are on same LAN.
B3 will forward this frame to LAN4 because T's LAN number in hash table is 4.
So, bridges B2/B3 & B4 will learn where U is.

No frame was not forwarded to LAN5 so W's interface will not see this frame.

B1

Destination	LAN
X	LAN1
U	LAN 2
T	LAN2

B2

Destination	LAN.
X	LAN2
U	LAN3
T	LAN3.

B3

Destination	LAN.
X	LAN3
U	LAN3
T	LAN4.

B4

Destination	LAN
X	LAN3
U	LAN6
T	LAN 3.