# Computer Network

Lecture-12

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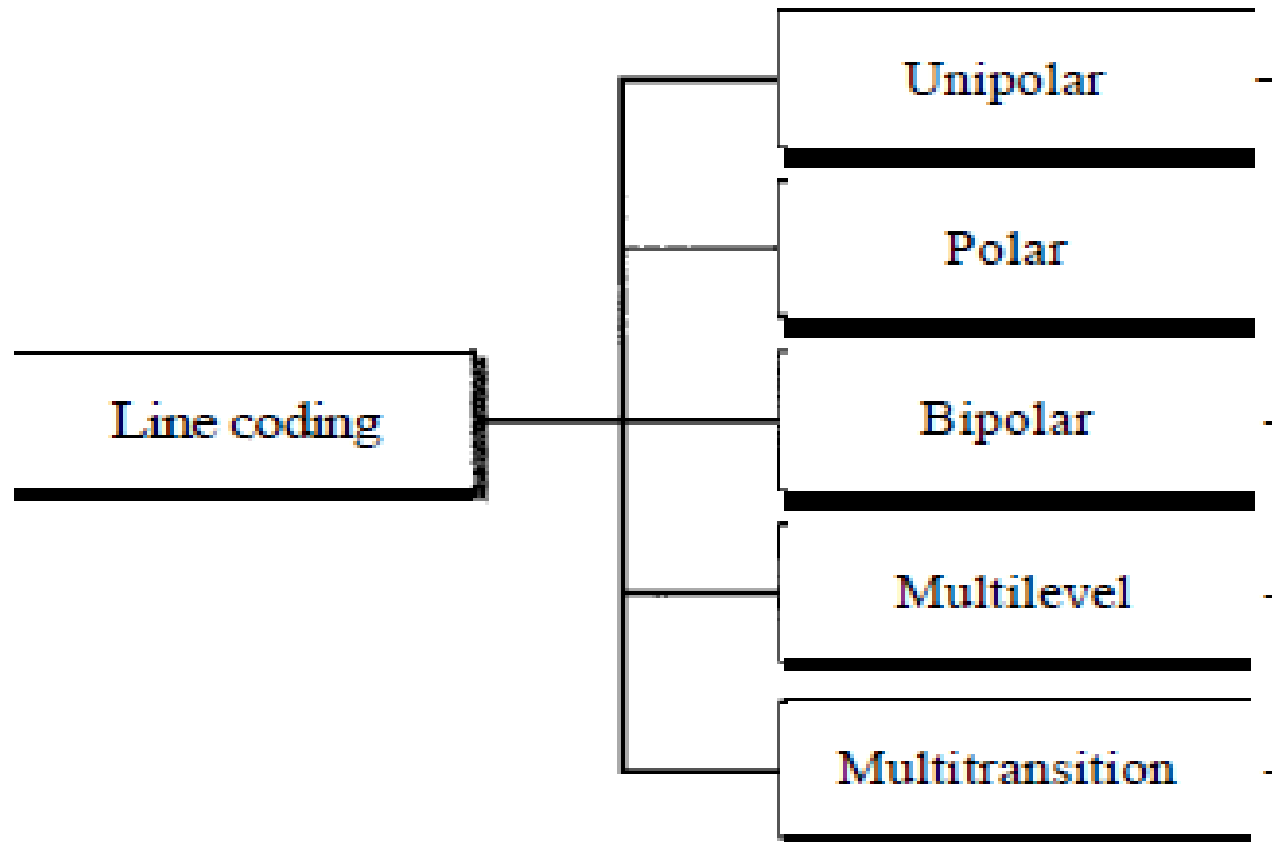# Encoding Schemes

Line Coding Schemes:

Line coding is the process of converting digital data to digital signals. We assume that data, in the form of text, numbers, graphical images, audio, or video, are stored in computer memory as sequences of bits.

Line coding converts a sequence of bits to a digital signal. At the sender, digital data are encoded into a digital signal; at the receiver, the digital data are recreated by decoding the digital signal. Following figure shows the process.
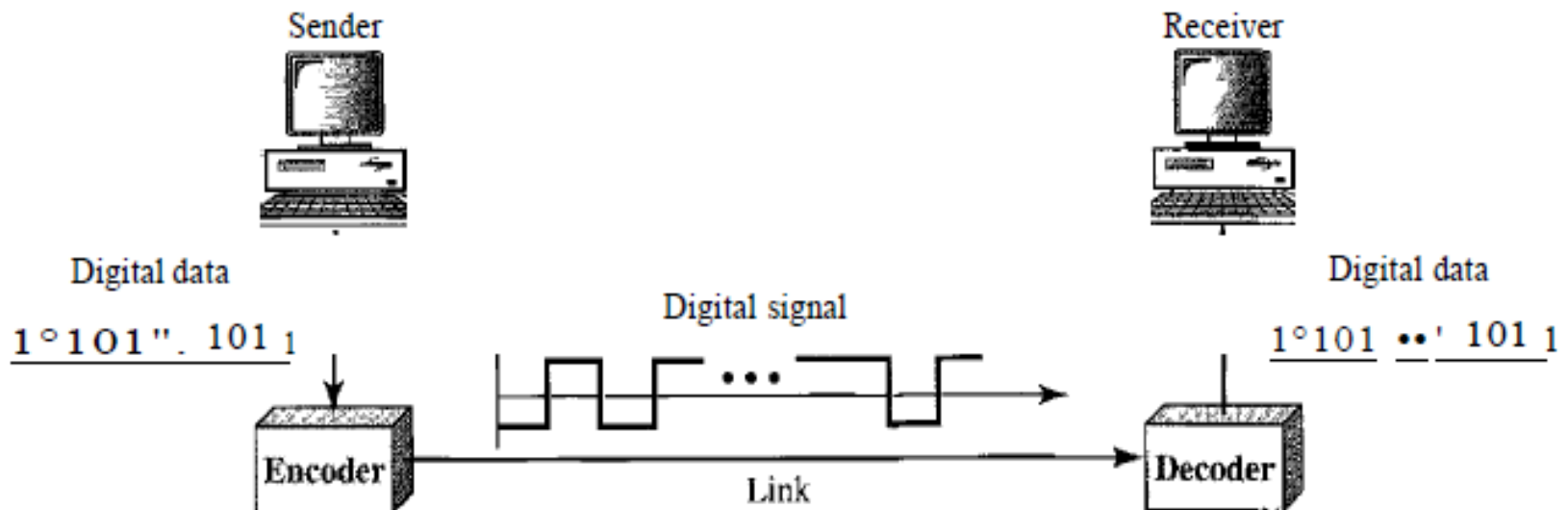
Encoding Schemes

We can roughly divide line coding schemes into five broad categories, as the following:-

```
                    ┌──────────  Unipolar        –

                    ├──────────  Polar

  Line coding ──────┼──────────  Bipolar         -

                    ├──────────  Multilevel      -

                    └──────────  Multitransition –
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Encoding Schemes

Unipolar Scheme:

In a unipolar scheme, all the signal levels are on one side of the time axis, either above or below.

NRZ (Non-Return-to-Zero): Traditionally, a unipolar scheme was designed as a non-return-to-zero (NRZ) scheme in which the positive voltage defines bit 1 and the zero voltage defines bit 0. It is called NRZ because the signal does not return to zero at the middle of the bit. Following figure shows a unipolar NRZ scheme.
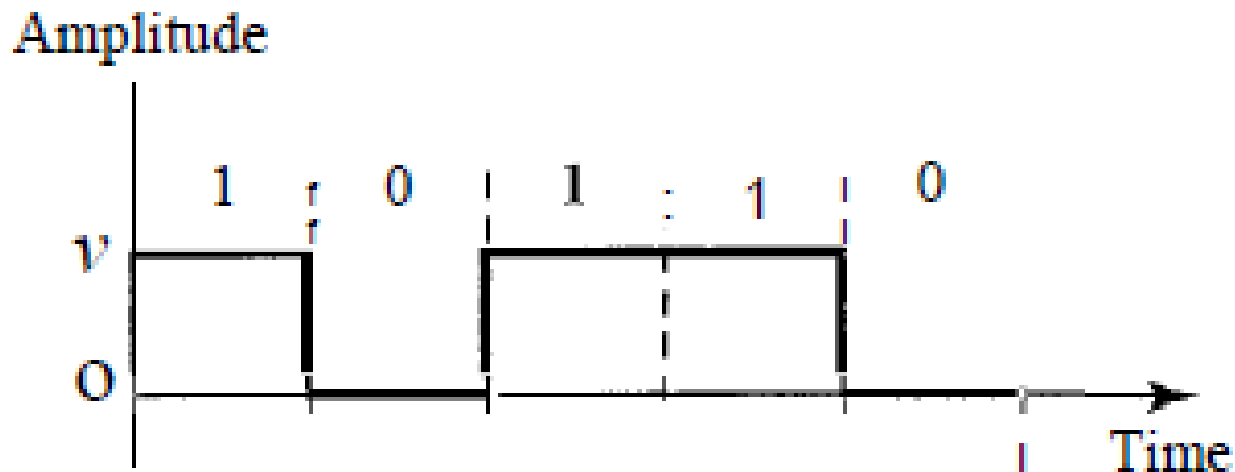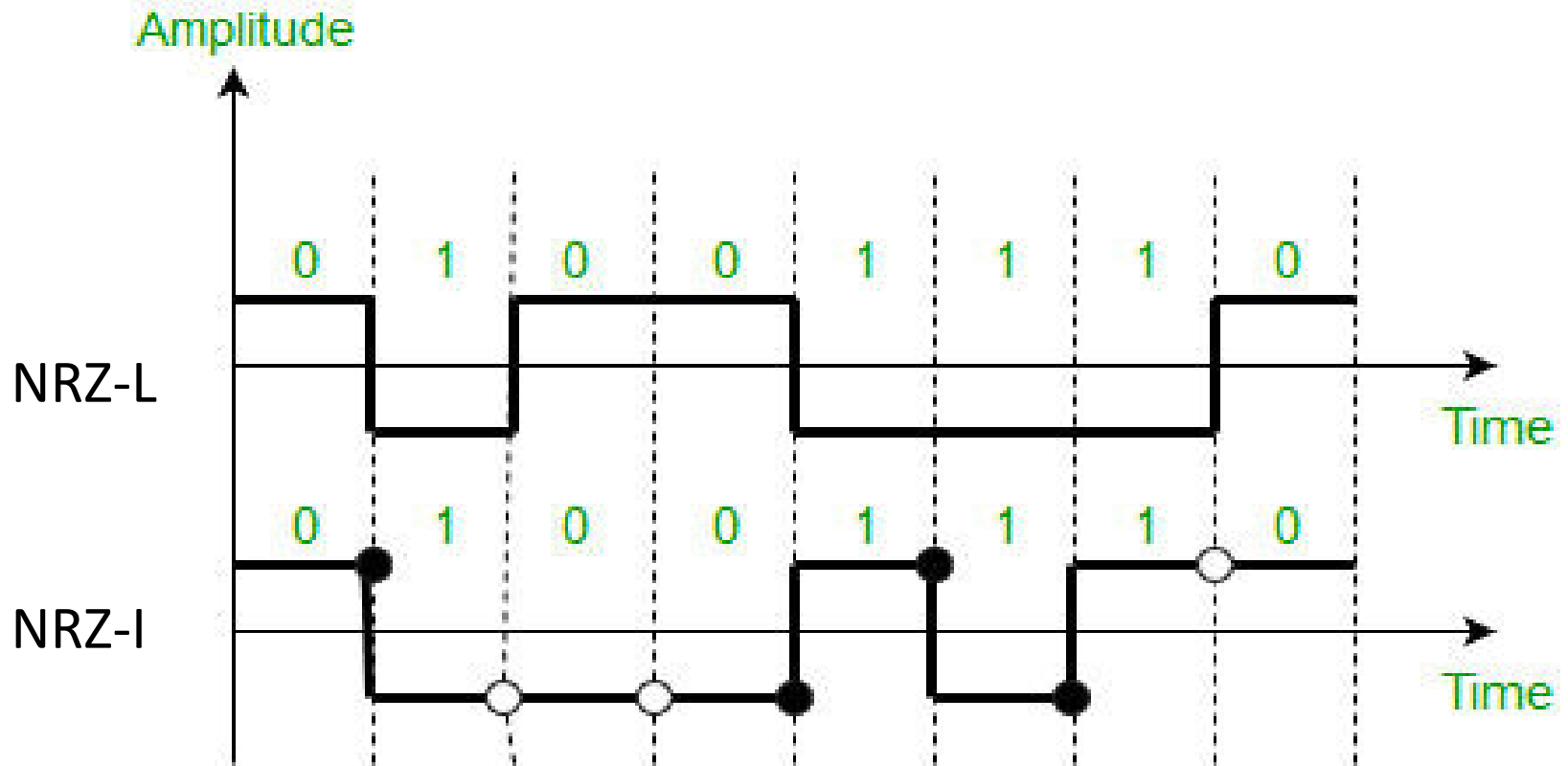
Encoding Schemes

Polar Schemes:

In polar schemes, the voltages are on the both sides of the time axis. For example, the voltage level for 0 can be positive and the voltage level for 1 can be negative.

Non-Return-to-Zero (NRZ):

- In polar NRZ encoding, we use two levels of voltage amplitude. There are two versions of polar NRZ: NRZ-L and NRZ-I.

- In the first variation, NRZ-L (NRZ-Level), the level of the voltage determines the value of the bit.

- In the second variation, NRZ-I (NRZ-Invert), the change in the level of the voltage determines the value of the bit. If there is no change, the bit is 0; if there is a change, the bit is 1.
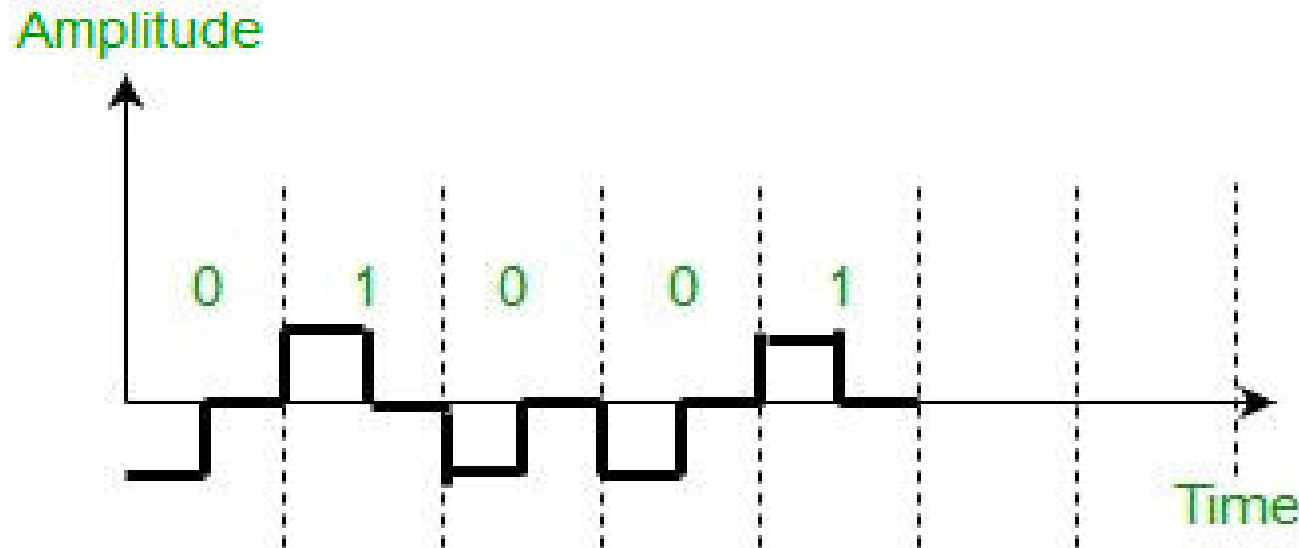
Encoding Schemes

Note: In NRZ-L the level of the voltage determines the value of the bit. In NRZ-I the inversion or the lack of inversion determines the value of the bit.

Encoding Schemes

Return to Zero (RZ):

Return-to-zero (RZ) scheme uses three values: positive, negative, and zero. In RZ, the signal changes not between bits but during the bit. It remains there until the beginning of the next bit.
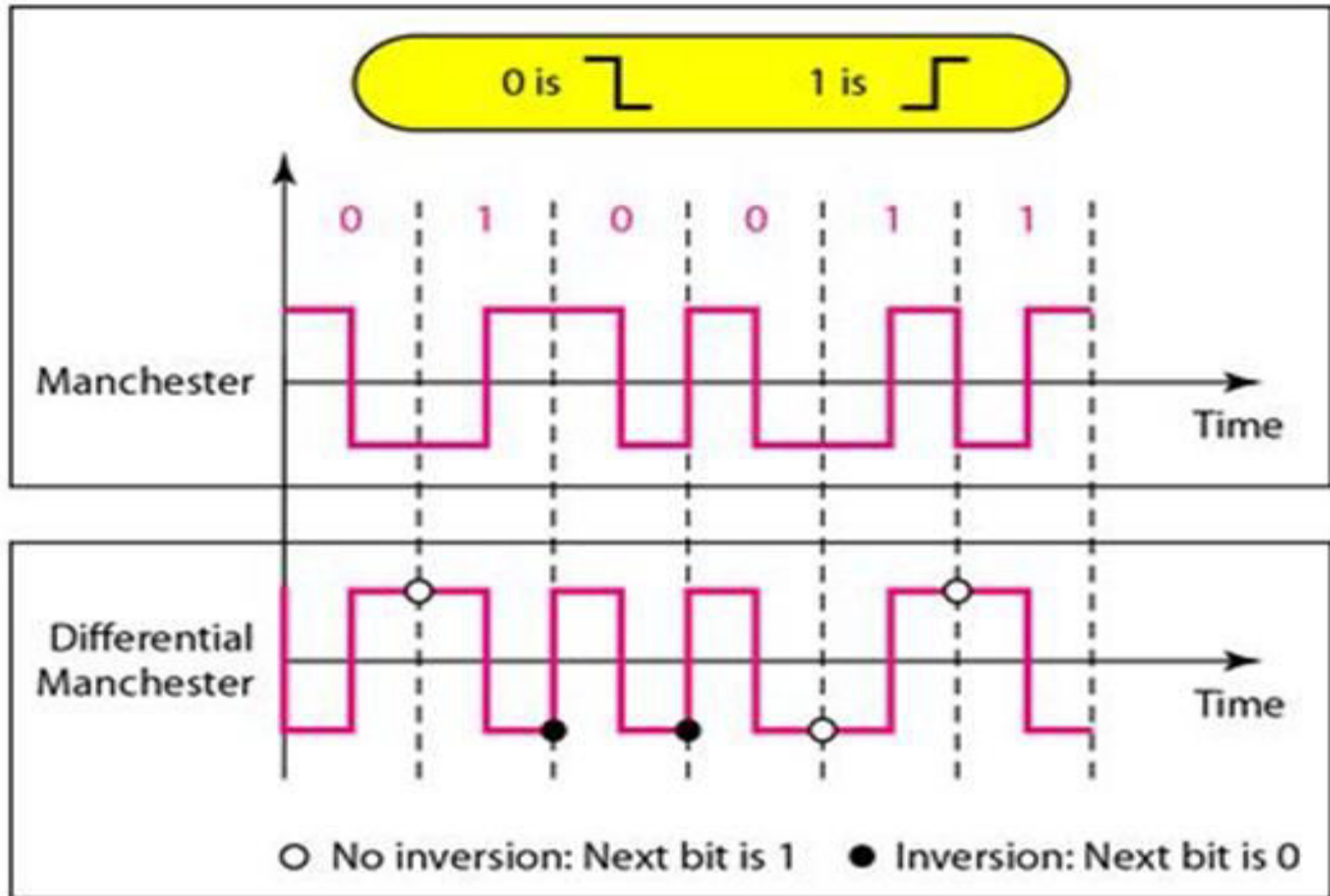
Encoding Schemes

Biphase: Manchester and Differential Manchester:

❖ The idea of RZ and the idea of NRZ-L are combined into the Manchester scheme. In Manchester encoding, the duration of the bit is divided into two halves. The voltage remains at one level during the first half and moves to the other level in the second half.

❖ Differential Manchester, on the other hand, combines the ideas of RZ and NRZ-I. There is always a transition at the middle of the bit, but the bit values are determined at the beginning of the bit. If the next bit is 0, there is a transition; if the next bit is 1, there is none.

Encoding Schemes

Encoding Schemes

Question: Sketch Manchester and differential Manchester encoding for the following bit stream: 101111000100100011101
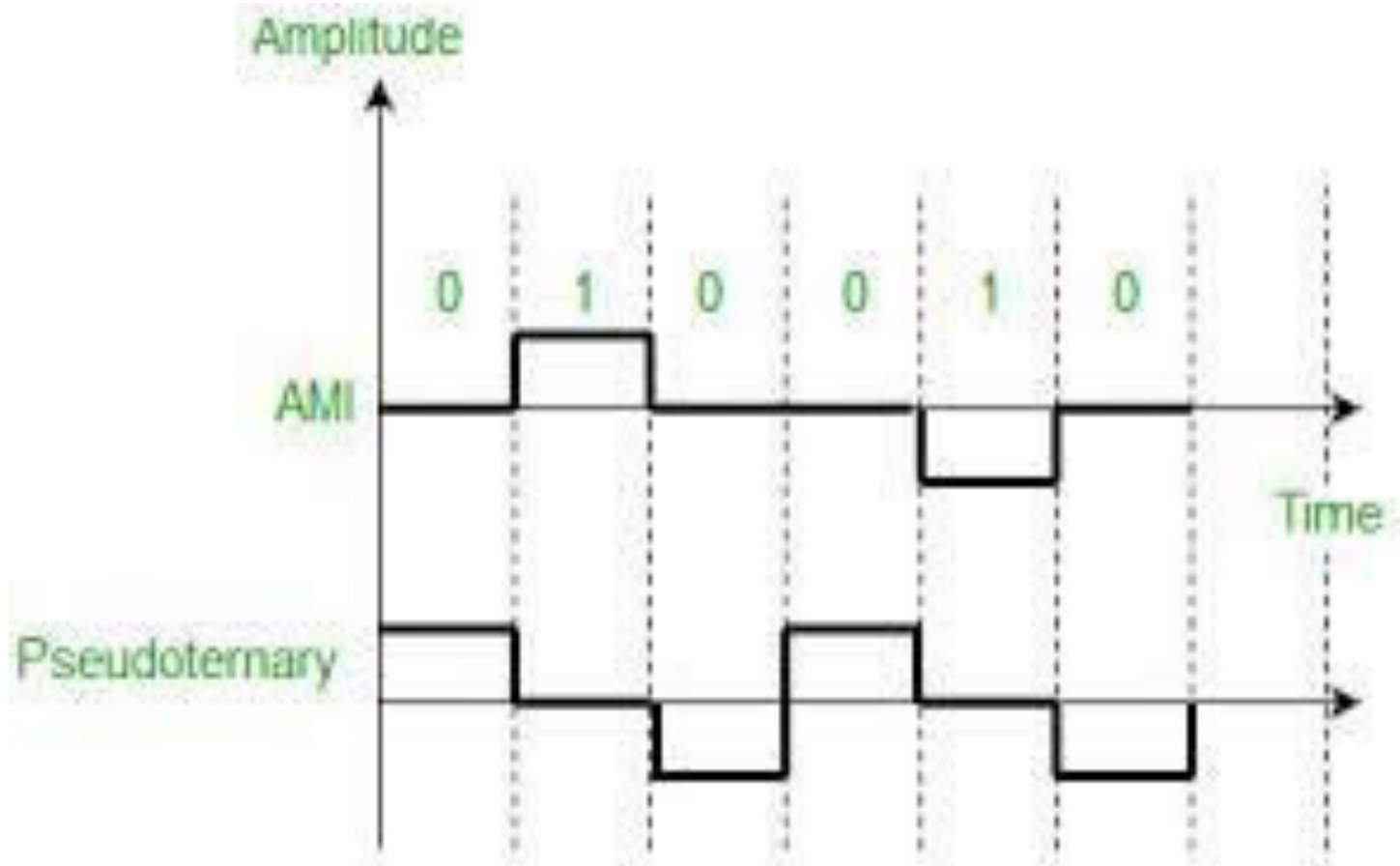
Encoding Schemes

Bipolar Schemes:

In bipolar encoding (sometimes called multilevel binary), there are three voltage levels: positive, negative, and zero. The voltage level for one data element is at zero, while the voltage level for the other element alternates between positive and negative.

AMI and Pseudoternary:

There are two variations of bipolar encoding: AMI and pseudoternary.

❖ A common bipolar encoding scheme is called bipolar alternate mark inversion (AMI). In the term alternate mark inversion, the word mark comes from telegraphy and means 1. So AMI means alternate 1 inversion. A neutral zero voltage represents binary 0. Binary 1's are represented by alternating positive and negative voltages.

❖ A variation of AMI encoding is called pseudoternary in which the 1 bit is encoded as a zero voltage and the 0 bit is encoded as alternating positive and negative voltages.

Encoding Schemes

Encoding Schemes

Question: Encode the data-stream 10011010 using the following encoding scheme:

i. Unipolar
ii. Bipolar NRZ-L
iii. Bipolar NRZ-I
iv. RZ
v. Manchestor
vi. Differential Manchestor
vii. AMI