Student Id : 15092

Question 1 (a)

Answer:

Physical layer in the OSI model plays the role of interacting with actual hardware and signaling mechanism. Physical layer is the only layer of OSI network model which actually deals with the physical connectivity of two different stations. This layer defines the hardware equipment, cabling, wiring, frequencies, pulses used to represent binary signals etc.

Physical layer provides its services to Data-link layer. Data-link layer hands over frames to physical layer. Physical layer converts them to electrical pulses, which represent binary data.The binary data is then sent over the wired or wireless media.

Signals

When data is sent over physical medium, it needs to be first converted into electromagnetic signals. Data itself can be analog such as human voice, or digital such as file on the disk.Both analog and digital data can be represented in digital or analog signals.

- **Digital Signals**

  Digital signals are discrete in nature and represent sequence of voltage pulses. Digital signals are used within the circuitry of a computer system.

- **Analog Signals**

  Analog signals are in continuous wave form in nature and represented by continuous electromagnetic waves.

Transmission Impairment

When signals travel through the medium they tend to deteriorate. This may have many reasons as given:

- **Attenuation**

  For the receiver to interpret the data accurately, the signal must be sufficiently strong.When the signal passes through the medium, it tends to get weaker.As it covers distance, it loses strength.

- **Dispersion**

  As signal travels through the media, it tends to spread and overlaps. The amount of dispersion depends upon the frequency used.

- **Delay distortion**

Signals are sent over media with pre-defined speed and frequency. If the signal speed and frequency do not match, there are possibilities that signal reaches destination in arbitrary fashion. In digital media, this is very critical that some bits reach earlier than the previously sent ones.

- **Noise**

  Random disturbance or fluctuation in analog or digital signal is said to be Noise in signal, which may distort the actual information being carried. Noise can be characterized in one of the following class:

  o **Thermal Noise**

    Heat agitates the electronic conductors of a medium which may introduce noise in the media. Up to a certain level, thermal noise is unavoidable.

  o **Intermodulation**

    When multiple frequencies share a medium, their interference can cause noise in the medium. Intermodulation noise occurs if two different frequencies are sharing a medium and one of them has excessive strength or the component itself is not functioning properly, then the resultant frequency may not be delivered as expected.

  o **Crosstalk**

    This sort of noise happens when a foreign signal enters into the media. This is because signal in one medium affects the signal of second medium.

  o **Impulse**

    This noise is introduced because of irregular disturbances such as lightening, electricity, short-circuit, or faulty components. Digital data is mostly affected by this sort of noise.

Question 1 (b)

Answer:

Question 1 (b)

Ans:-

$$1 ms = 1 \times 10^{-3} s = 1 \times 10^{-3} \times 10^{6} \mu s = 10^{-3} \mu s$$

Now Frequency in Kilo hertz

$$1 ms = 1 \times 10^{-3} s = 10^{-3} s$$

$$f = \frac{1}{10^{-3}} Hz = 10^{3} Hz$$

$$f = 1 KHz$$

One complete cycle $= 360°$

$$\frac{1}{4} cycle = \left(\frac{1}{4}\right)(360°) = 90°$$

In radians

$$90 \times \frac{2\pi}{360} rad = 1.57 rad$$

Question 2 (a)

Explain the classification of digital to digital conversion?

DIGITAL-TO-DIGITAL CONVERSION

Digital-to-digital encoding is the representation of digital information by a digital signal. When binary 1s and 0s generated by the computer are translated into a sequence of voltage pulses that can be propagated over a wire, this process is known as digital-to-digital encoding.
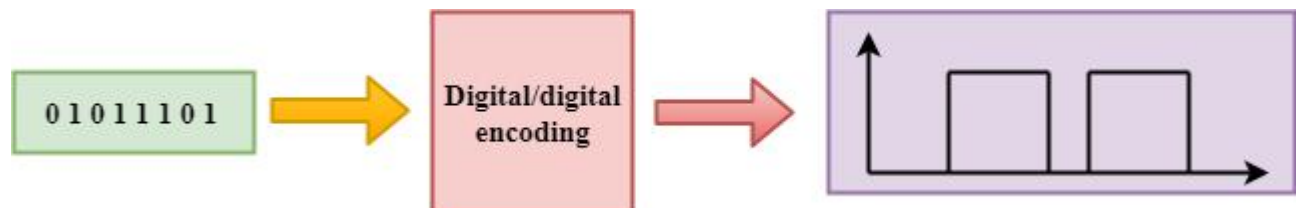
Digital-to-digital encoding is divided into three categories:

- o   Unipolar Encoding
- o   Polar Encoding

○ Bipolar Encoding
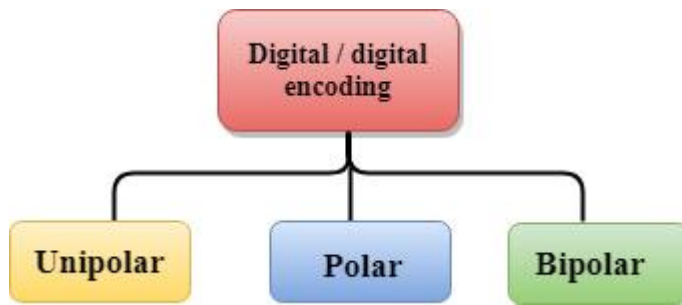
Unipolar

○ Digital transmission system sends the voltage pulses over the medium link such as wire or cable.
○ In most types of encoding, one voltage level represents 0, and another voltage level represents 1.
○ The polarity of each pulse determines whether it is positive or negative.
○ This type of encoding is known as Unipolar encoding as it uses only one polarity.
○ In Unipolar encoding, the polarity is assigned to the 1 binary state.
○ In this, 1s are represented as a positive value and 0s are represented as a zero value.
○ In Unipolar Encoding, '1' is considered as a high voltage and '0' is considered as a zero voltage.
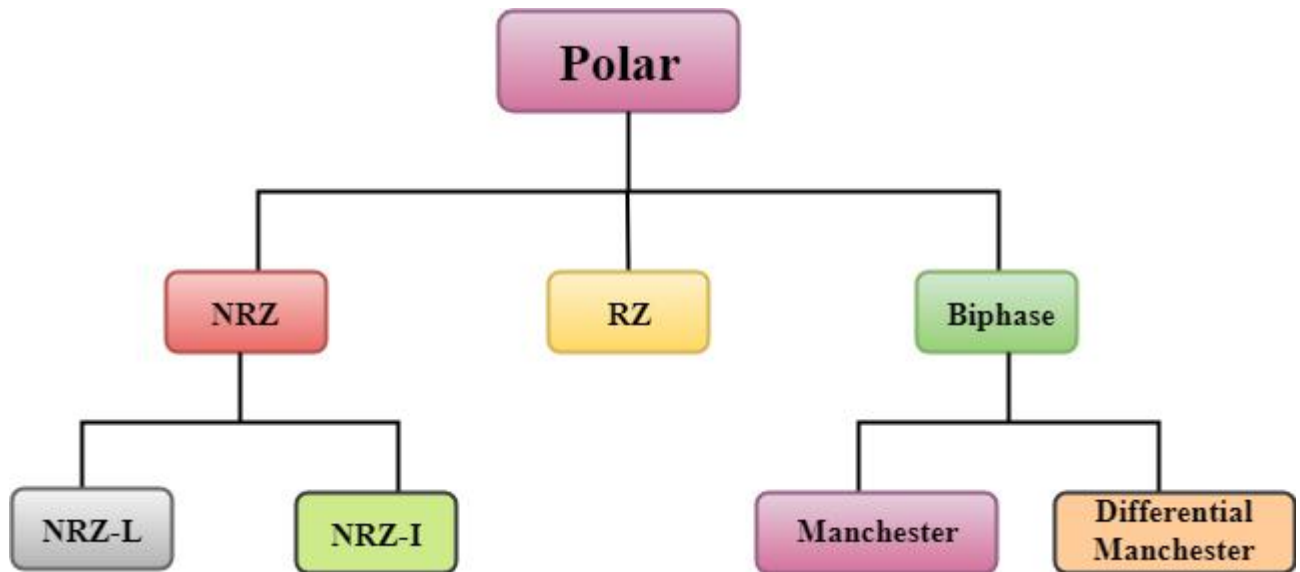○ Unipolar encoding is simpler and inexpensive to implement.
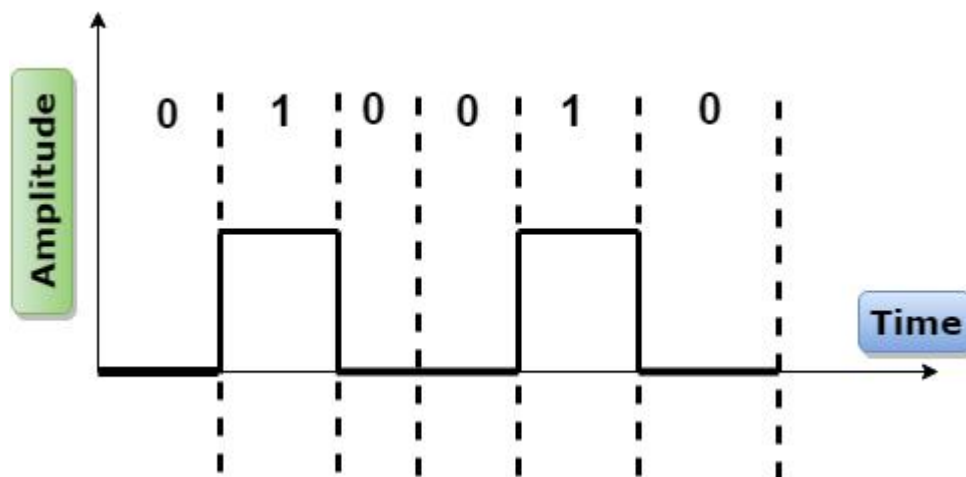
Unipolar encoding has two problems that make this scheme less desirable:

○ DC Component
○ Synchronization

Polar

○ Polar encoding is an encoding scheme that uses two voltage levels: one is positive, and another is negative.

- By using two voltage levels, an average voltage level is reduced, and the DC component problem of unipolar encoding scheme is alleviated.

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                          ┌──────────┐
                          │  Polar   │
                          └──────────┘
            ┌──────────────────┼──────────────────┐
       ┌─────────┐        ┌─────────┐        ┌──────────┐
       │   NRZ   │        │   RZ    │        │ Biphase  │
       └─────────┘        └─────────┘        └──────────┘
      ┌──────┴──────┐                      ┌──────┴──────────┐
 ┌─────────┐   ┌─────────┐          ┌────────────┐   ┌──────────────┐
 │  NRZ-L  │   │  NRZ-I  │          │ Manchester │   │ Differential │
 └─────────┘   └─────────┘          └────────────┘   │  Manchester  │
                                                     └──────────────┘
```

NRZ

- NRZ stands for Non-return zero.
- In NRZ encoding, the level of the signal can be represented either positive or negative.

**The two most common methods used in NRZ are:**

NRZ-L: In NRZ-L encoding, the level of the signal depends on the type of the bit that it represents. If a bit is 0 or 1, then their voltages will be positive and negative respectively. Therefore, we can say that the level of the signal is dependent on the state of the bit.

NRZ-I: NRZ-I is an inversion of the voltage level that represents 1 bit. In the NRZ-I encoding scheme, a transition occurs between the positive and negative voltage that represents 1 bit. In this scheme, 0 bit represents no change and 1 bit represents a change in voltage level.

RZ
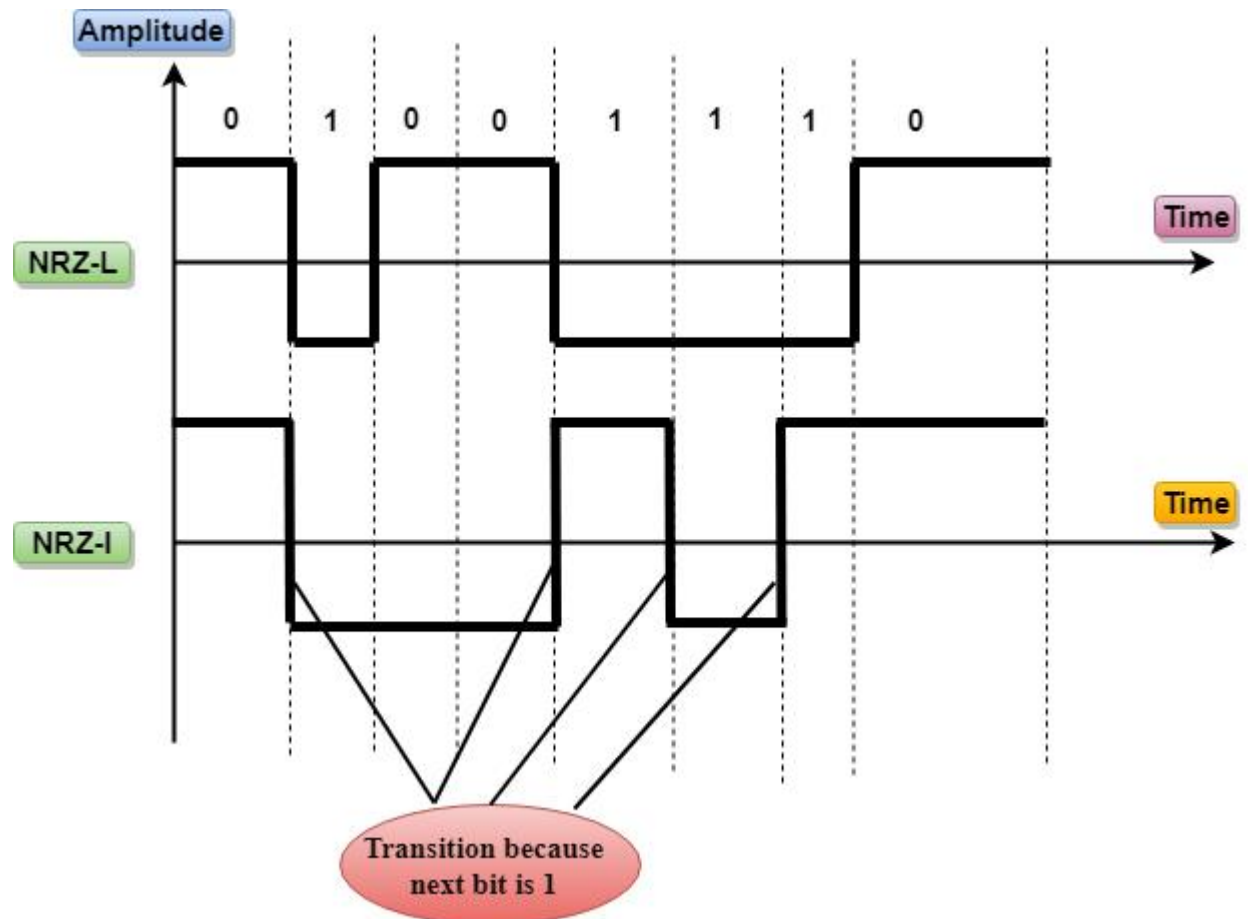
- o   RZ stands for Return to zero.
- o   There must be a signal change for each bit to achieve synchronization. However, to change with every bit, we need to have three values: positive, negative and zero.
- o   RZ is an encoding scheme that provides three values, positive voltage represents 1, the negative voltage represents 0, and zero voltage represents none.
- o   In the RZ scheme, halfway through each interval, the signal returns to zero.
- o   In RZ scheme, 1 bit is represented by positive-to-zero and 0 bit is represented by negative-to-zero.

These transitions can be used for synchronization.
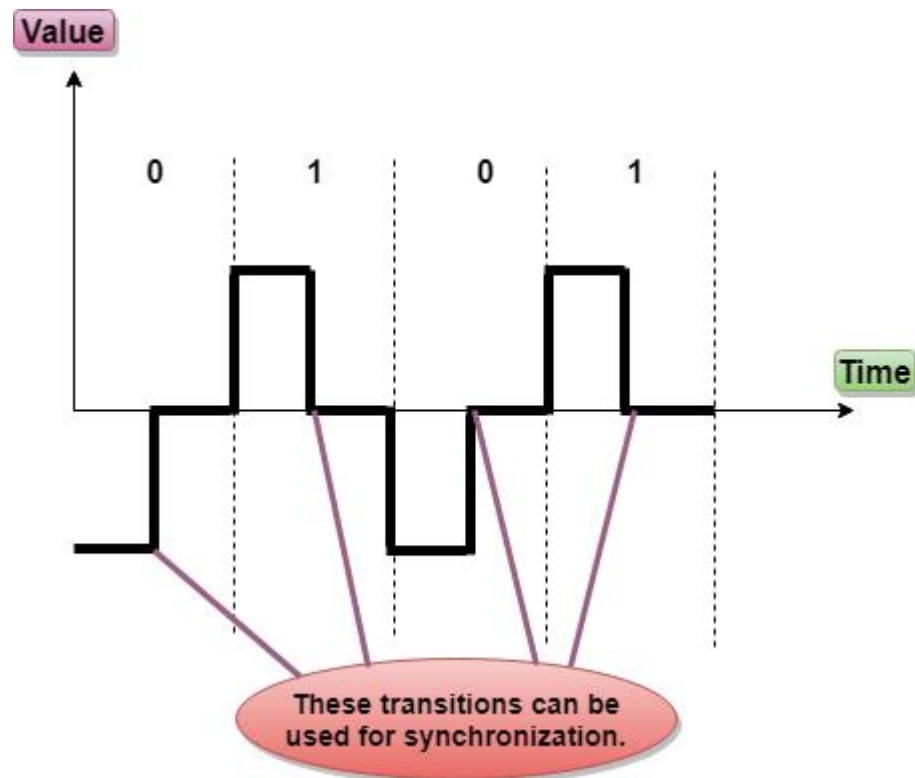
Disadvantage of RZ:

It performs two signal changes to encode one bit that acquires more bandwidth.

Biphase

- o Biphase is an encoding scheme in which signal changes at the middle of the bit interval but does not return to zero.

Biphase encoding is implemented in two different ways:

Manchester

- o It changes the signal at the middle of the bit interval but does not return to zero for synchronization.
- o In Manchester encoding, a negative-to-positive transition represents binary 1, and positive-to-negative transition represents 0.
- o Manchester has the same level of synchronization as RZ scheme except that it has two levels of amplitude.

Differential Manchester

- o It changes the signal at the middle of the bit interval for synchronization, but the presence or absence of the transition at the beginning of the interval determines the bit. A transition means binary 0 and no transition means binary 1.
- o In Manchester Encoding scheme, two signal changes represent 0 and one signal change represent 1.

Presence of transition at the beginning of bit means zero.
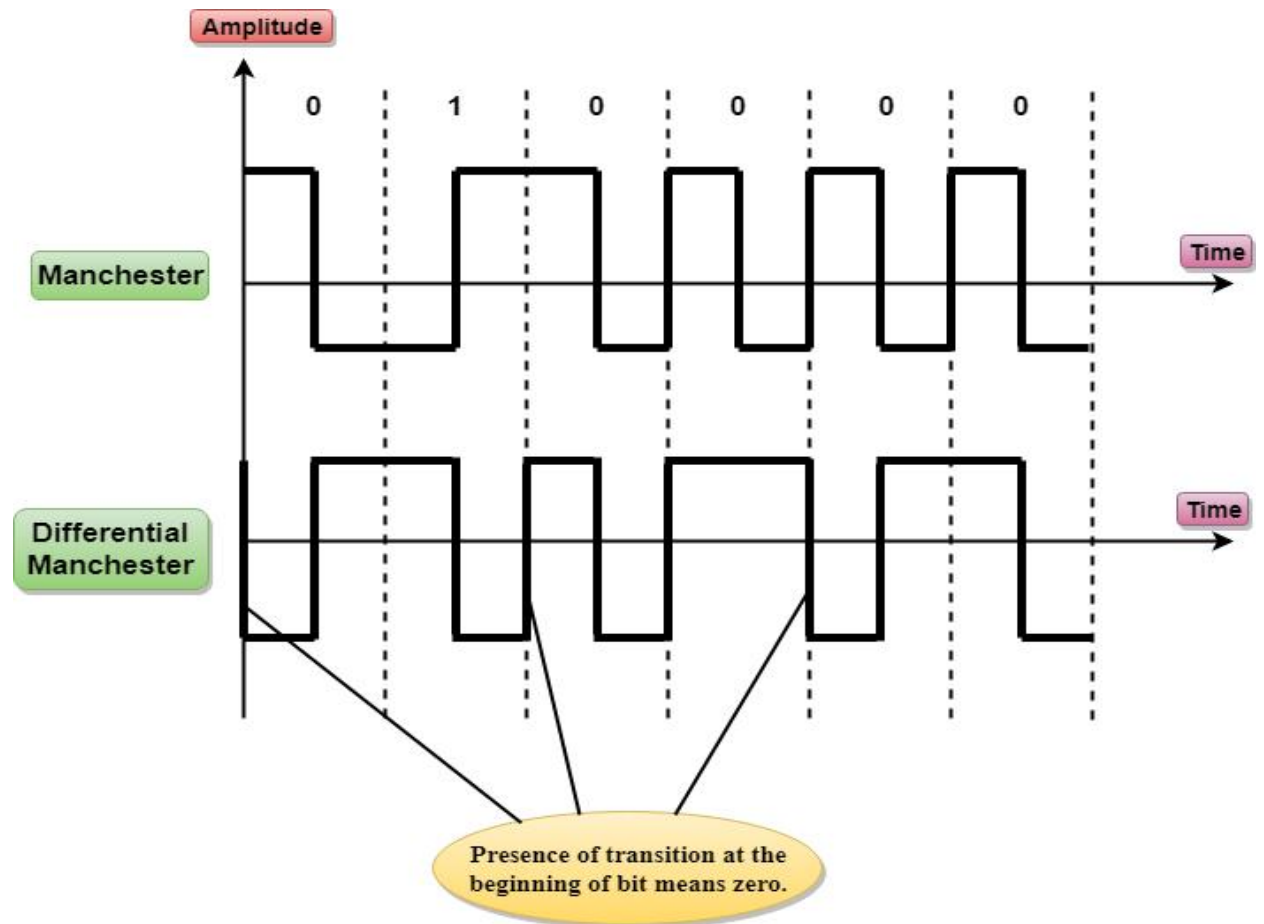
Bipolar

- o Bipolar encoding scheme represents three voltage levels: positive, negative, and zero.
- o In Bipolar encoding scheme, zero level represents binary 0, and binary 1 is represented by alternating positive and negative voltages.
- o If the first 1 bit is represented by positive amplitude, then the second 1 bit is represented by negative voltage, third 1 bit is represented by the positive amplitude and so on. This alternation can also occur even when the 1bits are not consecutive.

Difference between data element and signal element?

A data element is the smallest entity that can represent a piece of information (a bit). A signal element is the shortest unit of a digital signal. Data elements are what we need to send; signal elements are what we can send. Data elements are being carried; signal elements are the carriers.

- ● **Question 2 (b)**

    Answer:

the human voice normally contains frequencies from 0 to 4000 Hz. So the sampling rate and bit rate are calculated as follows:

Sampling rate= 4000 X 2 = 8000 samples/s

Bit rate = 8000X 7 = 56000 bps = 56 kbps

Question NO 3 (a)

Answer : TCP/IP. Stands for "Transmission Control Protocol/Internet Protocol." These two protocols were developed in the early days of the Internet by the U.S. military. The **purpose** was to allow computers to communicate over long distance networks. The **TCP** part has to do with the verifying delivery of the packets.

There are four layer of TCP/IP

Network layer:
Network Access Layer is the first layer of the four-layer TCP/IP model. Network Access Layer defines details of how data is physically sent through the network, including how bits are electrically or optically signaled by hardware devices that interface directly with a network medium, such as coaxial cable, optical fiber, or twisted pair copper wire.

Internet layer :
Internet Layer is the second layer of the four-layer TCP/IP model. The position of Internet layer is between Network Access Layer and Transport layer. Internet layer pack data into data packets known as IP datagrams, which contain source and destination address (logical address or IP address) information that is used to forward the datagrams between hosts and across networks. The Internet layer is also responsible for routing of IP datagrams.

Transport layer: is the third layer of the four-layer TCP/IP model. The position of the Transport layer is between Application layer and Internet layer. The purpose of Transport layer is to permit devices on the source and destination hosts to carry on a conversation. Transport layer defines the level of service and status of the connection used when transporting data.
The main protocols included at Transport layer are TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

Application layer: Application layer is the top most layer of four layer TCP/IP model. Application layer is placed on the top of the Transport layer. Application layer defines TCP/IP application protocols and how host programs interface with Transport layer services to use the network.
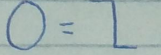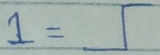
Application layer includes all the higher-level protocols like DNS (Domain Naming System), HTTP (Hypertext Transfer Protocol), Telnet, SSH, FTP (File Transfer Protocol), TFTP (Trivial File Transfer Protocol), SNMP (Simple Network Management Protocol), SMTP (Simple Mail Transfer Protocol) , DHCP (Dynamic Host Configuration Protocol), X Windows, RDP (Remote Desktop Protocol) etc.
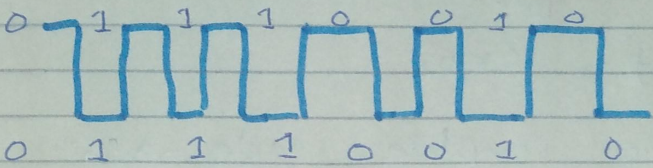
Question No 3(b)

Answer:

Question No 3 (b)

Ans :- Machester Coding

$0 = $ ⌐   and $1 = $ ⌐

Bit Stream = 01110010

0 1 1 1 0 0 1 0

0 1 1 1 0 0 1 0

* Bipolar Alternative Mark Inversion (AMI)
  * Alternative 1 inversion
  * Natural Zero Voltage = Binary 0
  * Binary 1 for alternative +ve and -ve voltage
  → Bit Stream = 01110010

0 1 1 1 0 0 1 0