15. Draw the graph of the NRZ-L scheme using each of the following data streams,
assuming that the last signa1 1evel has been positive. From the graphs, guess the
bandwidth for this scheme using the average number of changes in the signal level.
Compare your guess with the corresponding entry in Table 4.1.

a. 00000000

b. 11111111

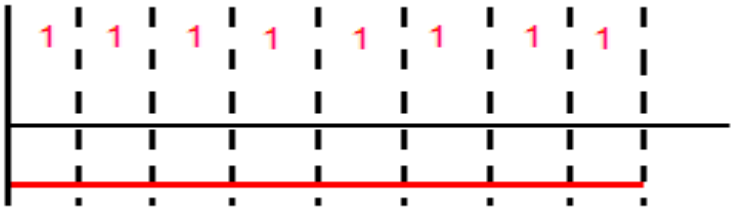
c. 01010101

d. 00110011

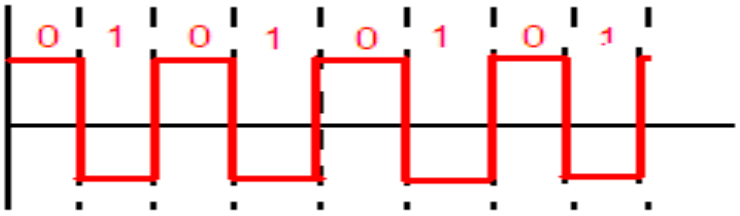
Average number of changes = (0+0+8+4)/4 = 3 for N =8

a) 00000000

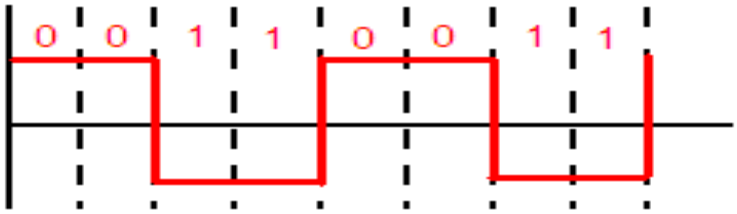
b) 1111111



c) 01010101

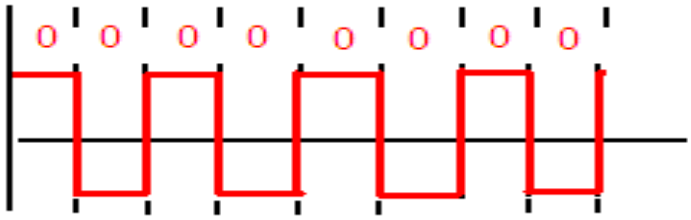


d) 00110011

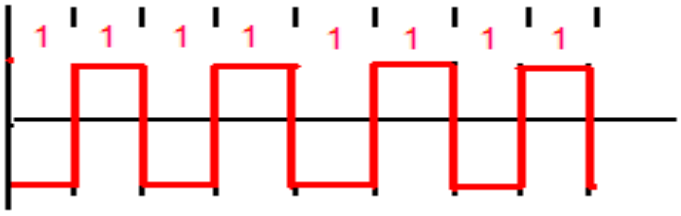


17 . Repeat Exercise 15 for the Manchester scheme.

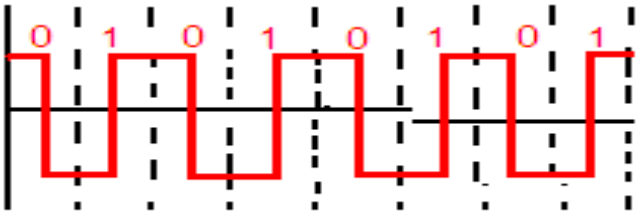
a) 0000000



b) 11111111



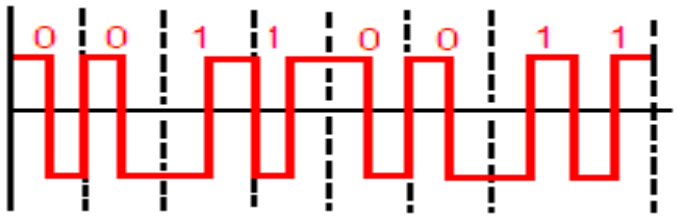
c) 01010101



d)

e)

d) 00110011



27. 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?

In a low pass signal the minimum frequency 0. Therefore:

$F_{max} = 0 + 200 = 200$ KHz

$F_s = 2 \text{ X } 200{,}000 = 400{,}000$ samples/s

In a band pass signal, the maximum frequency is equal to the minimum frequency plus the bandwidth we have:

$F_{max} = 100 + 200 = 300$ KHz

$f_s = 2 \text{ X } 300{,}000 = 600{,}000$ samples/s

28. 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.

Sampling rate: 2 x 200,000 = 400,000 Samples per second

Bit Rate: 400,000 X log2 1024

= 400,000 X 10

= 4000 Kbps

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

The maximum data rate can be calculated as;

N_{max}= 2 X b X n_b = 2 x 200 KHz X $\log_2 4$ = 800 Kbps

12. Calculate the bit rate for the given baud rate and type of modulation.

a. 1000 baud, FSK

b. 1000 baud, ASK

c. 1000 baud, BPSK

d. 1000 baud, 16-QAM

We use the formula $N=S \times r$ but first we need to calculate the value of r for each case.

- r = $\log_2 2$ = 1 therefore N = 1000 X 1 = 1000 bps
- r = $\log_2 2$ = 1 therefore S = 1000 X 1 = 1000 bps
- r = $\log_2 2$ = 1 therefore S = 1000 X 1 = 1000 bps
- r = $\log_2 16$ = 4 therefore S =1000 X 4 = 4000 bps

18. The telephone line has 4 KHz bandwidth. What is the maximum number of bits we

can send using each of the following techniques? Let d = 0.

a. ASK

b. QPSK

c. 16-QAM

d.64-QAM

a). B =(1 +d) x S = (1+ 0) x N x 1/r

N = (r x b/1 +d)

$r = \log_2 2 = 1$

N = [1/(1+0) x 1 x (4KHz)] = 4 Kbps

b) B =(1 +d) x S = (1+ 0) x N x 1/r

N = (r x b/1 +d)

$r = \log_2 4 = 2$

1/(1+0) x 2 x (4KHz) = 8Kbps

c) B =(1 +d) x S = (1+ 0) x N x 1/r

N = (r x b/1 +d)

$r = \log_2 16 = 4$

1/(1+0) x 4 x (4KHz) = 16Kbps

d)) B =(1 +d) x S = (1+ 0) x N x 1/r

N = (r x b/1 +d)

$r = \log_2 64 = 6$

1/(1+0) x 6 x (4KHz) = 24Kbps

19. A corporation has a medium with a I-MHz bandwidth (lowpass). The corporation
needs to create 10 separate independent channels each capable of sending at least
10 Mbps. The company has decided to use QAM technology. What is the minimum

number of bits per baud for each channel? What is the number of points in the constellation diagram for each channel? Let d =O.

First we calculate the bandwidth for the channel + (1 MHz)/10 = 100KHz. We then find the value of r for each channel:

B = (1 +d) X (1/r) X N therefore r = N/B

-: r = 1 Mbps/100KHz = 10

We can then calculate the number of levels $L = 2^r = 2^{10} = 1024$. This means that we need a 1024 QAM technique to achieve this data.