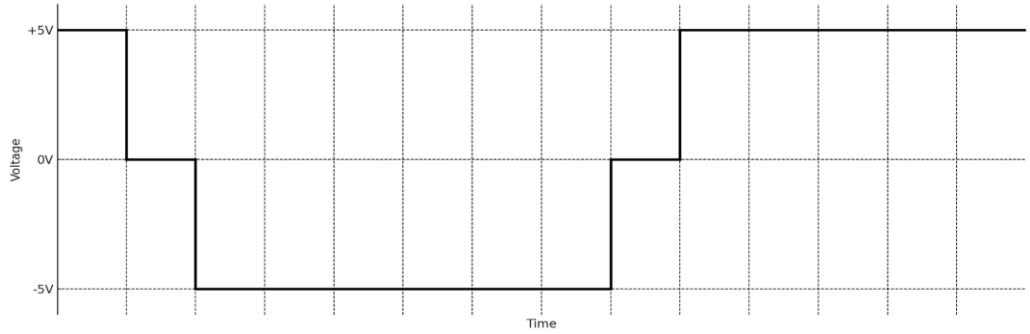
Assignment 5: Chapter 4

Question 1

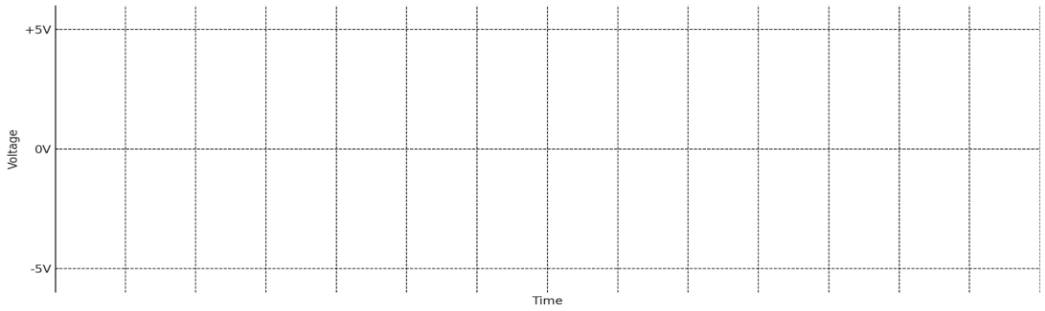
The following signal was obtained using a particular **line coding** scheme.



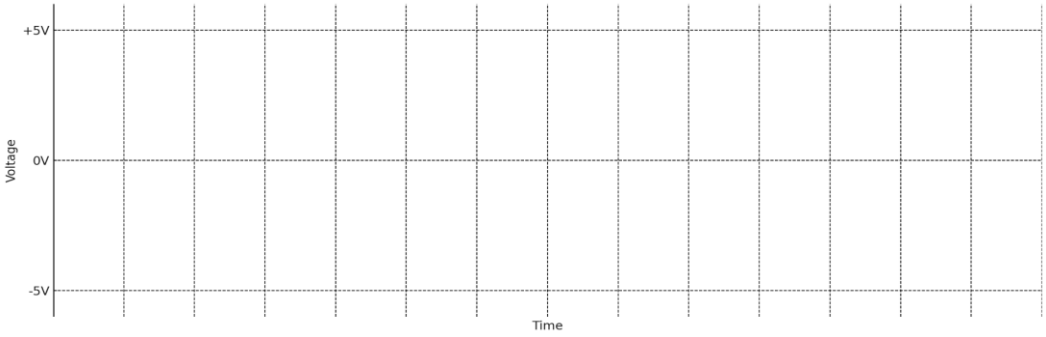
A. **Deduce** which line coding scheme was used and **decode** the original bit stream.

B. Explain whether this signal suffers from baseline wandering and DC components issue.

C. Redraw the signal using a suitable **scrambling** technique that does not suffer from these drawbacks of consecutive 4 zeros.



D. Encode the following binary sequence using HDB3 technique:
1001000001000011



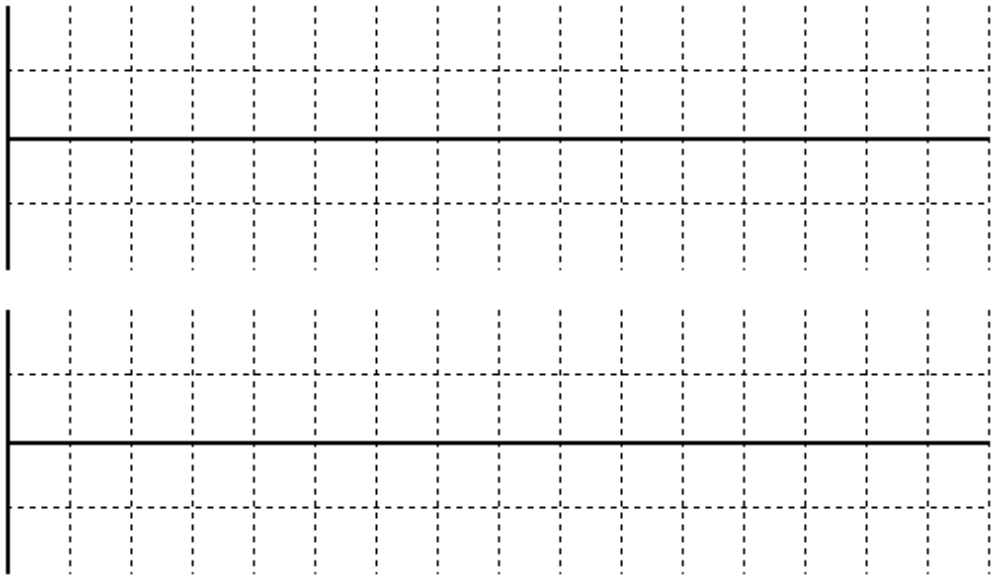
Question 2

A. Explain the BaseLine Wandering and DC component problems.

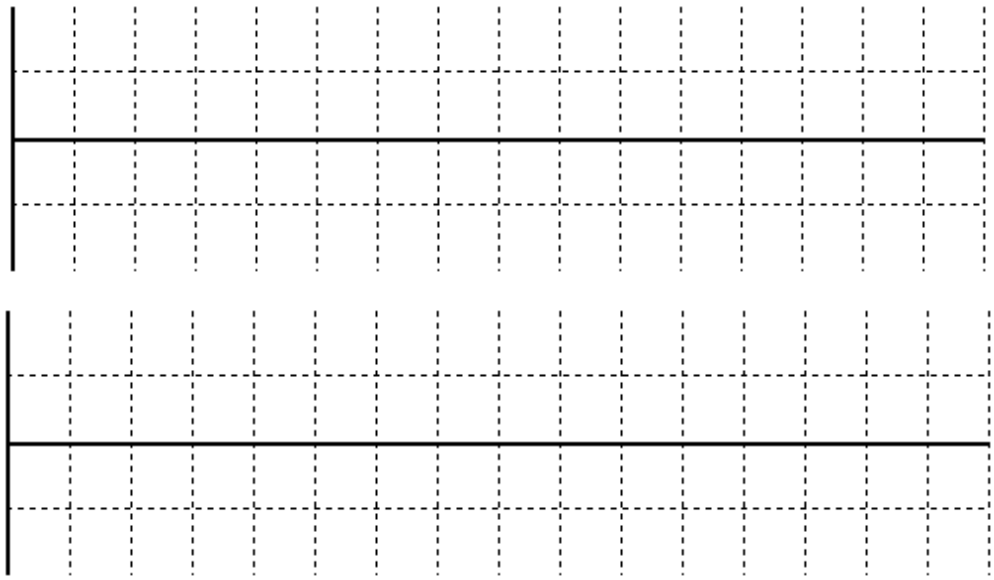
B. Convert the following bit streams to a digital signal using Bipolar-AMI:

I. 0 0 1 0 0 0 0 0 0 0 0 0 1 0

II. 1 0 1 0 0 0 0 1 0 0 0 0 1 0



C. Does the bit streams in (ii) contain the BaseLine Wandering problem? If so, then apply appropriate Scrambling techniques to decrease the number of consecutive 0's. Mention which technique is used for each bit-stream.



Question 3

A. To minimize the consecutive zero problem we are using the following block coding scheme shown in the table. Based on the scheme, answer the questions below:

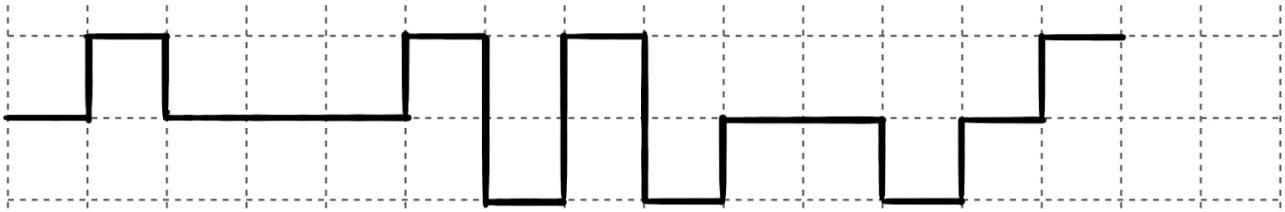
Data Sequence	***Encoded Sequence***
000	1100
001	0111
010	0101
011	1101
100	1110
101	1111
110	1011
111	1010

I. Calculate the percentage of redundant bits required for the scheme.

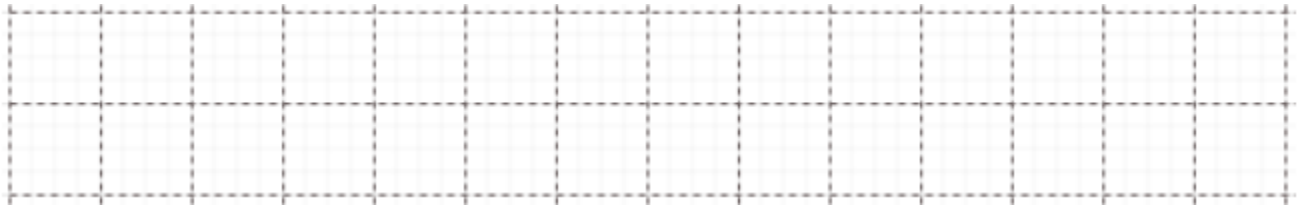
II. What will be the original bit stream for the following encoded bit stream:
0100101011110101

III. For any encoded sequence, what will be the maximum number of consecutive 0's if we use this block coding scheme?

B. The signal is drawn using HDB3 scrambling technique. Decode the signal and write the bit stream.



Now draw a digital signal using the Differential Manchester line coding scheme for the decoded bit stream.



Question 4

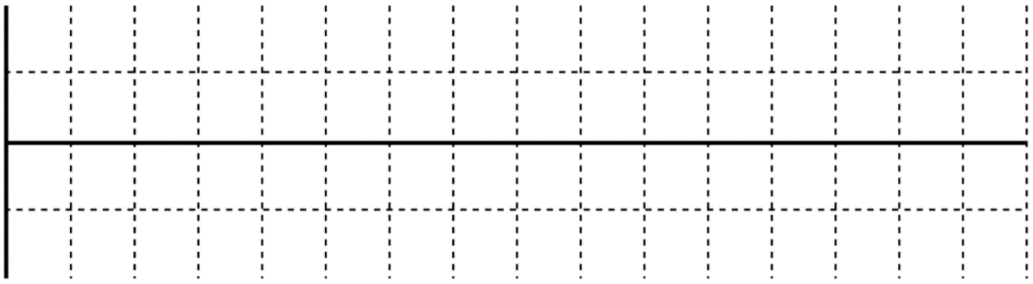
To minimize the consecutive zero problem, we are using the following 3B/5B block coding Scheme shown in the table. Based on the scheme, answer the questions below:

Data Sequence	Encoded Sequence
000	10110
001	11011
010	01001
011	10101
100	01111
101	01011
110	11101
111	01110

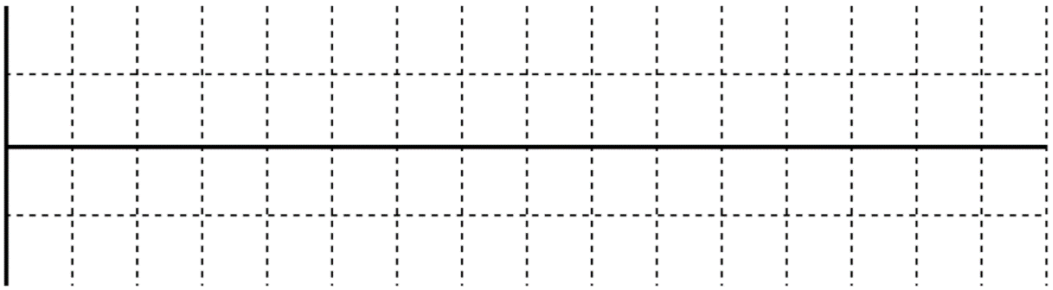
A. Encode this bit stream using the given table: 101000110100001.

B. Convert the encoded bit stream that you got from (a) to a digital signal using an appropriate line coding scheme following these requirements:

- This bi-phase line coding scheme combines the idea of RZ and NRZ-I.
- The minimum bandwidth required for this scheme is 2 times that of NRZ.



C. Does the block coding scheme have any drawbacks? If yes, use another technique to minimize the long sequence of 0s for the bit stream given in (a).



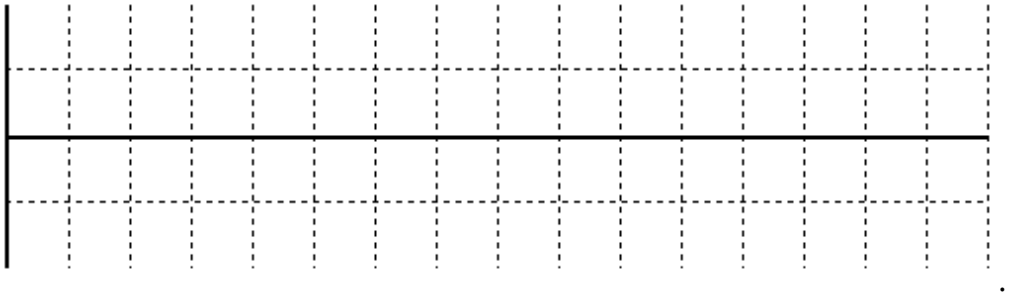
Question 5

A. **Convert** the following bit stream to a digital signal using an appropriate encoding scheme matching the requirements. Write the name of the signal encoding scheme.

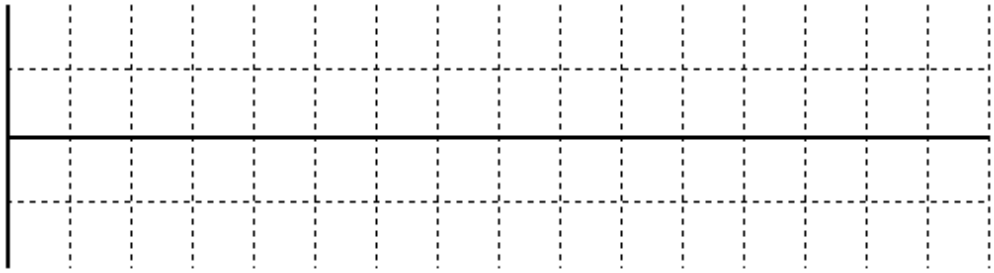
Data: 1 1 0 1 0 0 0 0 0 0 1 0 0 0

Requirements

- The encoding scheme does not support self-synchronization for long 0's. Additionally, this scheme is an alternative to the NRZ with the same signal rate but there is no DC component here.



- Now apply a technique to prevent long sequences of 0's in the above scheme without increasing the number of bits and signals.



B. What are the key characteristics of Bipolar-AMI? How does it address the problem of synchronization during long sequences of '1's?

C. What is quantization error? Between PCM and DM, which has a higher quantization error?

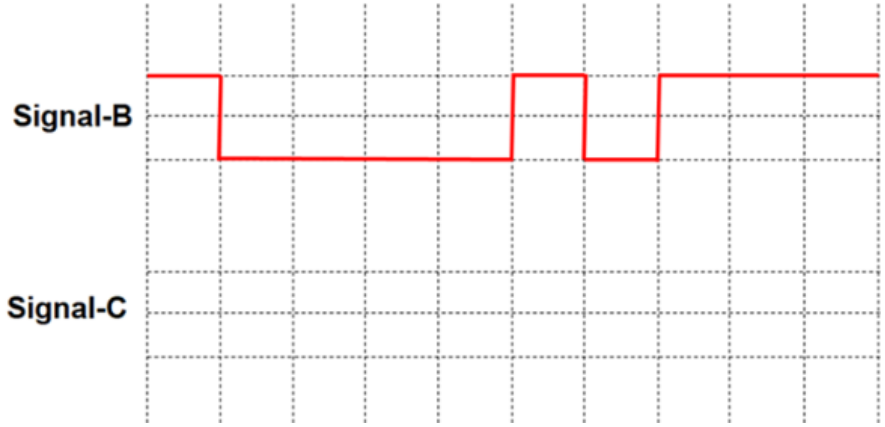
D. In bipolar encoding, how many levels are used? What are these levels?

Question 6

A. How to reduce the normalized error in PCM? Mention one solution.

B. Manchester and Differential Manchester solves the consecutive 0's and 1's problem. However, it requires more bandwidth to communicate - **explain** why?

C. Check the following diagram:

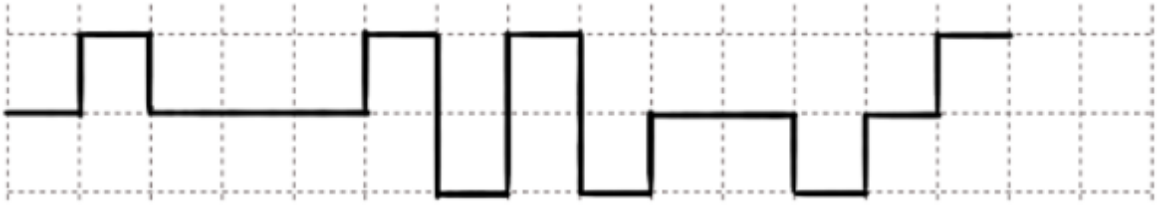


I. Decode the Signal B and generate the binary bit stream using appropriate line coding scheme.

II. Now from the extracted binary bits, draw the Signal-C where there is no synchronization problem.

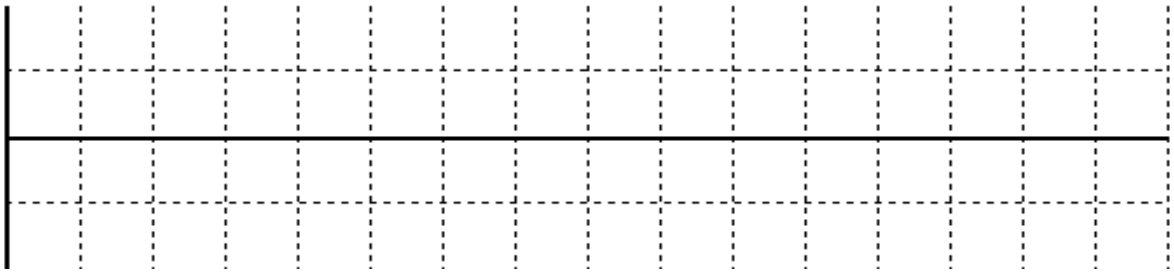
Question 7

The signal is drawn using HDB3 scrambling technique.



A. Decode the signal and write the bit stream.

B. Now draw a digital signal using the Differential Manchester line coding scheme for the decoded bit stream.

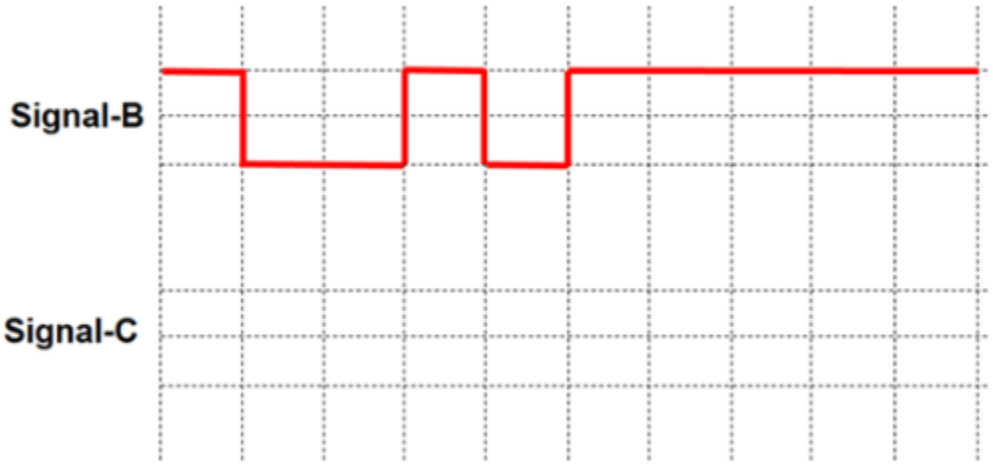


Question 8

A. Explain the synchronization problem. Why is the synchronization problem of NRZ-L and NRZ-I is solved by Manchester and Differential Manchester?

B. Baseline wandering is a common problem in both NRZ-I and NRZ-L, however, it is twice in NRZ-L scheme. Explain why. Hint: Inspect the nature of the encoding scheme and what happens for 0s and 1s.

C. Check the following diagram:



I. Decode the Signal B and generate the binary bit stream using appropriate line coding scheme.

II. Now from the extracted binary bits, draw the Signal-C where there is no synchronization problem.

Question 9

Write the differences of the following:

A. Unipolar vs Polar vs Bipolar vs Multitransition
B. NRZ-L vs NRZ-I
C. NRZ vs RZ
D. Line coding vs Block Coding
E. B8ZS vs HDB3
F. Manchester and Differential Manchester

Question 10

A. A system is using NRZ-I to transfer 10-Mbps data. What are the average signal rate and minimum bandwidth?

B. A telephone subscriber line must have a SNR_{dB} above 40. What is the minimum number of bits per sample?

C. In a digital transmission, the receiver clock is 0.2 percent faster than the sender clock. How many extra bits per second does the receiver receive if the data rate is 1 kbps? How many if the data rate is 1 Mbps?

D. Complete the following table (the white cells):
[Take help from Table 4.1 form the book]

Scheme	Category	Costly? (Yes/No)	Has DC Component problem? (Yes/No)	Has synchronization problem? (Yes/No)	Has baseline wandering problem? (Yes/No)	Signal Rate/ Bandwidth
NRZ	Unipolar					
NRZ-L						N/2 Bd
NRZ-I						
Manchester						
Differential Manchester						
AMI	Bipolar					
MLT-3						