Department of Electrical Engineering
Assignment
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Course Details

Course Title: Advance Computer Networks **Module:** 3rd
Instructor: Sir naeem ahmad jan **Total Marks:** 30

Student Details

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Q1.	(a)	Explain Physical layer services and Transmission Impairments?	Marks 6
	(b)	Express a period of 1 ms in microseconds, and express the corresponding frequency in kilohertzand A sine wave is offset one-fourth of a cycle with respect to time zero. What is its phase in degrees and radians?	Marks 4
Q2.	(a)	Explain the classification of digital to digital conversion? Difference between data element and signal element?	Marks 6
	(b)	We want to digitize the human voice. What is the bit rate, assuming 7 bits per sample?	Marks 4
Q3.	(a)	Explain the responsibilities of different layers of TCP/IP in detail?	Marks 6
	(b)	Convert the following data 01110010 to Manchester coding and Bipolar AMI?	Marks 4

Q1 (a) Explain Physical layer services and Transmission Impairments?

Physical Layer

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:

○ 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.

○ 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.

○ 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.

- **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.

(b) Express a period of 1 ms in microseconds, and express the corresponding frequency in kilohertz and A sine wave is offset one-fourth of a cycle with respect to time zero. What is its phase in degrees and radians?

1 ms = $1 * 10^{-3}$s

= $10^{-3} * 10^{3} * 10^{-3}$s
= $10^{3} * 10^{-6}$s
= 10^{3}μs

1 ms= 10^{-3}μs
As 1ms =10^{-3}

As f= 1/t

So

f = $1/10^{-3}$Hz
f = 10^{3} Hz
a sin wave is offset one fourth of a cycle with respect to time zero its phase is degree is :
f = 1000 Hz **f=1KHz**

As complete cycle is 360^{o}
Therefore ¼ cycle is

1/4 *360 = 90^{o}

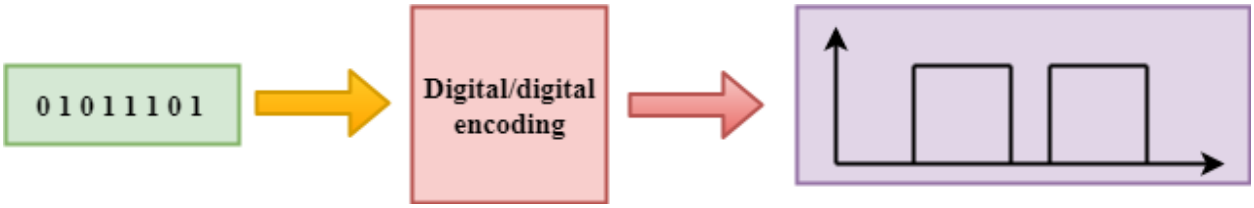
A sin wave is offset one forth of a cycle with respect to time zero its phase in radian is

$90^{o} * \frac{2\pi}{360} = \frac{\pi}{2}$ = **1.5708radian**

Q2 (a) Explain the classification of digital to digital conversion? Difference between data element and signal element?

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.



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

Digital-to-digital encoding is divided into three categories:

- Unipolar Encoding
- 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.

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.

Bipolar

- Bipolar encoding scheme represents three voltage levels: positive, negative, and zero.

- In Bipolar encoding scheme, zero level represents binary 0, and binary 1 is represented by alternating positive and negative voltages.
- 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.

(b) We want to digitize the human voice. What is the bit rate, assuming 7 bits per sample?

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

Q3 (a) Explain the responsibilities of different layers of TCP/IP in detail?

Layer 1. Network Access 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. The protocols/standards included in Network Access Layer are Ethernet, Token Ring, FDDI, X.25, Frame Relay etc. The most popular LAN architecture

among those listed above is Ethernet. Ethernet uses an Access Method called CSMA/CD (Carrier Sense Multiple Access/Collision Detection) to access the media, when Ethernet operates in a shared media. An Access Method determines how a host will place data on the medium. IN CSMA/CD Access Method, every host has equal access to the medium and can place data on the wire when the wire is free from network traffic. When a host wants to place data on the wire, it will check the wire to find whether another host is already using the medium. If there is traffic already in the medium, the host will wait and if there is no traffic, it will place the data in the medium. But, if two systems place data on the medium at the same instance, they will collide with each other, destroying the data. If the data is destroyed during transmission, the data will need to be retransmitted. After collision, each host will wait for a small interval of time and again the data will be retransmitted.

Layer 2. 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.

Packet switching network depends upon a connectionless internetwork layer. This layer is known as Internet layer. Its job is to allow hosts to insert packets into any network and have them to deliver independently to the destination. At the destination side data packets may appear in a different order than they were sent. It is the job of the higher layers to rearrange them in order to deliver them to proper network applications operating at the Application layer.

Layer 3. Transport Layer

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).

Layer 4. 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.

(b) Convert the following data 01110010 to Manchester coding and Bipolar AMI?

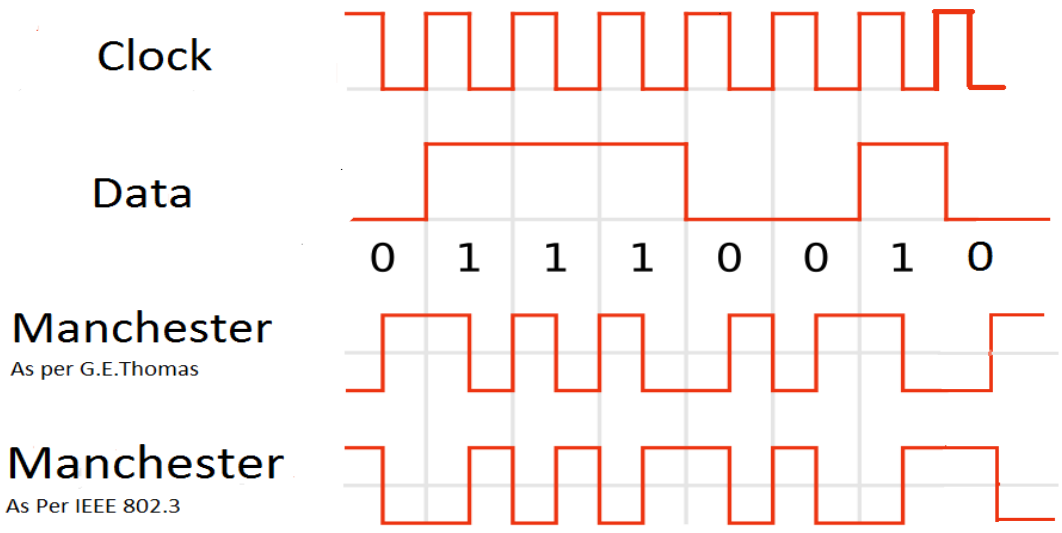
Application layer includes all the higher-level protocols like DNS (Domain Naming System), HTTP (Hypertext Transfer Protocol), Telnet, SSH, FTP (File Transfer Protocol), TFTP (Trivial File Transfer Protocol), SNMP (Simple Network Management Protocol), SMTP (Simple Mail Transfer Protocol) , DHCP (Dynamic Host Configuration Protocol), X Windows, RDP (Remote Desktop Protocol) etc.

Manchester Coding :

In telecommunication and data storage, Manchester code (also known as phase encoding, or PE) is a line code in which the encoding of each data bit is either low then high, or high then low, for equal time. It is a self-clocking signal with no DC component. As a result, electrical connections using a Manchester code are easily galvanic ally isolated.

The first of these was first published by G. E. Thomas in 1949 and is followed by numerous authors (e.g., Andy Tanenbaum). It specifies that for a 0 bit the signal levels will be low-high (assuming an amplitude physical encoding of the data) - with a low level in the first half of the bit period, and a high level in the second half. For a 1 bit the signal levels will be high-low.

The second convention is also followed by numerous authors (e.g., William Stallings) as well as by IEEE 802.4 (token bus) and lower speed versions of IEEE 802.3 (Ethernet) standards. It states that a logic 0 is represented by a high-low signal sequence and a logic 1 is represented by a low-high signal sequence.



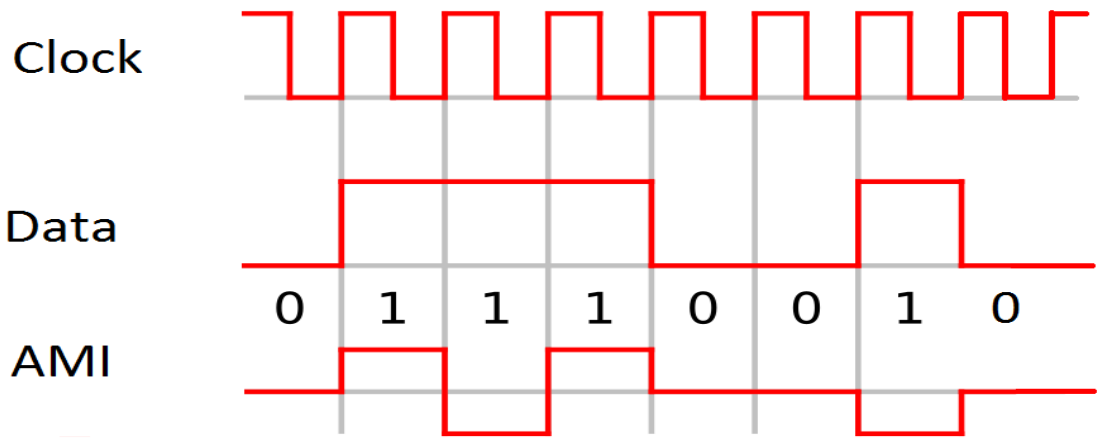
So data encodes to **1001010110100110**

Bipolar

- Bipolar encoding scheme represents three voltage levels: positive, negative, and zero.
- In Bipolar encoding scheme, zero level represents binary 0, and binary 1 is represented by alternating positive and negative voltages.
- 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

Bipolar AMI :

One kind of bipolar encoding is a paired disparity code, of which the simplest example is alternate mark inversion. In this code, a binary 0 is encoded as zero volts, as in unipolar encoding, whereas a binary 1 is encoded alternately as a positive voltage or a negative voltage. The name arose because, in the context of a T-carrier, a binary '1' is referred to as a "mark", while a binary '0' is called a "space"



So data encodes to **0 +1 -1 +1 0 0 -1 0**