

- 1 a) **Label** the frames (1 & 2) shown below in Figure No. 1 with appropriate port, IP and MAC addresses. The sender Host A has two applications running; one for FTP with port number 51024 and the other for accessing the web server with port number 52348. Frame 1 is coming from TEST web server to HOST A and Frame 2 is intended for the web server from Host A. Web server use port number 80 to send data to clients. (For indicating MAC addresses just mention the device or device interface).

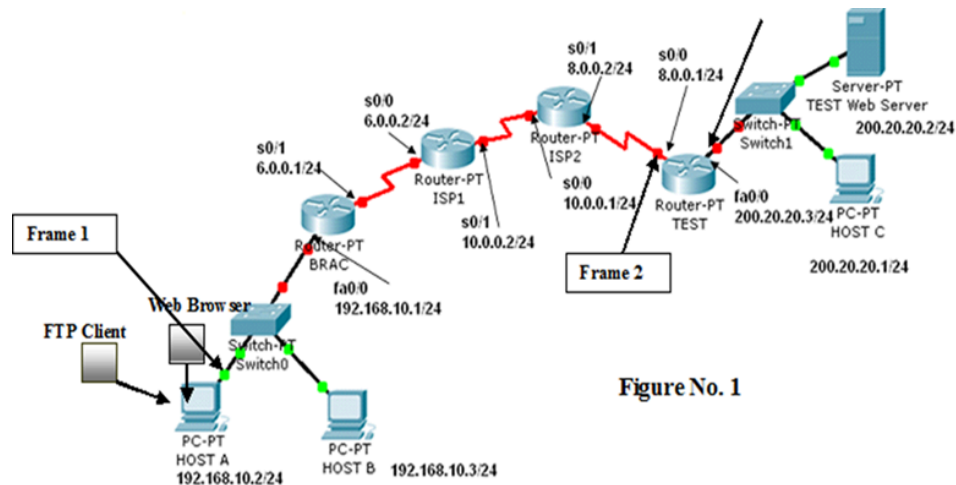


Figure No. 1

D.MAC	S.MAC	D.IP	S.IP	D.Port	S.Port	Frame 1
D.MAC	S.MAC	D.IP	S.IP	D.Port	S.Port	Frame 2

- b) **Show** diagrammatically a hybrid topology with a mesh backbone and three-star networks consisting of 4 nodes at each hub. In the topology drawn, **identify** any possible problems or failures that could bring the whole network down. Justify your answer.
- 3 a) **Convert** the following bit stream to a digital signal using an appropriate encoding scheme that matches the requirements given. Write which signal encoding scheme you are using.

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

Requirements

- The encoding scheme does not support self-synchronization for long 0's. Additionally, this scheme maintains a bipolar nature.

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

- b) The following table depicts a sampled analog signal for digital signal representation. By applying the concept of Pulse Code Modulation, assume there will be 3-bit code words for each sampled amplitude. **Show** the normalized quantized value and quantization code for the given analog signal value at different time stamps. Assume that the sampling amplitudes are between -40V to +40V.

Time	Analog Signal Value (V)
0	3.3
1	-12.7
2	26.8
3	-31.4
4	-18.6

- 1
- b) **List** two differences between IP and Port Address. Suppose, Bob needs to log into his bank account several times a day. Due to the sensitive information related to bank accounts, the data needs to be secured. **Select** which of the OSI model layer(s) might be responsible for this?
- c) **Identify** the name of the OSI model layers based on the following functionalities.
- The layer responsible for reducing the size of data at each hop.
 - The layer responsible for giving service to the user.
 - The layer responsible for restarting browsers which was idle for a long time.
 - The layer responsible for translating data.

3. CO2 a) **Convert** the following bit stream to digital signal using an appropriate encoding scheme that matches the requirements given. Write which signal encoding scheme you are using.

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

Requirements

- The encoding scheme supports self-synchronization for long 0's. Additionally, this scheme maintains no DC component.
 - Now apply a technique to prevent long sequences of 0's in the above scheme without increasing the number of bits and signals.
- b) The following table depicts a sampled analog signal for digital signal representation. By applying the concept of Pulse Code Modulation, assume there will be 3-bit code words for each sampled amplitude. **Show** the normalized quantized value and quantization code for the given analog signal value at different time stamps. Assume that the sampling amplitudes are between -24V to +24V.

Time	Analog Signal Value (V)
0	4.3
1	-13.7
2	6.8
3	16.4
4	-22.6

1. a) Considering the following scenarios:
- There are 10 labs in UB06, each having 40 PCs that can communicate with each other.
 - PCs in BU01 can communicate with PCs at BRAC Centre (Both are in different networks).
 - BRAC Center can communicate with BRAC CDM located at Rajendrapur.
 - A number of fire stations located in a city are connected, so office staff can easily communicate with one another.

Match each of the above scenarios to an appropriate network type (LAN, WAN, MAN). Give reasons for your choice.

- b) **Identify** different topologies in the following computer network of hybrid topology.

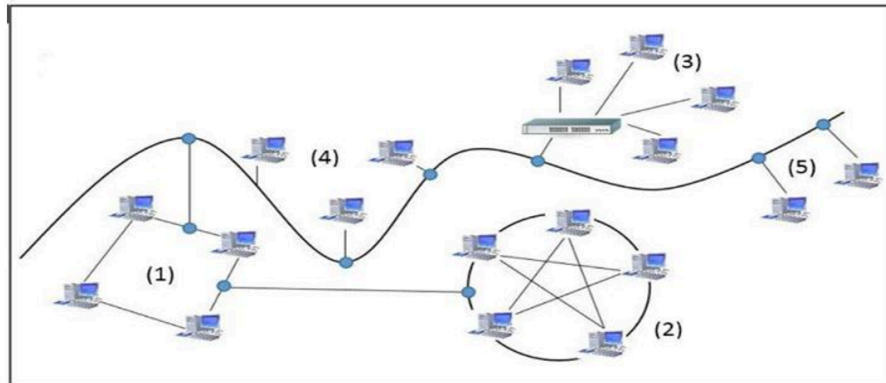


Figure 1 Hybrid Topology

2.
 - a) **Compare** between Attenuation and Noise and also **explain** how both of the impairments can be solved.
 - b) Consider a communications channel being used by a cable modem network. The channel has use of the spectrum between 104MHz and 119MHz. The signal power is 22mW and the noise power is 2mW.
 - **Interpret** the theoretical maximum capacity of the channel in bps.
 - Assuming the capacity of the channel could be realized, **distinguish** how many signal levels would be needed?
 - **Discuss** what advantage/disadvantage, if any, would there be in using twice this number of signal levels.
3.
 - a) **Convert** the following bit stream to a signal using an appropriate encoding scheme that matches the requirements given. Write which signal encoding scheme you are using.
 Data: 1 0 1 0 1 1 0 1 1 1 0 0 0 0 1
Requirements
 - The encoding scheme must occupy a low bandwidth. Any self-synchronization and DC component problem may be ignored.
 - The encoding scheme must be self-synchronizing and should not have a DC component problem. High bandwidth is Acceptable.
1.
 - a) **Identify** each of the below scenarios to an appropriate network type (PAN, LAN, WAN, MAN). Give reasons for your choice.
 - Adam is sending an audio file using WhatsApp from his mobile to his friend who is sitting beside him in a coffee shop.
 - In BRAC BANK Gulshan branch: IT department, employees are exchanging files among them using their network.

- PCs in Ayesha Abed Library can communicate with PCs at BRAC Center (Both are in different networks).
- A number of convenient stores (ex: Seven Eleven) located in a city are connected, so office staff can easily communicate with one another.

b) **Illustrate** a heterogeneous network made of four WANs and five LANs.

2. a) In which factors data rate depends on? What is the difference between bandwidth in hertz and bandwidth in bps?

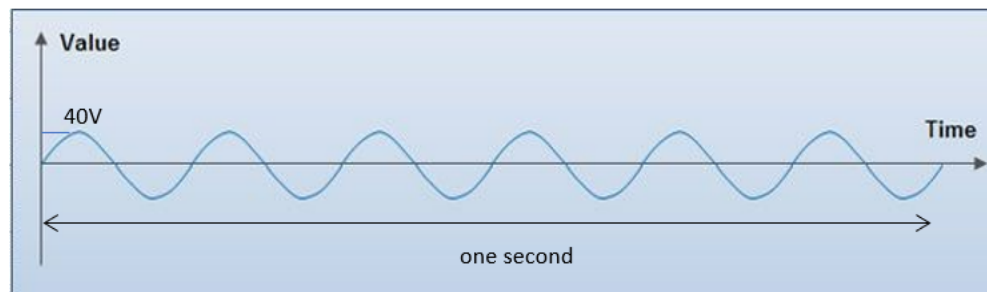


Figure 1: Analog Signal (time Vs Amplitude)

In the above Figure 1, **determine** the time period and frequency of the analog signal. Also **show** the frequency domain representation of the signal if the maximum amplitude is 40v.

3. a) **Convert** the following bit stream to a signal using an appropriate encoding scheme that matches the requirements given. Write which signal encoding scheme you are using.

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

Requirements

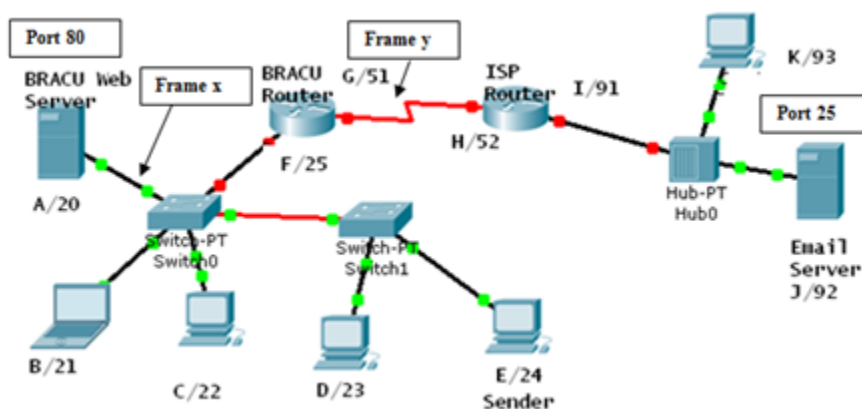
- The encoding scheme must occupy a low bandwidth. Any self-synchronization and DC component problem may be ignored.
- No DC component. Low bandwidth is required. Self-synchronization is ignored.

1. Banglalink has a bandwidth of 3.5 kHz (0.3 to 3.8 kHz) assigned for voice calls. If the signal-to-noise is 5021. What is the theoretical highest bit rate of Banglalink? How many levels are required? [5]

2. Write the difference between bandwidth and throughput. If the distance between the sender and receiver is higher then the transmission delay becomes higher as well. Yes or No? Explain your answer. [5]

2. Imagine, in a network, a PC is connected to a switch, and the switch is then connected to router R1. Router R1 is then connected with router R2. Which device is the first hop, if the PC is the source? Which device is the first hop, if router R2 is the source? Draw the physical topology. [5]

2. Complete the frames (x & y) given below with appropriate port, IP and MAC addresses. The sender Host E has two applications running; one for email with port number 63170 and the other for accessing the web server with port number 71033. The frame x is intended for the BRACU Web server and frame y is coming from the Email Server. (MAC addresses are alphabets and IP addresses are numbers) [5]



Frame X

D. Mac	S. MAC	D. IP	S. IP	D. Port	S. Port	Data	Trailer
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Frame Y

D. Mac	S. MAC	D. IP	S. IP	D. Port	S. Port	Data	Trailer
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1. b) **Illustrate** diagrammatically a *hybrid* topology with a *ring* backbone and three *star* networks consisting of 4 nodes at each hub. In the topology drawn, identify one possible problem or failure that could bring the whole network down and justify your answer.

c) **Identify** the name of the TCP/IP model layers based on the following functionalities:

- The layer processes information which helps us identify a network.
- The layer responsible for transmitting data over fiber-optic.
- This layer translates messages from one language to another.
- This layer uses sequence numbers to sort segments.

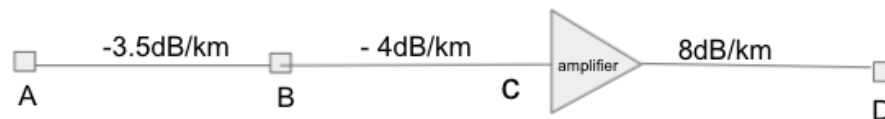
3. a) **Convert** the following bit stream to digital signal using an appropriate encoding scheme that matches the requirements given below. Write which signal encoding scheme you are using.

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

Given Requirement 1 : The encoding scheme does not support self-synchronization for long 0's.

Given Requirement 2 : Now apply a North American technique to prevent long sequences of 0's without increasing signals.

1. b) **Illustrate** diagrammatically a hybrid topology with a bus backbone and three-star networks consisting of 4 nodes at each hub. In the topology drawn, identify at least one possible problem or failure that could bring the whole network down and justify your answer.
2. b) Suppose $AB = 0.3\text{km}$, $BC = 0.5\text{km}$ and $CD = 0.3\text{km}$. The signal has a power of 4mW at the beginning of the cable (point A). **Predict** if the signal has gained or lost at point **D**? (measure in dB)



3. a) **Convert** the following bit stream to digital signal using an appropriate encoding scheme that matches the requirements given below. Write which signal encoding scheme you are using.

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

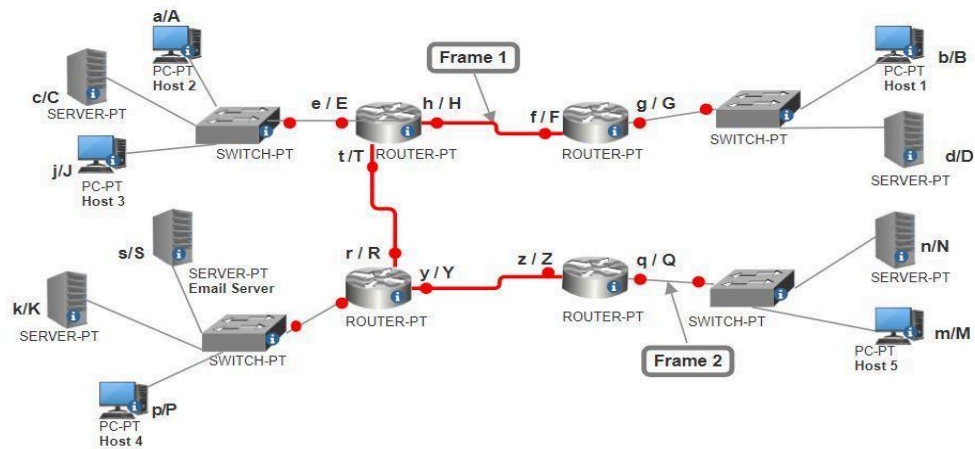
Given Requirement 1 : The encoding scheme must occupy a low bandwidth. Any self-synchronization and DC component problem may be ignored.

Given Requirement 2 : The encoding scheme must be self-synchronizing and should not have a DC component problem. High signal rate is not acceptable.

- b) The following table depicts a sampled analog signal for digital signal representation. By applying the concept of Pulse Code Modulation, assume there will be 3-bit code words for each sampled amplitude. **Show** the normalized quantized value and quantization code for the given analog signal value at different time stamps. Assume that the sampling amplitudes are between -16V to +16V.

Time	Analog Signal Value (V)
0	2.3
1	-12.7
2	6.8
3	-9.4
4	-14.8

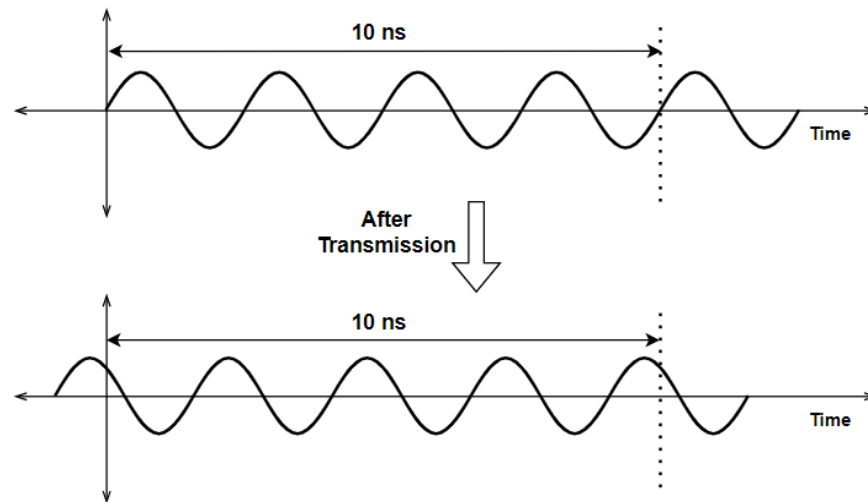
1. a) Complete the frames (1 & 2) given below with appropriate port, IP and MAC addresses. Frame 1 is intended for Host 5 for sending a message from Host 1. Frame 2 is coming from the Email server to Host 5. Assume that Mac addresses are Uppercase Letters, and logical addresses are lowercase letters. For Port Address, use Dynamic Port address, for the user processes (49,152 - 65,535), and for server, use well- known addresses (0-1023).



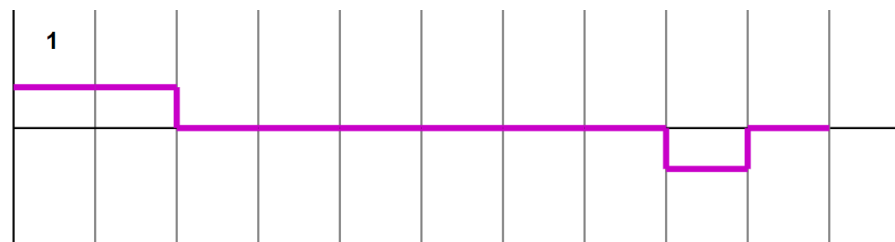
Frame 1	Destination MAC	Source MAC	Destination IP	Source IP	Destination Port	Source Port	Data	Trailer
Frame 2	Destination MAC	Source MAC	Destination IP	Source IP	Destination Port	Source Port	Data	Trailer

- b) Let there are 3 buildings in your university campus. Buildings are connected using mesh topology. Each building has 4 computer Labs. Each Lab has 8 computers. The computers are connected using bus topology but the Labs of a single building are connected using star topology. Draw your campus hybrid topology. How many links will there be?

2. a) I. Find the frequency and time period of the given signal.
- II. Can you relate any kind of transmission impairment with the scenario in the given figure? Justify your answer.



3. a) The following signal is drawn using a multi-transition line encoding technique where 3 transition rules and 3 levels are used.
- i. Decode the bit stream from it.
- ii. Encode it using Bipolar AMI encoding, **apply** any appropriate Scrambling method to get rid of the consecutive 0 problem if there is any.



1. b) Let there are 4 buildings in your university campus. Buildings are connected using star topology. Each building has 4 computer Labs. Each Lab has 5 computers. The computers are connected using bus topology but the Labs of a single building are connected using mesh topology. Draw your campus hybrid topology. How many links will there be?

c) Suppose you want to send a letter to your friend. Find out which layer of the **TCP/IP model** corresponds to the following tasks you are going to perform:

- For secrecy, you write the letter using Caesar cipher.
- Your building has multiple flats, but they use a common mailbox. You drop your letter to the mailbox.
- Your letter is sorted and redirected to the post office of the receiver's area by your area's post office.
- Your letter is carried by a postman from the mailbox of your building to the nearest post office.

3. a) The following signal is drawn using a multi-transition line encoding technique where 3 transition rules and 3 levels are used.
[CO2]

- i. Decode the bit stream from it.
- ii. Encode it using Bipolar AMI encoding, **apply** any appropriate Scrambling method to get rid of the consecutive 0 problem if there is any.

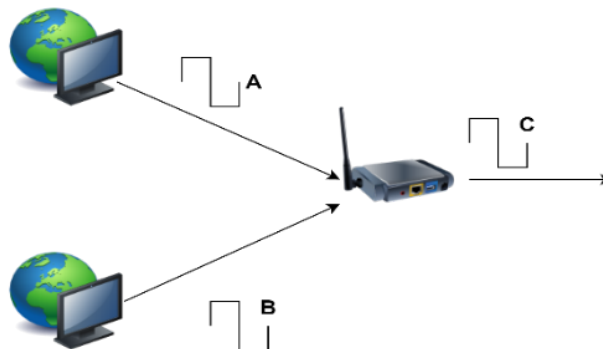


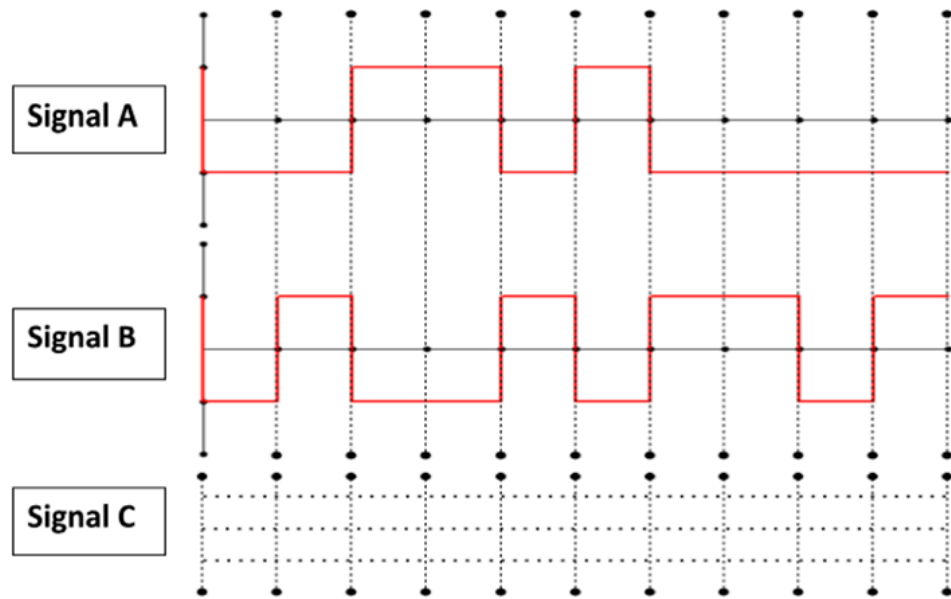
1. a) Suppose there are 4 buildings in BRACU's new campus. Buildings are connected using bus topology. Each building has 3 CSE Labs. Each Lab has 4 computers. The computers are connected using mesh topology but the Labs of a single building are connected using star topology. **Draw** the BRACU new campus hybrid topology. How many links will there be (links are using full-duplex transmission mode)?

b) **Identify** the name of the **TCP/IP model** layers based on the following functionalities.

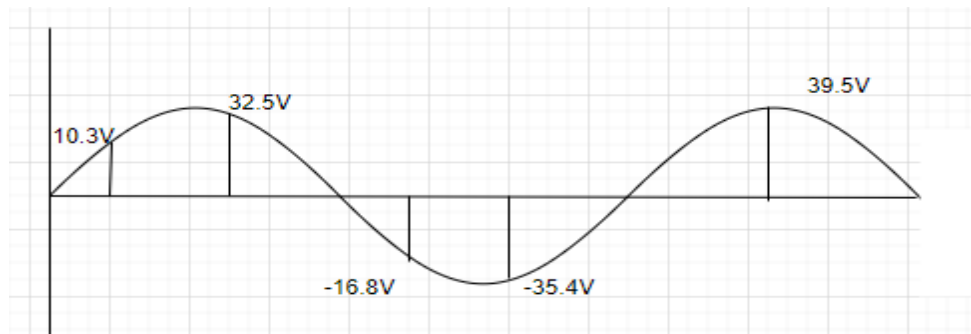
- Enables resource sharing and remote file access among network users.
- Responsible for converting data into signals for transmission over a physical medium.

- Responsible for establishing and terminating communication sessions.
 - Ensure reliable hop to hop transmission.
- c) **Identify** at least 2 differences amongst logical, physical and port addresses. Explain with an example why all these addresses are needed?
- c) Consider a communication channel that requires to send 108 GB within 6 hours. The link operates on signals with frequency range from 900 KHz to 14 MHz. If the link is perfect, i.e., no noise is introduced in the link,
- **Determine** the number of voltage levels needed to fulfill the requirement.
 - In practice, there is no noise free channel. Suppose, the strength of the noise power is 20mW which is 60 times weaker than the signal power. **What** will be the channel capacity considering the noise?
3. a) Two devices A and B are sending digital signals using the NRZ-I-line coding scheme. Device C is receiving the signal simultaneously and combining them using bitwise AND operation. Then produces the final digital signal using a line coding scheme that doesn't have the consecutive 0 problem. Illustrate the final signal produced by C. [You can use any valid line coding scheme for C] [Draw it in the question paper only.]





- b) The following figure depicts a sampled analog signal for digital signal representation. By applying the concept of **Pulse Code Modulation**, assume there will be **3-bit** code words for each sampled amplitude. **Show the normalized Quantized value and quantization code** for the given analog signal value at different time stamps. Assume that the sampling amplitudes are between -40V to $+40\text{V}$.



1.
 - b) **Identify** the name of the **TCP/IP model** layers based on the following functionalities.
 - Determines the logical address of the destination device.
 - Ensures no unintended party can eavesdrop on the data being transmitted.
 - Prevents traffic congestion between a device and its neighbouring hop.
 - Ensures that data is received by the correct process among many processes running on the destination host.
 - c) **Describe** how the sender and receiver use the capacity of the channel in simplex, half-duplex and full-duplex mode.
 - c) Consider a communication channel that requires to send 108 GB within 8 hours. The link operates on signals with frequency range from 800 KHz to 13 MHz. If the link is perfect, i.e., no noise is introduced in the link,
 - **Determine** the number of voltage levels needed to fulfill the requirement.
 - In practice, there is no noise free channel. Suppose, the strength of the noise power is 30mW which is 20 times weaker than the signal power. **What** will be the channel capacity considering the noise?

- b) The following figure depicts a sampled analog signal for digital signal representation. By applying the concept of **Pulse Code Modulation**, assume there will be **3-bit** code words for each sampled amplitude. **Show the normalized quantized value and quantization code** for the given analog signal value at different time stamps. Assume that the sampling amplitudes are between -20V to +20V.

