SCHEME : K

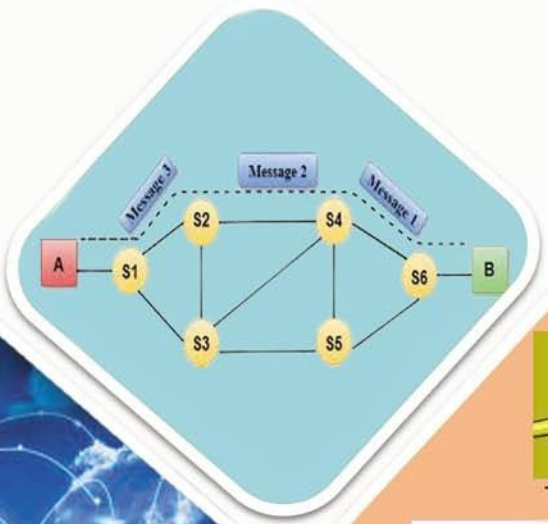
Name : _____

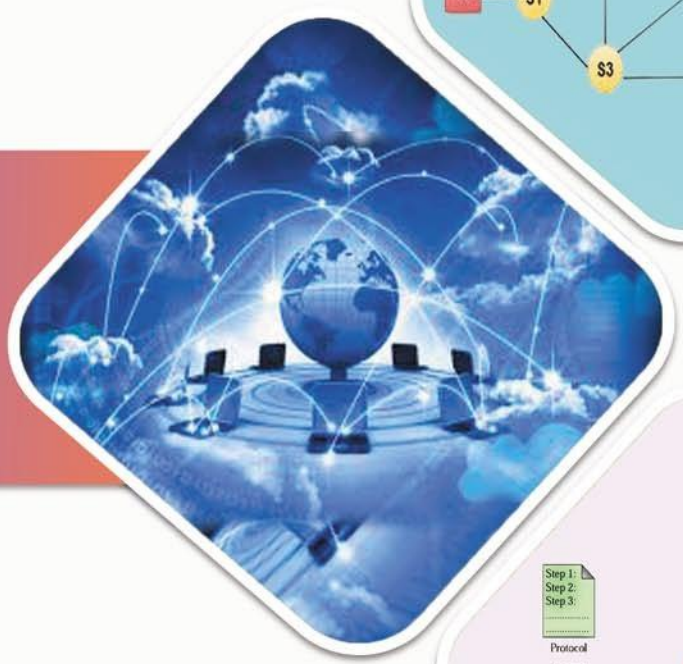
Roll No. : _____ Year : 20___ 20___

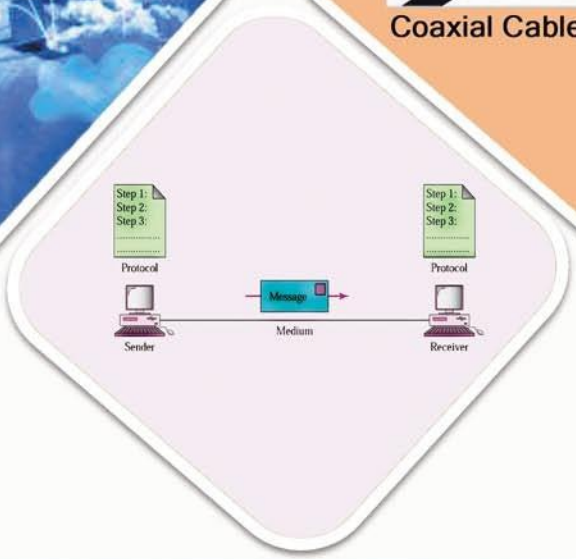
Exam Seat No. : _____

LABORATORY MANUAL FOR

DATA COMMUNICATION AND COMPUTER NETWORK - 314318







COMPUTER ENGINEERING GROUP

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001: 2015) (ISO/IEC 27001:2013)

Vision

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

Mission

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

Quality Policy

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

Core Values

MSBTE believes in the following:

- Skill development in line with industry requirements
- Industry readiness and improved employability of Diploma holders
- Synergistic relationship with industry
- Collective and Cooperative development of all stake holders
- Technological interventions in societal development
- Access to uniform quality technical education

A Practical Manual
for

Data Communication and Computer Network

(314318)

Semester-IV

AI/ AN/ BD/ CM/ CO/ CW/ DS/ HA/ IF/ IH

Maharashtra State Board of Technical Education, Mumbai

(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

"K" Scheme Curriculum

Maharashtra State Board of Technical Education, Mumbai
(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)
4th Floor, Government Polytechnic Building
49, Kherwadi, Bandra (East), Mumbai – 400051

Maharashtra State Board of Technical Education
Certificate

This is to certify that Mr./Ms. …… Roll No…… of the Fourth Semester of Diploma in …… Engineering/Technology (Program Code - .....4K) of the Institute …… (Inst. Code……) has completed the practical work satisfactorily for the course Data Communication and Computer Network (Course Code: 314318) for the academic year 20….. – 20…..... as prescribed in the curriculum.

Place ……. Enrollment No……

Date: …..... Exam Seat No. …….....

Course Teacher **Head of the Department** **Principal**

Seal of the Institute

Preface

Data Communication and Computer Network (314318) laboratory manual is meticulously crafted to equip fourth semester diploma engineering students with valuable practical learning experiences aligned with MSBTE 'K' Scheme Curriculum.

The primary objective of this manual is to enhance valuable skills in data communication and computer network of diploma engineering students which is vital to excel at the workplace. To achieve this, each practical is mapped with prescribed theory learning outcomes (TLOs), lab learning outcomes (LLOs) and course outcomes (COs). Course facilitators can adopt suitable pedagogical methods to impart the course with an aim to achieve the prescribed course outcomes effectively.

This laboratory manual is designed to help all stakeholders, especially the students and teachers to develop in the student the pre-determined outcomes. Every practical in this manual begins by identifying the Practical Significance, Industry/Employer expected outcome, Course Level Learning Outcomes, and Laboratory Learning Outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This laboratory manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students. Data communication deals with the transmission of digital data through a network. Many applications like Airline Reservations, Railway reservations, e-banking, e-governance, Online Shopping, e-learning can be managed by a single click. Diploma Engineers should be able to select, classify, install, troubleshoot and maintain different industrial data communication networks.

This laboratory manual gives the important concepts and techniques related to data communication and enable students to create, maintain and troubleshoot computer networks.

Program Outcomes (POs) to be achieved through Course:

PO1 Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

PO2 Problem analysis: Identify and analyses well-defined engineering problems using codified standard methods.

PO3 Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

PO4 Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO5 Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO6 Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

PO7 Life-long learning: Ability to analyses individual needs and engage in updating in the context of technological changes.

Practical Course Outcome Matrix

Course Outcomes (COs)

CO1	Analyze the functioning of Data Communication and Computer Network.
CO2	Select relevant Transmission Media and Switching Techniques as per need.
CO3	Analyze the Transmission Errors with respect to IEEE standards.
CO4	Configure different TCP/IP services.
CO5	Implement relevant Network Topology using Networking Devices.

Sr. No.	Title of the Experiment	CO1	CO2	CO3	CO4	CO5
1	* Amplitude Shift Keying(ASK) using any simulator	✓				
2	Frequency Shift Keying(FSK) using any simulator	✓				
3	Frequency Shift Keying(FSK) using any simulator	✓				
4	*Create and Test standard straight network cable(Universal Colour Code) using crimping tool		✓			
5	Create and Test standard Cross network cable(Universal Colour Code) using crimping tool		✓			
6	* Generate a Time Division Multiplexing(TDM) signal using relevant simulation software		✓			
7	*Create a Hybrid Network Using Bluetooth			✓		
8	*Locate the error bit in the given data string by applying checksum error detection method			✓		
9	*Implement Wireless network			✓		
10	Write a 'C' program for parity check error detection			✓		
11	*Write a 'C' program for Cyclic Redundancy Check(CRC) error detection			✓		
12	*Write a 'C' program for error correction using Hamming code			✓		
13	*Configure static IP address in operating system along with appropriate subnet mask for given problem				✓	
14	* Implement Classful Address in a given network node i)Identify range of IP Address in various classes ii)Justify the reason to choose various IP address classes for creating given network				✓	
15	*Execute TCP/IP network commands: ipconfig, ping,tracert				✓	
16	*Execute TCP/IP network commands: netstat, pathping, route				✓	

17	*1) Install Wireshark and configure as packet sniffer- i)Capture IP,TELNET, FTP packets using Wireshark				✓	
18	Capture TCP and UDP packet using Wireshark				✓	
19	Capture ARP and ICMP packet Traffic using Wireshark				✓	
20	Install Operating System Linux/Windows/Any other Server				✓	
21	Use FTP protocol to transfer file from one system to another system				✓	
22	Create IPv6 environment in a small network using simulator				✓	
23	*Create HTTP server					✓
24	*Create computers using Star topology with wired media					✓
25	Create Tree topology using CISCO packet tracer software					✓
26	Configure TELNET for remote login					✓
27	*Visit your computer laboratory)Identify the type of topology ii)Identify types of connecting devices with specifications iii)Identify types of cables with specifications iv)List the type of network applications commonly used in the laboratory iv)Draw the layout of installed network					✓
28	Share folder and printer in a network					✓

Guidelines to Teachers

1. Teacher is expected to refer complete curriculum document and follow guidelines for implementation before start of curriculum.
2. At the beginning teacher should make the students acquainted with any of the given Simulation software environment as few practical are based on simulation.
3. Teacher should provide the guideline with demonstration of practical to the students with all features.
4. Teacher shall explain prior concepts to the students before starting of each practical
5. Involve students in performance of each practical.
6. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
7. Teachers should give opportunity to students for hands on experience after the demonstration.
8. Teacher is expected to share the skills and competencies to be developed in the students.
9. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.

Instructions for Students

1. Listen carefully the lecture given by teacher about course, curriculum, learning structure, skills to be developed.
2. Before performing the practical student shall read lab manual of related practical to be conducted.
3. Organize the work in the group and make record of all observations.
4. Students shall develop maintenance skill as expected by industries.
5. Student shall attempt to develop related hand-on skills and gain confidence.
6. Student shall develop the habits of evolving more ideas, innovations, skills etc.
7. Student shall refer technical magazines, IS codes and data books.
8. Student should develop habit to submit the practical on date and time.
9. Student should well prepare while submitting write-up of exercise.

Content Page

List of Practical and Formative Assessment Sheet

Sr. No	Practical Title	Date of Performance	Date of Submission	Assessment Marks (25)	Teacher's Sign	Remark
1	* Amplitude Shift Keying(ASK) using any simulator					
2	Frequency Shift Keying(FSK) using any simulator					
3	Frequency Shift Keying(FSK) using any simulator					
4	*Create and Test standard straight network cable(Universal Colour Code) using crimping tool					
5	Create and Test standard Cross network cable(Universal Colour Code) using crimping tool					
6	* Generate a Time Division Multiplexing(TDM) signal using relevant simulation software					
7	*Create a Hybrid Network Using Bluetooth					
8	*Locate the error bit in the given data string by applying checksum error detection method					
9	*Implement Wireless network					
10	Write a 'C' program for parity check error detection					
11	*Write a 'C' program for Cyclic Redundancy Check(CRC) error detection					
12	*Write a 'C' program for error correction using Hamming code					
13	*Configure static IP address in operating system along with appropriate subnet mask for given problem					
14	* Implement Classful Address in a given network node i)Identify range of IP Address in various classes ii)Justify the reason to choose various IP address classes for creating given network					

15	*Execute TCP/IP network commands:ipconfig, ping,tracert					
16	*Execute TCP/IP network commands: netstat, pathping, route					
17	*Install Wireshark and configure as packet sniffer- i)Capture IP,TELNET, FTP packets using Wireshark					
18	Capture TCP and UDP packet using Wireshark					
19	Capture ARP and ICMP packet Traffic using Wireshark					
20	Install Operating System Linux/Windows/Any other Server					
21	Use FTP protocol to transfer file from one system to another system					
22	Create IPv6 environment in a small network using simulator					
23	*Create HTTP server					
24	*Create computers using Star topology with wired media					
25	Create Tree topology using CISCO packet tracer software					
26	Configure TELNET for remote login					
27	*Visit your computer laboratoryi)Identify the type of topology ii)Identify types of connecting devices with specifications iii)Identify types of cables with specifications iv)List the type of network applications commonly used in the laboratory iv)Draw the layout of installed network					
28	Share folder and printer in a network					
				Total		

***Total marks to be transferred to proforma published by MSBTE**

Note:

- '*' Marked Practical's (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

Practical No. 1: *Amplitude Shift Keying (ASK) using any simulator

I **Practical Significance**

Amplitude Shift Keying (ASK) is a type of Amplitude Modulation which represents the binary data in the form of variations in the amplitude of a signal. Any modulated signal has a high frequency carrier. The binary signal when ASK modulated, gives a zero value for Low input while it gives the carrier output for High input. This practical is designed to explain how change of amplitude in to level corresponds to logic 1 and logic 0.

II **Industry / Employer Expected Outcome(s)**

1. To test the performance of Amplitude Shift Keying (ASK) using relevant simulation software.
2. To gain knowledge about Amplitude Shift Keying (ASK)

III **Course Level Learning Outcomes(s)**

CO1 - Analyze the functioning of Data Communication and Computer Network

IV **Laboratory Learning Outcome(s)**

LLO 1.1 Implement Amplitude Shift Keying (ASK)

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

Proposition 1: Amplitude Shift Keying (ASK) is a digital modulation technique. It transmits the digital information by varying the amplitude of a carrier signal. In ASK, a high-amplitude carrier signal is used to represent a binary _1,‘ and a low-amplitude carrier signal represents a binary _0.‘

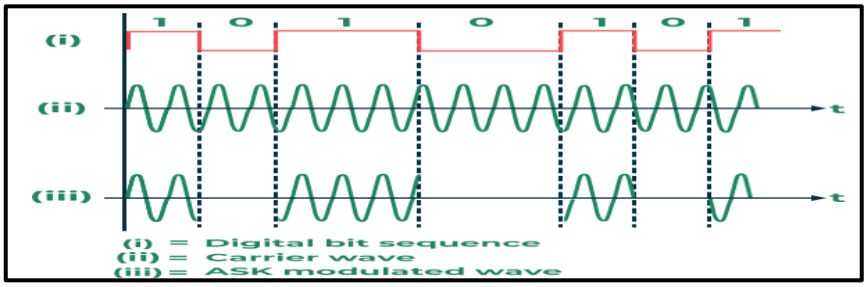


Fig.No.1.1. Amplitude Shift Keying (ASK)

VII **Recourses Required:**

- Desktop Computer
- Simulation Software (Lab view/ MATLAB /SCILAB/P Spice /HS Spice / Multisim/ Proteus or any other relevant open source software)

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure**

1. Open MATLAB
2. Go to file and create a new (.m) file.
3. Type the below code in the code window.

Use this link to install MATLAB software

https://in.mathworks.com/products/matlab-online.html

Sample code for ASK using MATLAB

```
clc;
close all;
clear all;
a=5;                                    %Amplitude
t=0:0.001:1;
f1=input('carrier frequency:');         % for example  25
f2=input('pulse frequency:');           % for example  5

x=a.*sin(2*pi*f1*t)+(a/2);              %carrier
subplot(3,1,1);
plot(t,x);
title('Carrier');
grid on;
u=a/2.*square(2*pi*f2*t)+(a/2);         %Message signal
subplot(3,1,2);
plot(t,u);
title('Square Pulses');
grid on;
v=x.*u;
subplot(3,1,3);
plot(t,v);
title('ASK Signal');
grid on;
```

4. Save the file.
5. Define the path directory.
6. Run the program using F5 key or run command.
7. Observe the output ASK signal in command window.

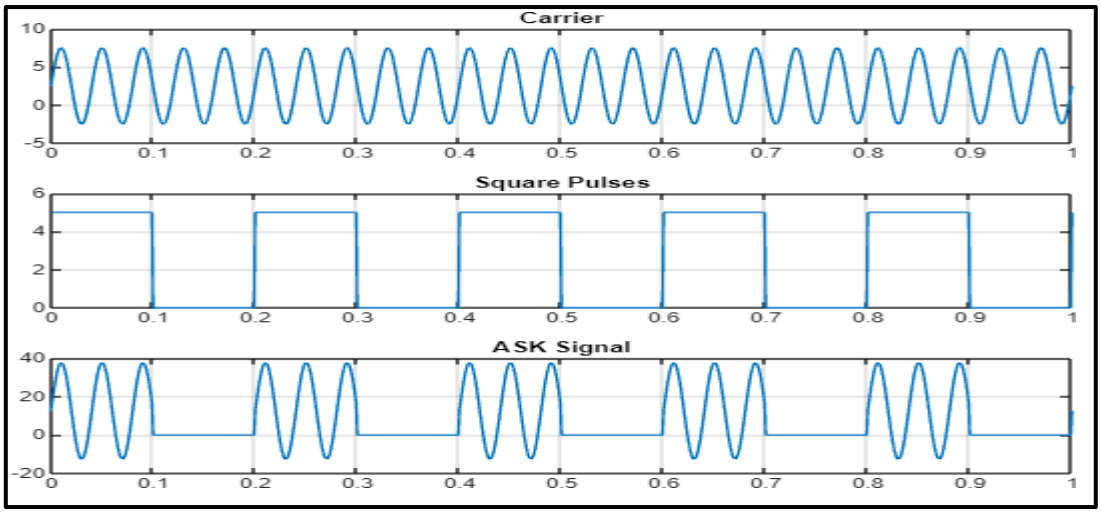


Fig .No.1.2.Output of ASK

X **Conclusion**

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XI **Practical related questions**

1. Explain use of Amplitude Shift keying (ASK)
2. Explain advantages of Amplitude Shift keying (ASK)
3. Explain modulation and demodulation of ASK
4. Explain working Amplitude shift keying (ASK)

Space for Answer

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XII References:

1. Digital iVision Labs!: Amplitude Shift Keying (ASK) Modulation MATLAB Simulation, With MATLAB Code (divilabs.com)
2. Amplitude Shift Keying (tutorialspoint.com)
3. Amplitude Shift Keying - GeeksforGeeks

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 2: Frequency Shift Keying (FSK) using any simulator

I Practical Significance

Frequency Shift Keying (FSK) is the digital modulation technique in which the frequency of the carrier signal varies according to the digital signal changes. In this practical student are able to view shifts in frequency as per the input digital data by using simulation software.

II Industry / Employer Expected Outcome(s)

1. Able to implement frequency Shift Keying using simulation software.

III Course Level Learning Outcomes(s)

CO1 - Analyze the functioning of Data Communication and Computer Network

IV Laboratory Learning Outcome(s)

LLO 2.1 Implement Frequency Shift Keying (FSK)

V Relevant Affective Domain related Outcomes

- Follow safely Measures
- Follow ethical practice

VI Relevant Theoretical Background

❖ Frequency Shift Keying (FSK)

In FSK, frequency of carrier signal is varied to represent the signal element. In FSK, one frequency represent binary 1 and other frequency represent binary 0.This is called as binary FSK. The frequency of modulated signal is constant for the duration of each bit and changes when bit changes. If FSK uses more than two frequencies then it is called as binary frequency.

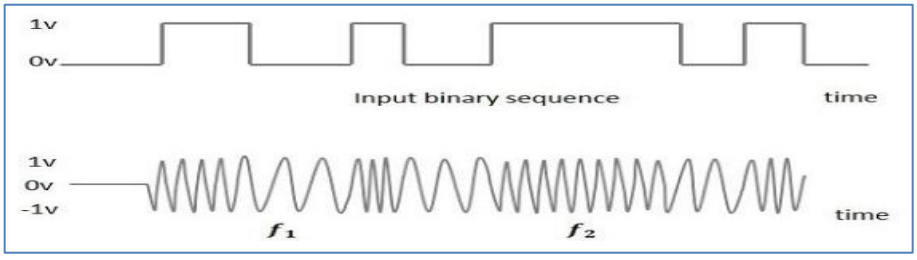

Fig.No.2.1. FSK Input-Output waveform

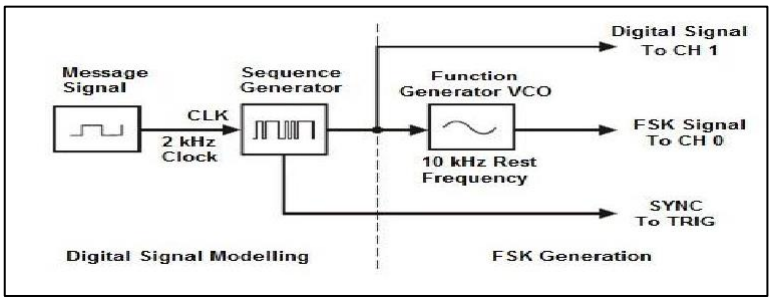

Fig.No.2.2. FSK Modulator

VII **Recourses Required:**

- Computer / Networked Computers (with internet connectivity)
- Simulation Software (Lab view/ MATLAB /SCILAB/P Spice /HS Spice / Multisim/ Proteus or any other relevant open-source software)

VIII **Precautions to be followed:**

1. Handle Computer system and peripherals with care.
2. Follow safety Practices

IX **Procedure**

1. Open MATLAB
2. Go to file and create a new (.m) file.
3. Type the below code in the code window.

Use this link to install MATLAB software

https://in.mathworks.com/products/matlab-online.html

Sample code for FSK using MATLAB

```
clc;
close all;
clear all;

% Message signal input and ploting
n=[1 0 1 0];          % Message signal in binary form
N=length(n);          % Length of message signal
fs = 1000*N;          % Sampling frequency
t=0:1/fs:N;           % Time division with step b
N1=length(t);         % Length of total divisions
i=1;
%Run for Loop
for j=1:N1
if t(j)<=i
```

```
x(j)=n(i);
else
i=i+1;
end
end
figure(1);

subplot(3,2,1);

plot(t,x,'Linewidth',2);          %Message signal plot
title('Message signal');
xlabel('Time');
ylabel('Amplitude');
grid on
```

%Carrier signals generation (x1,x2)

```
a=2;                    %Amplitude scale for carrier signal
f1=10;                  %1st carrier signal frequency
f2=5;                   %2nd carrier signal frequency

% Uncomment the following for user input
x1=a*sin(2*pi*f1*t);            %1st carrier signal
subplot(3,2,2);
plot(t,x1);                     %1st carrier signal plot
title('1st carrier signal');
xlabel('Time');
ylabel('Amplitude');
grid on
x2=a*sin(2*pi*f2*t);            %2nd carrier signal
subplot(3,2,3);
plot(t,x2);                     %2nd carrier signal plot
title('2nd carrier signal');
xlabel('Time');
ylabel('Amplitude');
grid on
```

%Modulation section

```
for j=1:N1
if x(j)==1
y1(j)=x1(j);
else
y1(j)=x2(j);
end
end
subplot(3,2,4);
```

```
%Plot of FSK output signal
plot(t,y1);
title('Modulated FSK output');
xlabel('Time');
ylabel('Amplitude');
grid on
```

4. Save the file.
5. Define the path directory.
6. Run the program using F5 key or run command.
7. Observe the output FSK signal in command window.

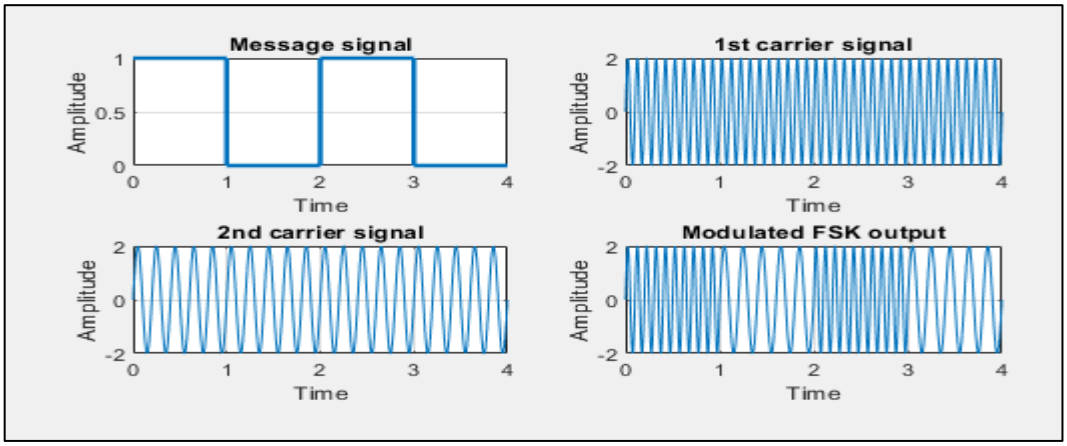

Fig.No.2.3. Output of FSK

X Conclusion

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XI Practical related questions

1. Write down applications of FSK.
2. Write a MATLAB program to generate FSK waveform for the input (a) 1010110 (b) 1100101
3. Write the advantages of FSK.

Space for Answer

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XII References:

1. https://www.tutorialspoint.com/digital_communication/digital_communication_frequency_shift_keying.htm
2. http://www.evalidate.in/lab2/pages/FSKS/FSK/FSK_T.html

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 3: Phase Shift Keying (PSK) using any open-source simulation software

I **Practical Significance**

Phase-shift keying (PSK) is a digital modulation process which conveys data by changing (modulating) the phase of a constant frequency carrier wave. The modulation is accomplished by varying the sine and cosine inputs at a precise time. In this practical student are able to view shifts in phase as per the input digital data by using simulation software.

II **Industry / Employer Expected Outcome(s)**

1. To test the performance of Phase Shift Keying (PSK) using relevant simulation software.
2. To gain knowledge about Phase Shift Keying (PSK)

III **Course Level Learning Outcomes(s)**

CO1 - Analyze the functioning of Data Communication and Computer Network

IV **Laboratory Learning Outcome(s)**

LLO 3.1 Implement Phase Shift Keying (PSK)

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

Proposition 1: Phase Shift Keying PSK is the digital modulation technique in which the phase of the carrier signal is changed by varying the sine and cosine inputs at a particular time. It allows information in a more efficient way to be carried over a radio communications signal compare with other modulation forms. Data communication is rising with different forms of communication formats like analog to digital to carry data along with different modulation forms. PSK technique is widely used for wireless LANs, bio-metric, contactless operations, along with RFID and Bluetooth communications

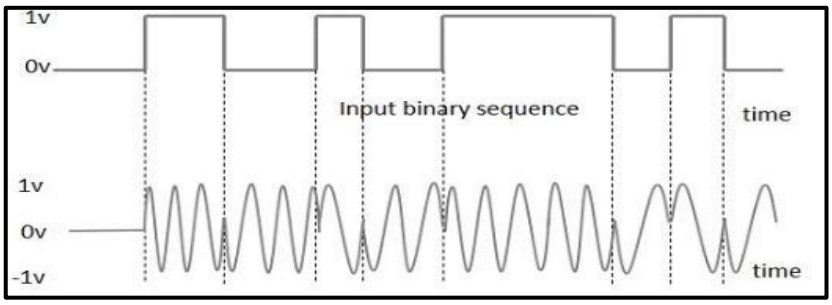

Fig. No.3.1. Phase shift keying

VII **Recourses Required:**

- Computer / Networked Computers (with internet connectivity)
- Simulation Software (Lab view/ MATLAB /SCILAB/P Spice /HS Spice / Multisim/ Proteus or any other relevant open-source software)

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure:**

1. Open MATLAB
2. Go to file and create a new (.m) file.
3. Type the below code in the code window.

Use this link to install MATLAB software

https://in.mathworks.com/products/matlab-online.html

Sample code for PSK using MATLAB

```
clc;
close all;
clear all;
a=5;                          % Amplitude
t=0:0.001:1;
f1=input('carrier frequency:');     % for example 20
f2=input('pulse frequency:');       % for example 5

x=a.*sin(2*pi*f1*t);                %carrier
subplot(3,1,1);
plot(t,x);
title('Carrier');
grid on;
```

```
u=square(2*pi*f2*t)          % Message signal
subplot(3,1,2);
plot(t,u);
title('Square Pulses');
grid on;
v=x.*u;
subplot(3,1,3);
plot(t,v);
title('PSK Signal');
grid on;
```

4. Save the file.
5. Define the path directory.
6. Run the program using F5 key or run command.
7. Observe the output PSK signal in command window.

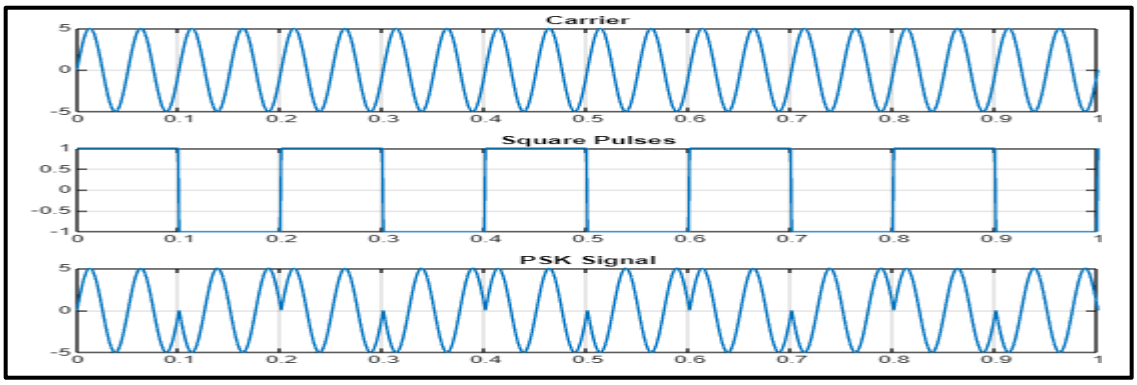

Fig.No.3.2. Output of PSK

X Conclusion

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XI Practical related questions

1. Explain use of Phase Shift keying (PSK)
2. Explain advantages of Phase Shift keying(PSK)
3. Explain modulation and demodulation of PSK
4. Explain Difference between ASK, FSK, PSK

Space for Answer

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XII References:

1. Phase Shift Keying : Types, Forms, and Its Applications (watelectronics.com)
2. Digital Communication - Phase Shift Keying (tutorialspoint.com)

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 4: *Create and Test standard straight network cable (Universal Colour Code) using crimping tool

I **Practical Significance**

Student should be able to create and test standard straight network cable using crimping tool

II **Industry / Employer Expected Outcome(s)**

1. To identify different network cable.
2. To Prepare straight and crossover network cable.
3. To test network cable

III **Course Level Learning Outcomes(s)**

CO2 - Select relevant Transmission Media and Switching Techniques as per need

IV **Laboratory Learning Outcome(s)**

LLO 4.1 Create standard network straight cable by using cable tester

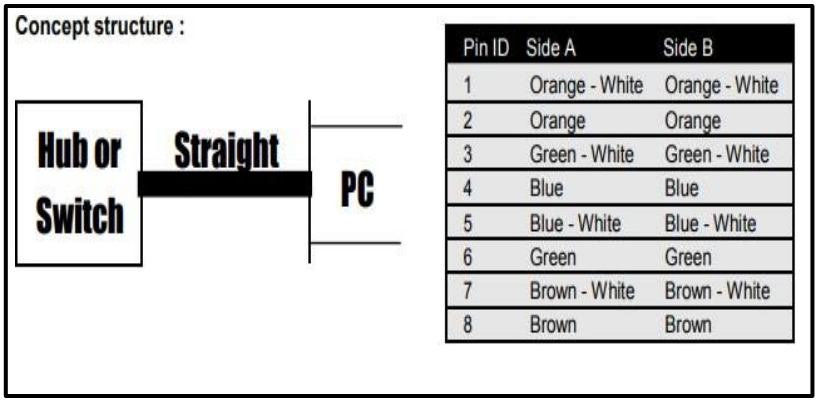
V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

Straight network cable

Straight-through cables will be used to connect different of hosts to each other. This means that whenever you are connecting a computer to a router, a router to a switch, and so on, you will have to use a straight-through cable for the hosts to communicate with each other.



Pin ID	Side A	Side B
1	Orange - White	Orange - White
2	Orange	Orange
3	Green - White	Green - White
4	Blue	Blue
5	Blue - White	Blue - White
6	Green	Green
7	Brown - White	Brown - White
8	Brown	Brown

Fig.No.4.1. Colour Code on Both Side

Proposition 2: RJ45 Connector and Crimper

1. RJ45 stands for Registered Jack 45 and is the most commonly used connector in wired networks. The jacks are mainly used to connect to the Local Area Network
2. RJ45 has a transparent plastic structure and is an 8-pin connector. It is an 8P8C connector and the number of wires that can be connected is 8. The jacks are mostly used with Shielded Twisted Pair cables or Unshielded Twisted Pair cables.
3. A crimping tool is designed to crimp or connect a connector to the end of cable
4. Network cables and phone cables are created using a crimping tool to connect the RJ-45 connectors to the end of the cable.

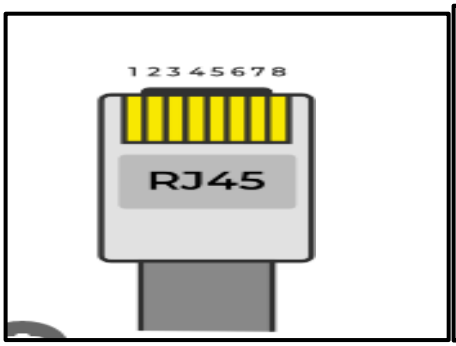


Fig. No. 4.2. RJ 45 Connector

Fig. No. 4.3. Crimping Tool

VII Recourses Required:

1. UTP/STP cable.
2. Connector (Mainly RJ45 connector)
3. Networks toolkit (Mainly Crimping tool.)
4. Line tester or cable tester.
5. Computer and Network control devices.

VIII **Precautions to be followed:**

1. Handle carefully Crimping Tool and network devices.

2. Follow safety Practices

IX **Procedure: Prepare straight cable**

1. Cut into the plastic sheath 1 inch from the end of cut cable. The crimping tool has a razor blade that will do the trick

Fig. No. 4.4 .Cut cable plastic cover

2. Unwind it and pair of the similar colors

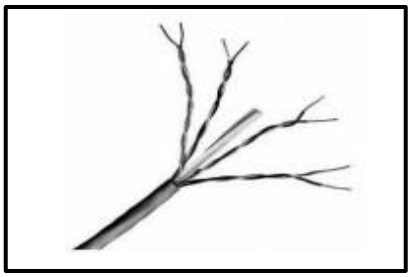


Fig. No. 4.5. Separate pair wires

3. After that straighten them out. Pinch the wires between your fingers

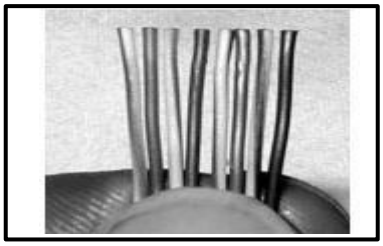


Fig. No. 4.6. Straighten Wire

4. Use scissors to make a straight cut across the wires 1/2 Inch from the cut sleeve to the end of. Push the wire into connector

Fig. No.4.7. Fit cable in to Connector

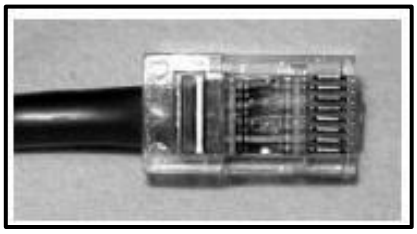


Fig. No. 4.8. Top view of Connector

5. Crimping the Cable: carefully place the connector into the Ethernet Crimper and cinch down on the handles tightly. The copper splicing tabs on the connector will pierce into each of the eight wires. There is also a locking tab that holds the blue plastic sleeve in place for a tight compression fit. When you remove the cable from the crimper, the cable is ready to use.

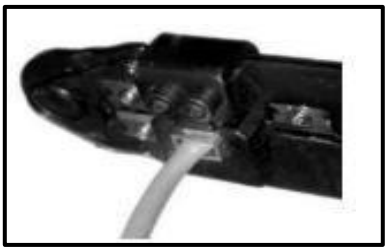


Fig. No. 4.9. Crimping the Cable

6. Repeat all steps on the other end of the Ethernet cable exactly.

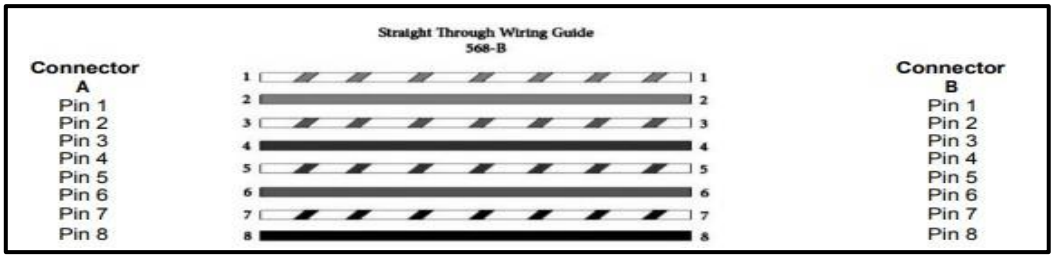


Fig. No. 4.10. Pin Format on both Side

7. Make sure to test the cables using line tester before installing them. An inexpensive Ethernet cable tester does this quite well.

Fig. No.4.11. Cable or line Tester

X **Conclusion**

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XI **XII. Practical related questions**

1. Which tool is used to test network cable?

2. Explain Use of Cable in networking

3. Explain types of Transmission medium

4. State the purpose to use RJ45 connector.

5. Give the names of RJ45 pinout for each pin along with pin number.

Space for Answer

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XII References:

1. https://gesrepair.com/wire-crimping-process/
2. https://www.wikihow.com/Crimp-Rj45
3. https://jemelectronics.com/cable-crimping-methods-101/

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 5: Create and Test standard Cross network cable (Universal Colour Code) using crimping tool

I **Practical Significance**

Student should be able to create and test standard cross network cable using crimping tool

II **Industry / Employer Expected Outcome(s)** To identify different network cable.

1. To Prepare straight and crossover network cable.
2. To test network cable

III **Course Level Learning Outcomes(s)**

CO2 - Select relevant Transmission Media and Switching Techniques as per need

IV **Laboratory Learning Outcome(s)**

LLO 5.1 Create standard network Cross cable by using cable tester

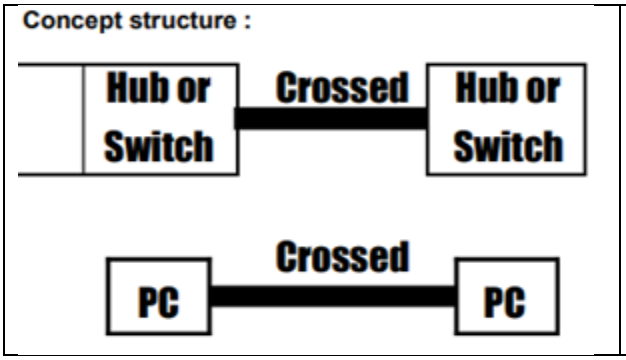
V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Cross network cable**

Cross network cable It is used to connect two devices of the same type: two computers or two switches to each other. Both sides (side A and side B) of cable have wire arrangement with different color



Pin ID	side A	side B
1	Orange-white	green-white
2	Orange	green
3	green-white	orange-white
4	blue	brown-white
5	blue-white	Brown
6	green	orange
7	brown-white	Blue
8	brown	blue-white

Fig.No.5.1. Colour Code on Both Side

❖ **RJ45 Connector and Crimper**

1. RJ45 stands for Registered Jack 45 and is the most commonly used connector in wired networks. The jacks are mainly used to connect to the Local Area Network
2. RJ45 has a transparent plastic structure and is an 8-pin connector. It is an 8P8C connector and the number of wires that can be connected is 8. The jacks are mostly used with Shielded Twisted Pair cables or Unshielded Twisted Pair cables.
3. A crimping tool is designed to crimp or connect a connector to the end of cable
4. Network cables and phone cables are created using a crimping tool to connect the RJ-45 connectors to the end of the cable.

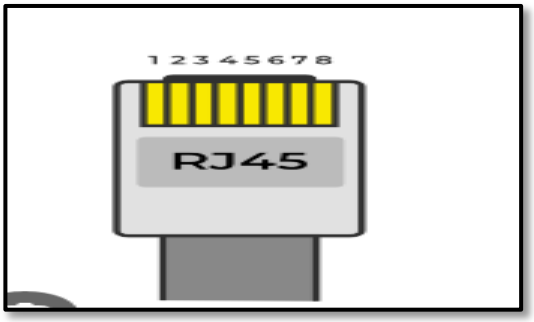


Fig .No. 5.2 .RJ 45 Connector

Fig. No.5.3.Crimping Tool

VII **Recourses Required:**

1. UTP/STP cable.
2. Connector (Mainly RJ45 connector)
3. Networks toolkit (Mainly Crimping tool.)
4. Line tester or cable tester.
5. Computer and Network control devices.

VIII **Precautions to be followed:**

1. Handle carefully Crimping Tool and network devices.
2. Follow safety Practices

IX **Procedure: Prepare Cross Cable.**

1. Cut into the plastic sheath 1 inch from the end of cut cable. The crimping tool has a razor blade that will do the trick

Fig. No.5.4. Cut cable plastic cover

2. Unwind it and pair of the similar colors

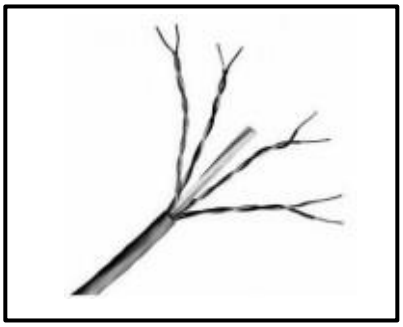


Fig. No.5.5. Separate pair wires

3. After that straighten them out. Pinch the wires between your fingers

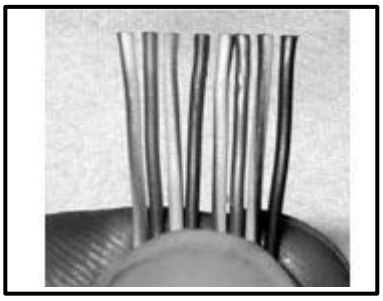


Fig. No. 5.6. Straighten Wire

4. Use scissors to make a straight cut across the wires 1/2 Inch from the cut sleeve to the end of. Push the wire into connector

Fig.No.5.7. Fit cable in to Connector

Fig .No. 5.8 .Top view of Connector

5. Crimping the Cable: carefully place the connector into the Ethernet Crimper and cinch down on the handles tightly. The copper splicing tabs on the connector will pierce into each of the eight wires. there is also a locking tab that holds the blue plastic sleeve in place for a tight compression fit. When you remove the cable from the crimper, the cable is ready to use.

Fig.No.5.9. Crimping the Cable

6. Repeat all steps on the other end of the Ethernet cable exactly.

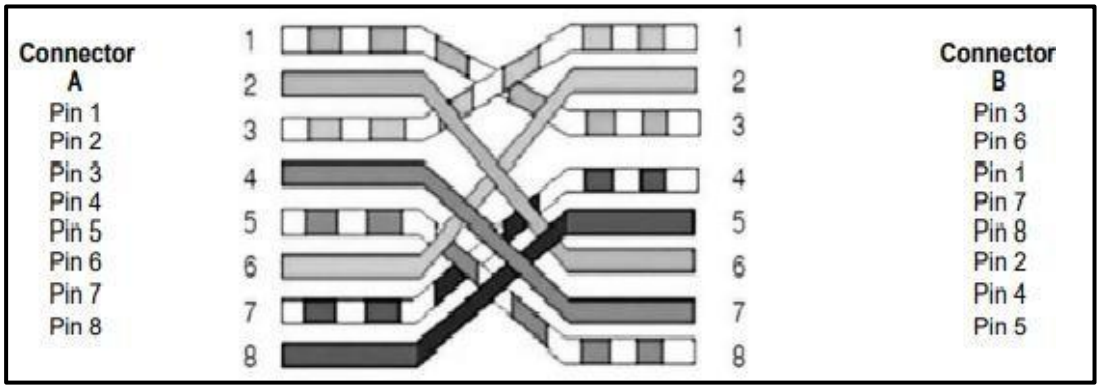


Fig.No.5.10. Pin Format on both Side

7. Make sure to test the cables using line tester before installing them. An inexpensive Ethernet cable tester does this quite well.

Fig. No. 5.11. Cable or Line Tester

X Conclusion

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XI Practical related questions

1. What is a use of crossover network cable?
2. Explain uses of transmission medium
3. State the use of connector and give the name of connector used in laboratory
4. Explain Difference Between straight and cross cable.
5. What is the meaning of RJ?

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XII References:

1. How To Make Your Own Ethernet Cross-Over Cable (7 Steps) (electronicproducts.com)
2. https://www.wikihow.com/Crimp-Rj45
3. How To Make An Ethernet Cross-Over Cable (makeuseof.com)

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

**Practical No. 6: ***Generate a Time Division Multiplexing (TDM) signal using relevant simulation software

I **Practical Significance**

Time division multiplexing (TDM) is a communication process that transmits two or more streaming digital signals over a common channel. In TDM, incoming signals are divided into equal fixed-length time slots. After multiplexing, these signals are transmitted over a shared medium and reassembled into their original format after demultiplexing. Time slot selection is directly proportional to overall system efficiency. In this practical, students will generate TDM signal and reconstruct it using simulation software

II **Industry / Employer Expected Outcome(s)**

1. Able to use basic programming skills to simulate communication system.
2. Able to Generate a TDM signal using relevant simulation software.

III **Course Level Learning Outcomes(s)**

CO2 - Select relevant Transmission Media and Switching Techniques as per need.

IV **Laboratory Learning Outcome(s)**

LLO 6.1 Use basic programming skills to simulate communication systems.
LLO 6.2 Debug and execute the program for Time Division Multiplexing (TDM)

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **TDM (Time Division Multiplexing)**

Time-division multiplexing is a multiplexing technique that is used to transmit two or more streaming digital signals above a common channel. In this type of multiplexing technique, incoming signals are separated into equivalent fixed-length time slots. Once multiplexing is done, these signals are sent over a shared medium & after de-multiplexing, they are reassembled into their original format.

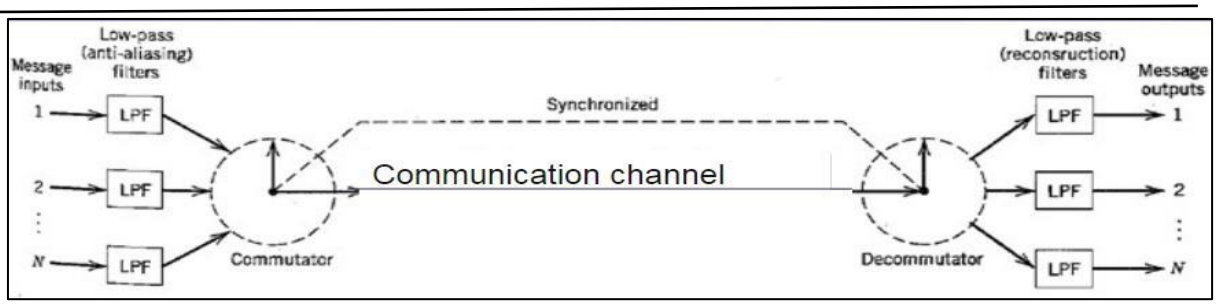

Fig.No.6.1.TDM block diagram

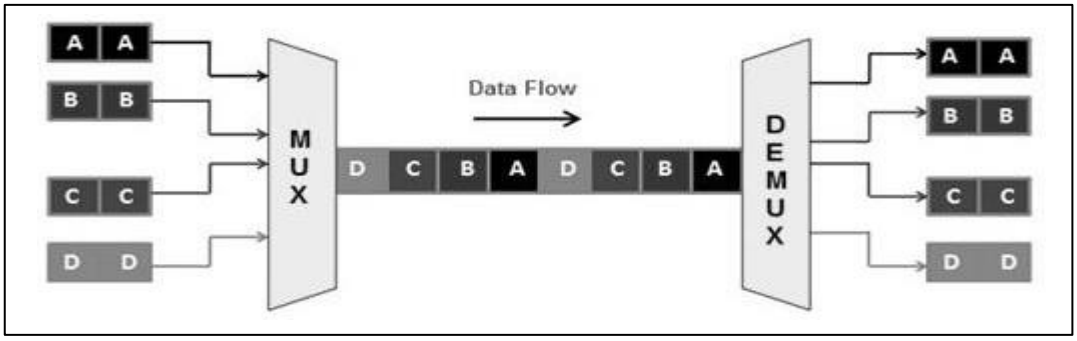

Fig.No.6.2.TDM

VII **Recourses Required:**

- Computer / Networked Computers
- Simulation Software(Lab view/ MATLAB /SCILAB/P Spice /HS Spice / Multisim/ Proteus or any other relevant open source software)

VIII **Precautions to be followed:**

1. Handle Computer system and peripherals with care.
2. Follow safety Practices

IX **Procedure**

1. Open MATLAB
2. Go to file and create a new (.m) file.
3. Type the below code in the code window.

Use this link to install MATLAB software

https://in.mathworks.com/products/matlab-online.html

Sample code for TDM signal Generation using MATLAB -code

```
clc;
close all;
clear all;
% Signal generation
```

```
x=0:.5:4*pi;              % signal taken upto 4pi
sig1=8*sin(x);            % generate 1st sinusoidal signal
l=length(sig1);
sig2=8*triang(l);         % Generate 2nd triangular Signal
```

% Display of Both Signal

```
subplot(2,2,1);
plot(sig1);
title('Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

subplot(2,2,2);
plot(sig2);

title('Triangular Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
```

% Display of Both Sampled Signal

```
subplot(2,2,3);
stem(sig1);
title('Sampled Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
subplot(2,2,4);
stem(sig2);
title('Sampled Triangular Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

l1=length(sig1);
l2=length(sig2);
for i=1:l1
sig(1,i)=sig1(i); % Making Both row vector  to a matrix
sig(2,i)=sig2(i);
end
```

% TDM of both quantize signal

```
tdmsig=reshape(sig,1,2*l1);
```

% Display of TDM Signal figure

```
stem(tdmsig);
title('TDM Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
% Demultiplexing of TDM Signal
```

```
demux=reshape(tdmsig,2,l1);
for i=1:l1
sig3(i)=demux(1,i); % Converting The matrix  into row vectors
sig4(i)=demux(2,i);
end
```

4. Save the file.
5. Define the path directory.
6. Run the program using F5 key or run command.
7. Observe the output TDM signal in command window.
8. Paste the print out under observations heading.

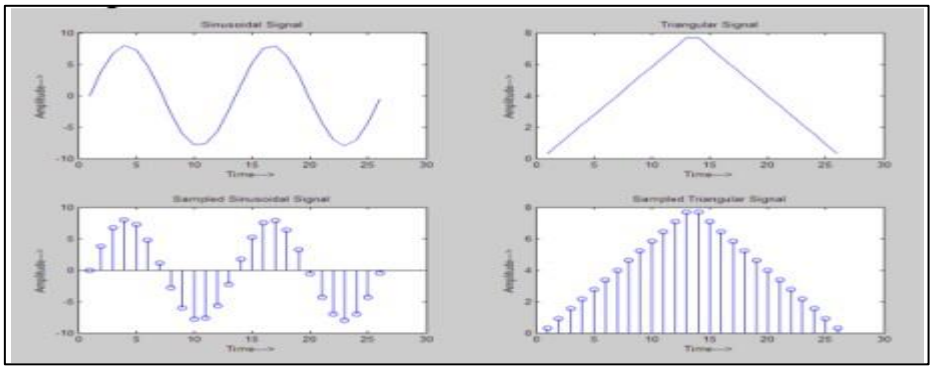

Fig.No.6.3. Sinusoidal and Triangular Signal

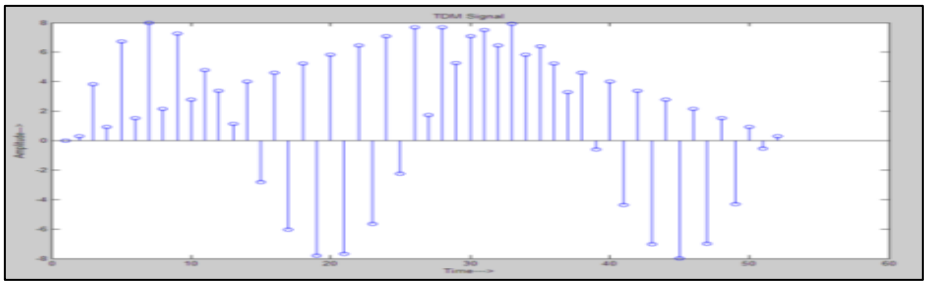

Fig.No.6.4. TDM Signal

X Conclusion

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XI Practical related questions

1. Write down applications of TDM.
2. Why TDM more suitable for digital signal transmission.
3. State the function of commutator and decommutator switches.

Space for Answer

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XII References:

1. https://www.mathworks.com/matlabcentral/fileexchange/28422-time-divisionmultiplexing-tdm
2. https://www.geeksforgeeks.org/frequency-division-and-time-division-multiplexing/

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

**Practical No. 7: ***Create a Hybrid Network Using Bluetooth

I **Practical Significance**

Bluetooth is used for short-range wireless voice and data communication. It is a Wireless Personal Area Network (WPAN) technology and is used for data communications over smaller distances. A Bluetooth network is called a piconet and a group of interconnected piconets is called a scatternet. Student should be able to create a Hybrid Network using Bluetooth.

II **Industry / Employer Expected Outcome(s)**

1. Identify Bluetooth enabled devices
2. Create Hybrid network using Bluetooth

III **Course Level Learning Outcomes(s)**

CO3 - Analyze the Transmission Errors with respect to IEEE standards.

IV **Laboratory Learning Outcome(s)**

LLO 7.1 Transfer data using Bluetooth

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Piconet**

A piconet is the type of connection that is formed between two or more Bluetooth-enabled devices such as modern cell phones or PDAs over a short range of 10m radius. Network ranges from two to eight connected devices. When network is established, one device takes the role of the master while all other devices act as slaves. The master node is the primary station that manages the small network. The slave stations are secondary stations that are synchronized with the primary station. Communication can take place between a master node and a slave node in either one-to-one or one-to-many manner. However, no direct communication takes place between slaves

❖ **Scatternet**

A scatternet is a number of interconnected piconets that supports communication between more than 8 devices. Scatternets can be formed when a member of one piconet (either the

master or one of the slaves) elects to participate as a slave in a second, separate piconet. The device participating in both piconets can relay data between members of both ad hoc networks. However, the basic Bluetooth protocol does not support this relaying - the host software of each device would need to manage it. Using this approach, it is possible to join together numerous piconets into a large scatternet, and to expand the physical size of the network beyond Bluetooth's limited range.

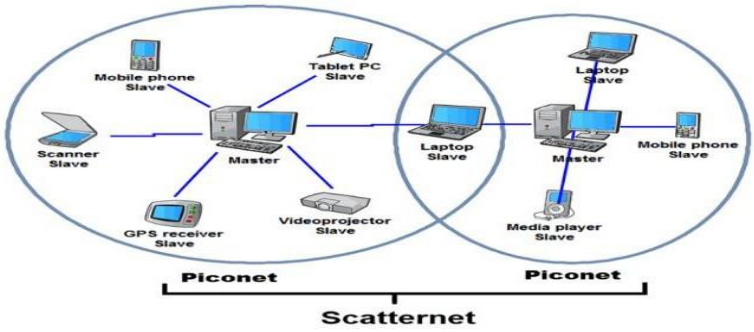

Fig.No. 7.1. Piconet and scatternet

VII **Recourses Required:**

- Bluetooth enabled Mobile Phone
- Bluetooth enabled Laptop/Tablet/PC

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure**

Steps to Create a Hybrid Network Using Bluetooth

1. First ensure Bluetooth is enabled on the device you want to pair with your computer.
2. Next ensure Bluetooth is enabled on your computer.
   On Windows 10, visit **Settings > Devices > Bluetooth & other devices**. If the **Bluetooth** slider at the top is off, turn it on. Then choose **Add Bluetooth or other device**, followed by the **Bluetooth** type.

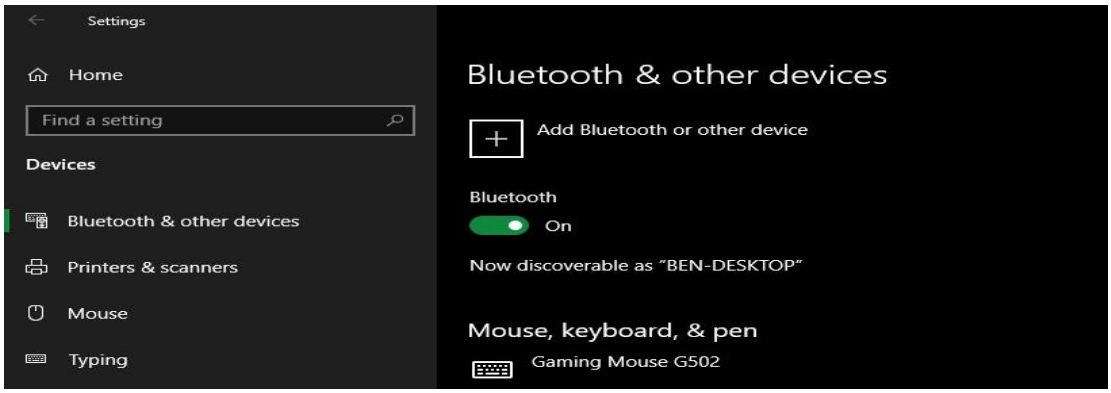

Fig.No.7.2. Steps to enabled Bluetooth on computer

3 Bluetooth Pairing

During the pairing process, follow any instructions that appear on your PC or phone. In some cases, you'll have to type or confirm a passcode. If you don't see a code appear on either device, it's probably a generic number like **1234** or **0000**. Once you confirm this code, your phone should connect to your PC and will automatically do so in the future, as long as the devices are in range.

If you can't get the devices to find each other, one of them is likely not discoverable. As a security feature, most Bluetooth devices only broadcast themselves when you have their Bluetooth options open.

The connection will remain active until you turn off Bluetooth, manually disconnect the devices, turn one of them off, or move them out of range.

4.Transfer Files Between a Phone and PC Using Bluetooth

Once you've paired your phone and computer wirelessly, the actual Bluetooth file transfer process is pretty simple. Sharing from your phone to a PC is most generally available on Android, since iOS devices use AirDrop for this.

To transfer from your phone, all you need to do is select a file in whatever app you're using, and choose the option to share it. The exact method depends on the app, but most have a universal **Share** icon to look for.

When you see the list of methods you can share through, look for the **Bluetooth** entry. Then select your PC as the destination device. Windows will then request confirmation and start downloading the file. You may be allowed to choose the save location, or it might save to a standard **Downloads** folder.

When transferring a file from your PC to your phone, simply open File Explorer and right-click on the file you want to transfer. Select **Send to > Bluetooth device**.

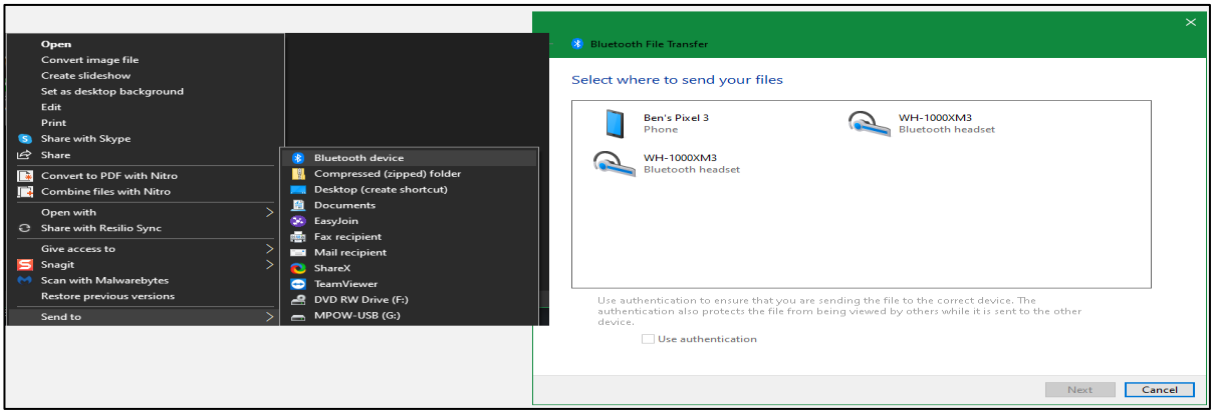

Fig. No. 7.3. Transferring a file from PC to mobile using Bluetooth

This will open a new window where you can select the device to send the file to. Your phone may ask for your approval. Once you confirm, the file will transfer over Bluetooth. You can transfer multiple files in either direction. Just select them all at once and follow the above steps.

X **Conclusion**

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XI **Practical related questions**

1. What is Wireless Network?
2. What is Piconet?
3. What is scatternet?
4. What is the range of Piconet?

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XII References:

1. https://www.tutorialspoint.com/differentiate-between-piconet-and-scatternet
2. https://www.makeuseof.com/tag/how-to-connect-your-cell-phone-to-your-pc-through-bluetooth/
3. https://www.tutorialspoint.com/what-is-piconet

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Dated Signature of Course Teacher	

Practical No. 8: *Locate the error bit in the given data string by applying checksum error detection method

I Practical Significance

Error is a condition when the receiver's information does not match with the sender's information. During transmission, digital signals suffer from noise that can introduce errors in the binary bits travelling from sender to receiver. That means a 0 bit may change to 1 or a 1 bit may change to 0. To avoid this, error-detecting codes are used which are additional data added to a given digital message to detect any error that has occurred during transmission of the message. The student will be able to detect errors in a given data stream by using checksum error detection method.

II Industry / Employer Expected Outcome(s)

1. Locate error bit in the given data stream
2. To gain knowledge about checksum error detection method

III Course Level Learning Outcomes(s)

CO3 - Analyze the Transmission Errors with respect to IEEE standards.

IV Laboratory Learning Outcome(s)

LLO 8.1 Identify different error detection methods.
LLO 8.2 Detect errors using Checksum

V Relevant Affective Domain related Outcomes

- Follow safely Measures
- Follow ethical practice

VI Relevant Theoretical Background

Error is a condition when the receiver's information does not match the sender's information.

Types of error

1. Single-Bit Error
2. Burst Error

1. Single-Bit Error: The only one bit of a given data unit is changed from 1 to 0 or from 0 to1

2 Burst Error: The two or more bits are changed from 0 to 1 or from 1 to 0 is known as Burst Error. Whenever a message is transmitted, it may get scrambled by noise and the data may get corrupted. Basic approach used for error detection is the use of redundancy bits, where additional bits are added to facilitate detection of errors.

Some of the techniques for error detection are:

1. Parity check
2. Two-dimensional Parity check
3. Checksum
4. Cyclic redundancy check

❖ **Checksum**

In checksum error detection scheme, the data is divided into k segments each of m bits. In the sender's end the segments are added using 1's complement arithmetic to get the sum. The sum is complemented to get the checksum. The checksum segment is sent along with the data segments.

At the receiver's end, all received segments are added using 1's complement arithmetic to get the sum. The sum is complemented. If the result is zero, the received data is accepted; otherwise, the received data is discarded.

VII **Recourses Required:**

- Computer/Network Computer

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure**

Example

Suppose that the sender wants to send 4 frames each of 8 bits, where the frames are 10011001 11100010 00100100 10000100.

The sender adds the bits using 1s complement arithmetic. While adding two numbers using 1s complement arithmetic, if there is a carry over, it is added to the sum.

After adding all the 4 frames, the sender complements the sum to get the checksum 11011010, and sends it along with the data frames.

Data transmitted to Receiver is –

10011001 11100010 00100100 10000100	11011010
Data	**Checksum**

The receiver performs 1s complement arithmetic sum of all the frames including the checksum. The result is complemented and found to be 0. Hence, the receiver assumes that no error has occurred.

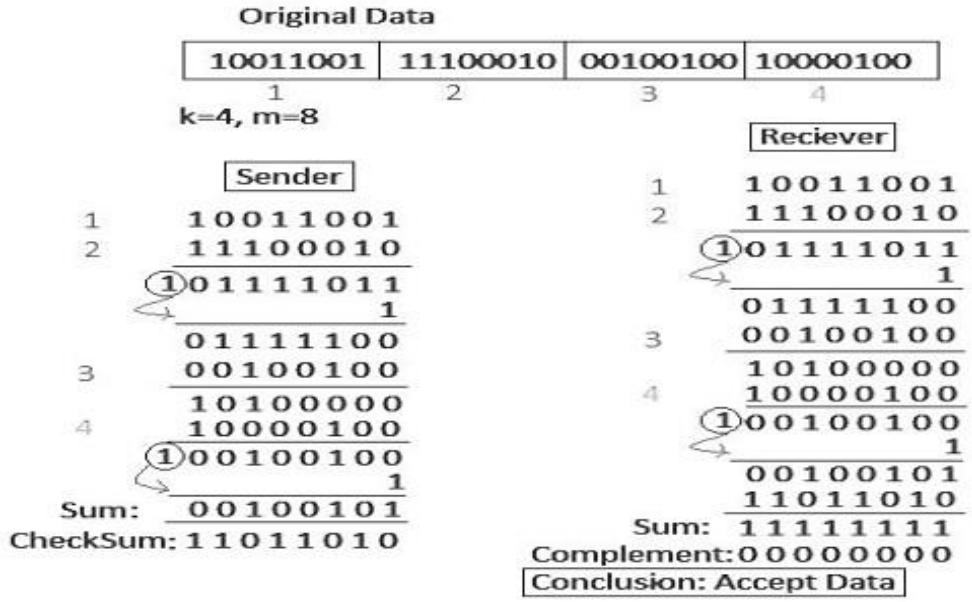

Fig.No.8.1. Example of checksum error detection method

X **Conclusion**

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XI **Practical related questions**

1. Define error. List types of error
2. List types of error detection techniques.
3. For the bit sequence 10101001 00111001, determine the checksum
4. For the bit sequence 110101, 101010, 100100, 111100, determine the checksum

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XII References:

1. https://www.geeksforgeeks.org/error-detection-code-checksum/
2. https://www.tutorialspoint.com/error-detecting-codes-checksums
3. https://www.youtube.com/watch?v=aNqiTCZ-nko

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 9: *Implement Wireless Network

I **Practical Significance**

Student should be able to study settings of wireless network.

II **Industry / Employer Expected Outcome(s)**

1. Understand basic of TCP/IP utilities.
2. Understand networking commands

III **Course Level Learning Outcomes(s)**

CO3 - Analyze the Transmission Errors with respect to IEEE standards.

IV **Laboratory Learning Outcome(s)**

LLO 9.1 create WI-FI environment.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Wireless Network**

A wireless network refers to a computer network that makes use of Radio Frequency (RF) connections between nodes in the network. A wireless network keeps devices connected to a network while still allowing them the freedom to move about, unencumbered by wires. A wireless network is a computer network that uses wireless data connections between network nodes.

Wireless networking is a method by which homes, telecommunications networks and business installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Wireless telecommunications networks are generally implemented and administered using radio communication. This implementation takes place at the physical level (layer) of the OSI model network structure. Examples of wireless networks include cell phone networks, wireless local area networks (WLANs), wireless sensor networks, satellite communication networks, and terrestrial microwave networks.

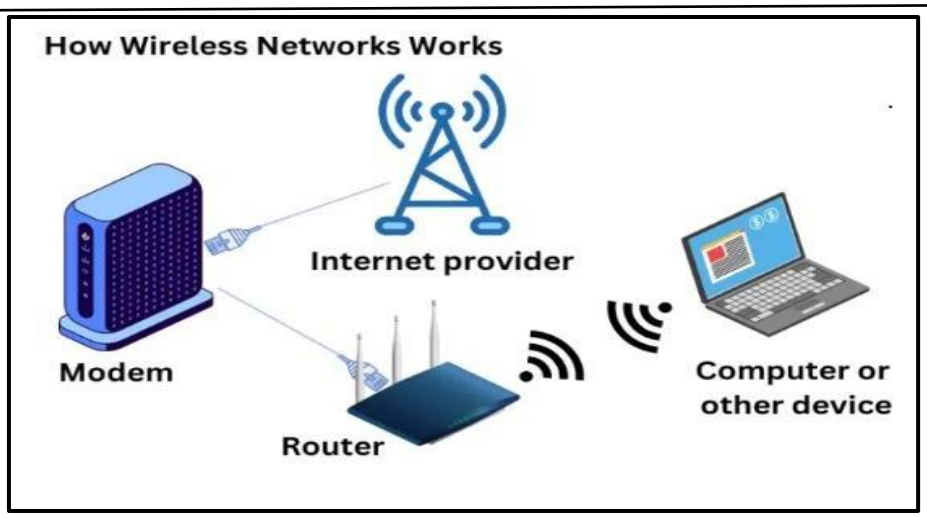

Fig. No. 9.1. Wireless Network

❖ **Wireless Router**

A wireless router or Wi-Fi router is a device that performs the functions of a router and also includes the functions of a wireless access point. It is used to provide access to the Internet or a private computer network. Depending on the manufacturer and model, it can function in a wired local area network, in a wireless-only LAN, or in a mixed wired and wireless network.

Fig. No. 9.2. Wireless Router

❖ **Wireless Network Adapter**

A wireless adapter is a hardware device that is generally attached to a computer or other workstation device to allow it to connect to a wireless system. Before the advent of consumer devices with built-in Wi-Fi connectivity, devices required the use of wireless adapters to connect to a network.

Fig. No. 9.3. Wireless Network Adapter

VII **Recourses Required:**

1. Computer / Networked Computer
2. Router
3. Network Cable
4. RJ 45 Connector

VIII **Precautions to be followed:**

1. Handle Computer system carefully

2. Follow safety Practices

IX **Procedure: Implementation of wireless Network**

Follow the instructions below to setup your wireless network.

1. Find the best location for your wireless router.

2. Turn off the modem. Power off the cable or DSL modem from your ISP before connecting your equipment.

3. Connect the router to the modem. Plug an Ethernet cable into the router‘s WAN port and then the other end to the modem.

4. Connect your laptop or computer to the router. Plug one end of another Ethernet cable into the router‘s LAN port and the other end into your laptop‘s Ethernet port.

5. Power up the modem, router, and computer in turn.

6. Go to the management web page for your router. Open a browser and type in the IP address of the router's administration page.

7. Change the default administrator user name and password for your router. This setting is usually found in a tab or section called administration. Remember to use a strong password that you won't forget.

8. Add WPA2 security. This step is essential. You can find this setting in the wireless security section, where you'll select which type of encryption to use and then enter a passphrase of at least 8 characters—the more characters and the more complex the password, the better.

9. Change the wireless network name (SSID). To make it easy for you to identify your network, choose a descriptive name for your SSID (Service Set Identifier) in the wireless network information section.

10. Change the wireless channel. If you‘re in an area with a lot of other wireless networks, you can minimize interference by changing your router's wireless channel to one less used by other networks. You can use a WiFi analyzer app for your smartphone to find the least crowded channel or just use trial and error (try channels 1, 6, or 11, since they don't overlap).

11. Set up the wireless adapter on the computer. After saving the configuration settings on the router above, you can unplug the cable connecting your computer to the router. Then plug your USB or PC card wireless adapter into your laptop, if it doesn't already have a wireless adapter installed or built-in. Your computer may automatically install the drivers or you may have to use the setup CD that came with the adapter to install it.

12. Finally, connect to your new wireless network. On your computer and other wireless-enabled devices, find the new network you set up and connect to it.

X **Conclusion**

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XI **Practical related questions**

1. Write Difference between wire and Wireless Network

2. Explain use of Wireless Router

3. Explain Concept of WPAN

4. Explain advantages of Wireless Network.

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XII References:

1. How to Set up Wireless Network? (linkedin.com)
2. AWS ping
3. ML | Amazon Web Services (youtube.com)

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 10: Write a C Program for Parity check error detection

I **Practical Significance**

Parity check is a simple error detection method that involves adding an extra bit to a data transmission**.** Student should be able to write a C program for parity check error detection.

II **Industry / Employer Expected Outcome(s)**

1. To write a C program for parity check error detection
2. To gain knowledge about parity check error detection method

III **Course Level Learning Outcomes(s)**

CO3 - Analyze the Transmission Errors with respect to IEEE standards.

IV **Laboratory Learning Outcome(s)**

LLO 10.1 Draw block diagram for parity check.
LLO 10.2 Implement parity check with examples.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Parity Check**

In Parity Check, a parity bit is an extra bit included in binary message to make total number of 1‘s either odd or even. Parity word denotes number of 1‘s in a binary string. There are two parity systems – even and odd parity checks.

1. **Even Parity Check:** Total number of 1‘s in the given data bit should be even. So, if the total number of 1‘s in the data bit is odd then a single 1 will be appended to make total number of 1‘s even else 0 will be appended
2. **Odd Parity Check:** In odd parity system, if the total number of 1‘s in the given binary string (or data bits) are even then 1 is appended to make the total count of 1‘s as odd else 0 is appended.

VII **Recourses Required:**

- Computer/Network Computer
- Turbo C.

IX **Procedure**

Example

For example, consider a message string 100011 that needs to be transmitted. Let us assume the even parity scheme. The following will now happen.

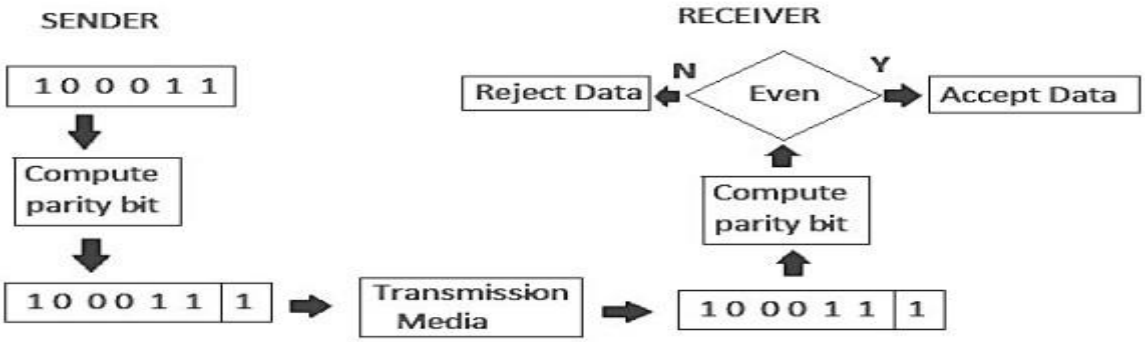
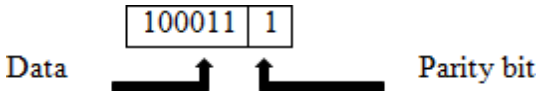


Fig. No.10.1. Parity Check Error Detection technique

1. The sender examines this message string and notes that the number of bits containing a value 1 in this message string is 3. Therefore, it adds an extra 1 to the end of this message. This extra bit is called parity bit.

2. The sender sends the original bits 100011 and the additional parity bit 1 together to the receiver



3. The receiver separates the parity bit from the original bits and it also examines the original bits. It sees the original bits as 100011, and notes that the number of 1s in the message is three i.e. odd.

4. The receiver now computes the parity bit again and compares this computed parity bit with the 1 parity bit received from the sender, it notes that are equal and accepts the bit string as correct.

X **Conclusion**

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XI Practical related questions

1. What is Even and Odd Parity check?
2. Write a C program for Parity Check error detection method.
3. For 1011000 data, find out codeword that send to receiver by using Parity check detection method**.**

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XII References:

1. https://www.geeksforgeeks.org/error-detection-codes-parity-bit-method/
2. https://www.youtube.com/watch?v=aNqiTCZ-nko
3. https://www.javatpoint.com/computer-network-error-detection

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

**Practical No. 11: ***Write a C program for Cyclic Redundancy Check (CRC) error detection

I **Practical Significance**

Student should be able to write a C program for error detection.

II **Industry / Employer Expected Outcome(s)**

1. To write a C program for CRC error detection.
2. To gain knowledge about CRC

III **Course Level Learning Outcomes(s)**

CO3 - Analyze the Transmission Errors with respect to IEEE standards.

IV **Laboratory Learning Outcome(s)**

LLO 11.1 Implement C Program for CRC

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Cyclic Redundancy Check (CRC)**

When data is transmitted from one device to another device, the system does not guarantee whether the data received by the device is identical to the data transmitted by another device. An Error is a situation when the message received at the receiver end is not identical to the message transmitted it is called error detection. A cycle redundancy check (CRC) in C programming is an error detecting technique commonly used in storage devices, etc. Block of data is entered and is checked and it is based on if the remainder is 0 or not and if it is not found to be zero then an error is detected in the code. CRCs are popular because they are simple to implement in binary hardware. CRCs basically are used as xor operation is performed between two numbers if remainder is zero then no error if it‘s not zero then error is detected.

Example of Cyclic Redundancy Check (CRC)

Dividend / Data word: 100100

Divisor :1101

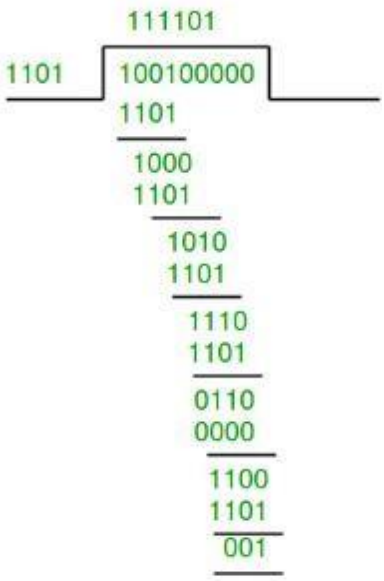

Fig. No.11.1. Sender Side

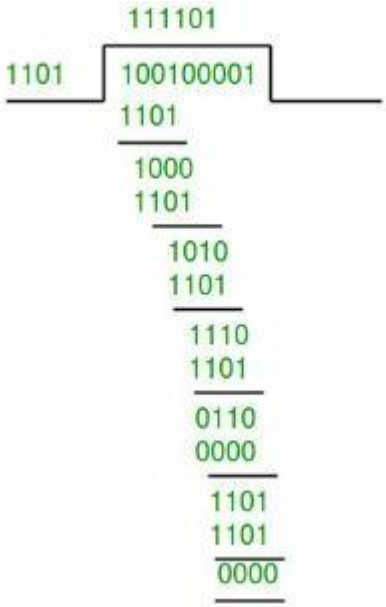

Fig.No.11.2. Receiver side

Sender side remainder is 001 which is encoded with data word 100100001. Code word received at receiver side 100100001. And divisor is same 1101. After performing division, the remainder is all 0000 hence, the data received has no Error.

VII **Recourses Required:**

1. Computer / Networked Computer
2. Turbo C.

VIII **Precautions to be followed:**

1. Handle Computer system carefully
2. Follow safety Practices

IX **Procedure: Write a C program for Cyclic Redundancy check error detection for dividend 10111011 and divisor 1001. And check output that is error is present or not.**

X **Conclusion**

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XI Practical related questions

1. What is CRC?
2. Define Error Detection
3. Explain types of Error Detection methods
4. How to check error with CRC.

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XII References:

1. Computer Network | Error Detection - javatpoint
2. Cyclic Redundancy Code (CRC) in C - Naukri Code 360
3. CRC Program in C - Scaler Topics

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 12: *Write a C program for error correction using Hamming code

I **Practical Significance**

Hamming code is an error correction system that can detect and correct errors when data is stored or transmitted. It requires adding additional parity bits with the data. Student should be able to write a C program for error correction using hamming code

II **Industry / Employer Expected Outcome(s)**

1. To write a C program for error correction using hamming code
2. To gain knowledge about Hamming Code error correction method

III **Course Level Learning Outcomes(s)**

CO3 - Analyze the Transmission Errors with respect to IEEE standards.

IV **Laboratory Learning Outcome(s)**

LLO 12.1 Implement Hamming code in any suitable programming language

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ Error Correction

Once the errors are detected in the network, the deviated bits sequence needs to be replaced with the right bit sequence so that the receiver can accept the data and process it. This method is called Error Correction. We can correct the errors in the Network in two different ways which are Forward Error Correction: In this Error Correction Scenario, the receiving end is responsible for correcting the network error. There is no need for retransmission of the data from the sender‘s side. Backward Error Correction: Backward Error Correction means that the receiver needs to correct the error either by transmitting the corrupted message or retransmitting the entire message to the destination.

Proposition 2: Hamming Code

In this method, extra parity bits are appended to the message which are used by the receiver to correct the single bit error and multiple bit error. Consider the below example to understand this method in a better way.

Example:

Construct the even parity Hamming code word for a data byte 1001101.

The number (1001101) of bits is 7.

The value of r is calculated as −

$$2^R \geq M + R + 1$$

$$\Rightarrow 2^4 \geq 7 + 4 + 1$$

Therefore, the number of redundancy bits = 4

Now, let's calculate the required number of parity bits.

We take $P = 2$, then $2^P = 2^2 = 4$ and $n + P + 1 = 4 + 2 + 1 = 7$

The 2 parity bits are not sufficient for the 4-bit data.

Now, we will take $P = 3$, then $2^P = 2^3 = 8$ and $n + P + 1 = 4 + 3 + 1 = 8$

Therefore, 3 parity bits are sufficient for 4-bit data.

The total bits in the codeword are − 4 + 3 = 7

Position 1: checks the bits 1,3,5,7,9 and 11.

? _1_0 0 1_1 0 1 0.In position 1 even parity so set position 1 to a 0:0_1_0 0 1_1 0 1 0.

0	1	0	1		1	0	0		1		0

Position 2: checks bits 2,3,6,7,10,11.

0 ? 1_0 0 1_1 0 1 0. In position 2 odd parity so set position 2 to.a 1:0 1 1_0 0 1_1 0 1 0

0	1	0	1		1	0	0		1	1	0

Position 4 checks bits 4,5,6,7,12.

0 1 1 ? 0 0 1_1 0 1 0. In position 4 odd parity so set position 4 to.a 1: 0 1 1 1 0 0 1_1 0 1 0

0	1	0	1		1	0	0	1	1	1	0

Position 8 checks bits 8,9,10,11,12

0 1 1 1 0 0 1 ? 1 0 1 0. In position 8 even parity so set position 8 to a 1: 0 1 1 1 0 0 1 0 1 0 1 0

0	1	0	1	0	1	0	0	1	1	1	0

Code Word = 011100101010

0	1	1	1	0	0	1	0	1	0	1	0

VII **Recourses Required:**

- Computer/Network Computer
- Turbo C.

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure**

The procedure used by the sender to encode the message encompasses the following steps −

- **Step 1** − Calculation of the number of redundant bits.
- **Step 2** − Positioning the redundant bits.
- **Step 3** − Calculating the values of each redundant bit.

Once the redundant bits are embedded within the message, this is sent to the user.

Decoding a message in Hamming Code

Once the receiver gets an incoming message, it performs recalculations to detect errors and correct them. The steps for recalculation are

- **Step 1** − Calculation of the number of redundant bits.
- **Step 2** − Positioning the redundant bits.
- **Step 3** − Parity checking.
- **Step 4** − Error detection and correction

X **Conclusion**

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XI **Practical related questions**

1. Explain Error Correction?
2. Difference between Error detection and Error Correction.
3. Explain Advantages of hamming code method.
4. Calculate the number of parity bits required for given data (1011).

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XII References:

1. Hamming Code in Computer Network - Naukri Code 360
2. Error Correcting Codes - Hamming codes (tutorialspoint.com)
3. Hamming Code in Computer Network - GeeksforGeeks

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 13: *Configure static IP address in operating system along with appropriate subnet mask for given problem

I **Practical Significance**

An IP address is an address used in order to uniquely identify a device on an IP network. The address is made up of 32 binary bits, which can be divisible into a network portion and host portion with the help of a subnet mask. The 32 binary bits are divided into four octets (1 octet = 8 bits). Each octet is converted to decimal and separated by a period (dot). For this reason, an IP address is said to be expressed in dotted decimal format (for example, 192.168.50.100). The value in each octet ranges from 0 to 255 decimal, or 00000000 - 11111111 binary. Student should be able to configure static IP address in operating system along with appropriate subnet mask

II **Industry / Employer Expected Outcome(s)**

1. Able to assign Static IP address to the machine along with appropriate subnet mask.

III **Course Level Learning Outcomes(s)**

CO4 - Configure different TCP/IP services.

IV **Laboratory Learning Outcome(s)**

LLO 13.1 Use IP address and appropriate subnet mask for given problem statement.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Internet Protocol (IP) Address**

An Internet Protocol address (IP address) is a numerical label assigned to each device participating in a computer network that uses the Internet Protocol for communication. An IP address is an identifier for a computer or device on a TCP/IP network. Two versions of the Internet Protocol (IP) are in use: IP Version 4 (IPv4) and IP Version 6 (IPv6).

IPv4 addresses are of 32 bits that are canonically represented in dot-decimal notation, which consists of four decimal numbers, each ranging from 0 to 255, separated by dots e.g.,192.168.50.12.

IPv6 addresses are of 128 bits that are represented as eight groups of four hexadecimal digits separated by colons.

e.g. 2001:0db8:85a3:0042:1000:8a2e: 0370:7334

IP addresses are assigned to a host either dynamically as they join the network, or persistently by configuration of the host hardware or software. Persistent configuration is also known as using a static IP address. When a computer's IP address is assigned each time it restarts, this is known as using a dynamic IP address.

Static IP Address: It is manually configured for a device. Routers, phones, tablets,laptops, desktops can be configured to have a static IP address.

Dynamic IP Address: It is a temporary IP address assigned to a computing device or node when it is connected to a network. A dynamic IP address is an automatically configured IP address assigned by a DHCP server to every new network node. They are normally implemented by internet service providers and network that have a large number of connecting end nodes. The dynamic IP address is assigned to a node until it is connected to the network and hence a device may have different IP address every time it is connected to the network.

- **IP Address Classes:**

In the IPv4 IP address space, there are five classes: A, B, C, D and E. Each class has a specific range of IP addresses**.** Primarily, class A, B, and C are used by the majority of devices on the Internet. Class D and class E are for special uses.

IP Address Class	IP Address Range (First octet decimal value)
Class A	1-126 (00000001 to 01111110) *
Class B	128-191 (10000000 to 10111111)
Class C	192-223 (11000000 to 11011111)
Class D	224-239 (11100000 to 11101111)
Class E	240-255 (11110000 to 11111111)

Class A Extremely large network, 16,777.000 available host address.

Class B Large network, 16,384 networks,each supporting more then 65,000 hosts.

Class C small networks, more than 2 million networks,each supporting up to 256 host.

- **Subnet Mask:**

IP addresses contain two parts: a network identifier and a host identifier.

A **subnet mask** is a 32-bit number which is used to identify the subnet of an IP address. The subnet mask is combination of 1‘s and 0‘s. 1‘s represents network ID and 0‘s represents the host ID.

Class	Binary	Dotted-Decimal
A	11111111 00000000 00000000 00000000	255.0.0.0
B	11111111 11111111 00000000 00000000	255.255.0.0
C	11111111 11111111 11111111 00000000	255.255.255.0

VII **Recourses Required:**

- Desktop computers/Networked Computer

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Avoid the repetition of similar IP addresses on two or more PCs. It may cause IP conflict error in networking.
3. Follow safety Practices

IX **Procedure**

To set a static IP address on windows computer

1. Click Start menu => control panel =>Network and Internet = >network and sharing center.

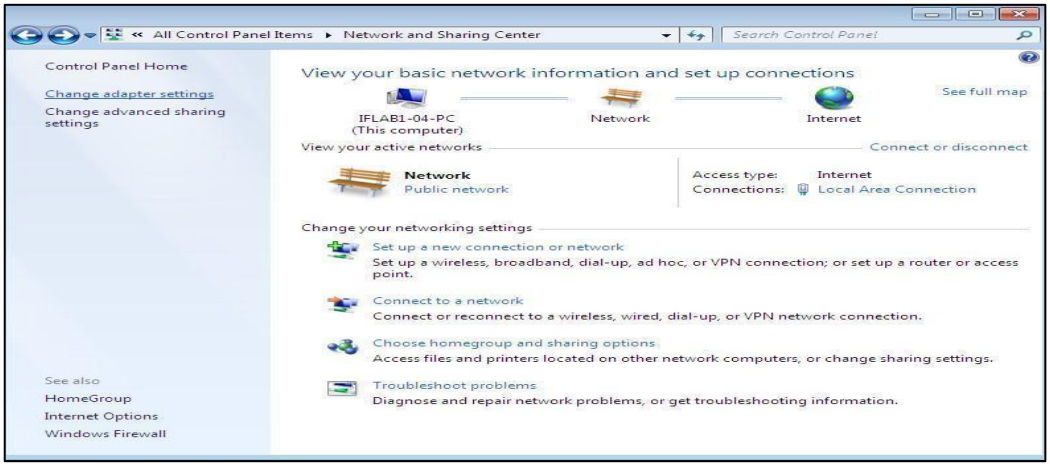

Fig. No. 13.1. Click Start menu => control panel =>Network and Internet = >network and sharing center.

2. Click “Change Adapter Settings”. Right Click “Local Area Connection” and then click on “Properties”

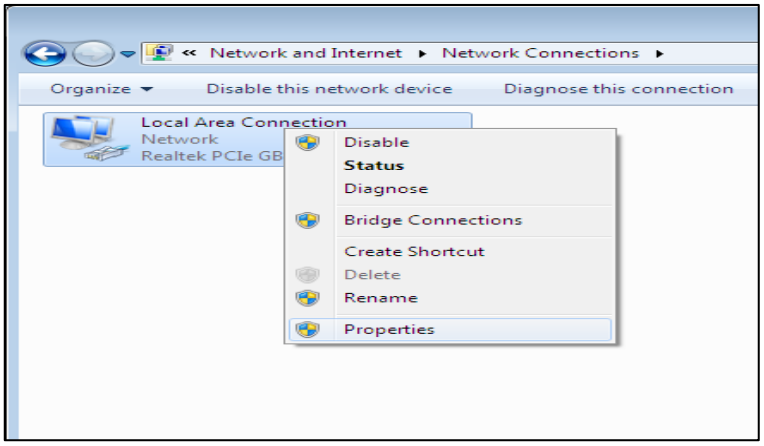

Fig. No. 13.2. Click "Change Adapter Settings". Right Click "Local Area Connection" and then click on "Properties"

3. Select Internet Protocol Version 4(TCP/IPv4). Click on "Properties"
4. Select "Use the following IP address" and enter the IP address, Subnet Mask, Default Gateway and DNS server. Click OK and Close the Local Area Connection properties window.

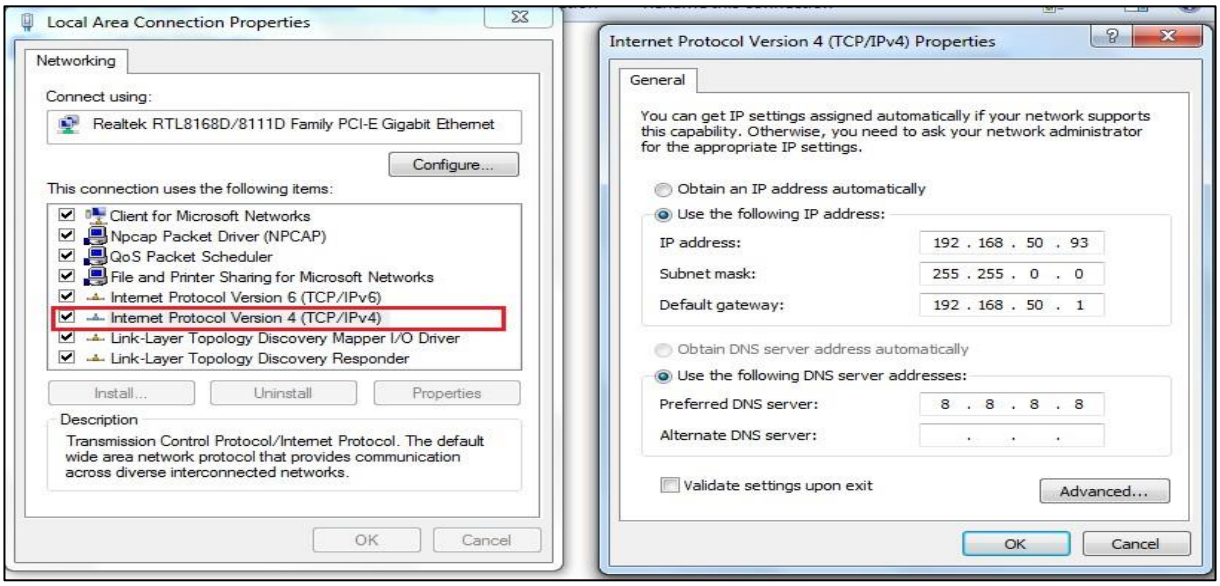

Fig. No. 13.3. Assign IP address, Subnet Mask, Default Gateway and DNS server

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Conclusion

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XI Practical related questions

1. What is difference between static and dynamic address?
2. What is IP addressing? State and Explain IP Address Classes.
3. What is subnet mask? What is subnet mask for Class A, B and C?
4. What is Default gateway?

Space for Answer

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XII References:

1. https://nptel.ac.in/courses/106105183

2. https://www.pcmag.com/how-to/how-to-set-up-a-static-ip-address

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

**Practical No. 14: ***Implement Classful Address in a given network node i) Identify range of IP Address in various classes ii) Justify the reason to choose various IP address classes for creating given network.

I **Practical Significance**

An IPv4 address originally had a fixed-length prefix, but three fixed-length prefixes (n = 8, n = 16, and n = 24) were created in order to support both small and big networks. The entire address space was partitioned into five classes (classes A, B, C, D, and E). Classful addressing is the term used to describe address space of an IP address

II **Industry / Employer Expected Outcome(s)**

1. Understand the concept of classful addressing
2. Understand and identify the classes of IP address

III **Course Level Learning Outcomes(s)**

CO4 - Configure different TCP/IP services

IV **Laboratory Learning Outcome(s)**

LLO 14.1 Implement IP addresses for intranet in Class A, Class B, Class C

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

Classful Address

The IP address, often known as the Internet address, is the unique identifier used in the IP layer of the TCP/IP protocol suite to identify each device's connection to the Internet. A host's or router's connection to the Internet is defined by its 32-bit IPv4 address, which is unique and used worldwide. The network is defined by the first component of the address, known as the **prefix**, and the node is defined by the second component, known as the **Suffix** (connection of a device to the Internet).

The lengths of the prefix and suffix are n bits and (32 - n) bits, respectively. Prefixes can have variable or fixed lengths. The IPv4 network identification was initially intended to be a fixed-length prefix. classful **addressing** is the term used to describe this outmoded system. An IPv4 address originally had a fixed-length prefix, but three fixed-length prefixes (n = 8, n = 16, and n = 24) were created in order to support both small and big networks. As shown in the figure below, the entire address space was partitioned into five classes (classes A, B, C, D, and E). Classful addressing is the term used to describe this system.

Classes of IP address

Class A

Class A addresses are for networks with large number of total hosts. Class A allows for 126 networks by using the first octet for the network ID. The first bit in this octet, is always zero. The remaining seven bits in this octet complete the network ID. The 24 bits in the remaining three octets represent the hosts ID and allows for approximately 17 million hosts per network. Class A network number values begin at 1 and end at 127.

- Public IP Range: 1.0.0.0 to 127.0.0.0
- First octet value ranges from 1 to 127
- Private IP Range: 10.0.0.0 to 10.255.255.255
- Subnet Mask: 255.0.0.0 (8 bits)
- Number of Networks: 126
- Number of Hosts per Network: 16,777,214

Class B

Class B addresses are for medium to large sized networks. Class B allows for 16,384 networks by using the first two octets for the network ID. The first two bits in the first octet are always 1 0. The remaining six bits, together with the second octet, complete the network ID. The 16 bits in the third and fourth octet represent host ID and allows for approximately 65,000 hosts per network. Class B network number values begin at 128 and end at 191.

- Public IP Range: 128.0.0.0 to 191.255.0.0
- First octet value ranges from 128 to 191
- Private IP Range: 172.16.0.0 to 172.31.255.255 (See Private IP Addresses
- Subnet Mask: 255.255.0.0 (16 bits)
- Number of Networks: 16,382
- Number of Hosts per Network: 65,534

Class C

addresses are used in small local area networks (LANs). Class C allows for approximately 2 million networks by using the first three octets for the network ID. In a class C IP address, the first three bits of the first octet are always 1 1 0. And the remaining 21 bits of first three octets

complete the network ID. The last octet (8 bits) represents the host ID and allows for 254 hosts

per network. Class C network number values begin at 192 and end at 223.

- Public IP Range: 192.0.0.0 to 223.255.255.0
- First octet value ranges from 192 to 223
- Private IP Range: 192.168.0.0 to 192.168.255.255
- Special IP Range: 127.0.0.1 to 127.255.255.255
- Subnet Mask: 255.255.255.0 (24 bits)
- Number of Networks: 2,097,150
- Number of Hosts per Network: 254

Class D IP addresses are not allocated to hosts and are used for multicasting. Multicasting allows a single host to send a single stream of data to thousands of hosts across the Internet at the same time. It is often used for audio and video streaming, such as IP-based cable TV networks. Another example is the delivery of real-time stock market data from one source to many brokerage companies.

- Range: 224.0.0.0 to 239.255.255.255
- First octet value ranges from 224 to 239
- Number of Networks: N/A
- Number of Hosts per Network: Multicasting

Class E IP addresses are not allocated to hosts and are not available for general use. These are reserved for research purposes.

Range: 240.0.0.0 to 255.255.255.255
First octet value ranges from 240 to 255
Number of Networks: N/A
Number of Hosts per Network: Research/Reserved/Experimental

VII **Recourses Required:**

Network Computer

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure**

1. Visit to Your Computer Network Lab
2. Check the IP address assign to device
3. Understand and identify which types of class use in IP address
4. Justify the reason to choose IP address classes for creating network

X **Conclusion**

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XI **Practical related questions**

1. Define IP address with Example
2. Difference between classfull and classless addressing
3. Explain classes of IP address with Example
4. Identify the classes of IP address for 1) 192.158.1.38 2) 168.212.226

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XII References:

1. 5 Classes of IPv4 Addresses [Class A, B, C, D and E] (meridianoutpost.com)
2. Introduction to IP addressing and subnetting | TechTarget
3. Introduction of Classful IP Addressing - GeeksforGeeks

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 15: *Execute TCP/IP network commands: ipconfig, ping, tracert

I **Practical Significance**

The full form of TCP/IP is Transmission Control Protocol/Internet Protocol..TCP/IP is the key part of the fundamental structure of the system. It enables you to talk with another system just by implementing a program or command. Student should be able to study and run basic TCP/IP utilities and networking commands: ipconfig, ping, tracert.

II **Industry / Employer Expected Outcome(s)**

1. Run TCP/IP Utilities: ipconfig, ping, tracert
2. Able to check configuration details of computer
3. Able to troubleshoot computer network by commands

III **Course Level Learning Outcomes(s)**

CO4 - Configure different TCP/IP services

IV **Laboratory Learning Outcome(s)**

LLO 15.1 Troubleshoot computer network using commands.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **TCP/IP utilities**:

To assist with the management of TCP/IP. There are three types of TCP/IP-based utilities.
1. **Connectivity utilities** that you can use to interact with and use resources on a variety of systems.
2. **Diagnostic utilities** that you can use to detect and resolve networking problems.
3. **TCP/IP server software** that provides printing and publishing services to TCP/IP based Microsoft Windows client.

Utility Type	Examples (networking commands)
Connectivity	FTP, LPR, TELNET, TFTP, RSH, RCP
Diagnostic	Ping, Ipconfig, Tracert, ARP, Hostname
Server software	TCP/IP Printing service, Internet Information Services, Peer Web Services

❖ **Ipconfig Command**

IPCONFIG stands for **Internet Protocol Configuration**.

This Command Displays detailed information about all adapters, including the IP address,

subnet mask, default gateway, DHCP server, and DNS servers etc.

Used without parameters ipconfig displays the IP address, subnet mask, and default gateway for all adapters. By default, this command displays only the IP address, subnet mask, and default gateway for each adapter bound to TCP/IP.

Syntax:

ipconfig [/allcompartments] [/? | /all | /renew [adapter] | /release [adapter] |/renew6 [adapter] | /release6 [adapter] | /flushdns | /displaydns | /registerdns |/showclassid adapter | /setclassid adapter [classid] |/showclassid6 adapter | /setclassid6 adapter [classid]]

Following table shows use of ipconfig command with different options

Parameter	Description
/?	Displays the help message
/all	Displays complete configuration information
/release	Uses DHCP to release the IP address for the specified adapter
/release6	Uses DHCPv6 to release the IPv6 address for the specified adapter
/renew	Uses DHCP to renew the IP address for the specified adapter
/renew6	Uses DHCPv6 to renew the IPv6 address for the specified adapter
/flushdns	Purges the DNS cache
/registerdns	Uses DHCP to refresh all DHCP leases and re-registers DNS names
/displaydns	Displays the contents of the DNS cache
/showclassid	Displays all the DHCP class IDs allowed for the adapter

/setclassid	Modifies the DHCP class ID
/showclassid6	Displays all the DHCPv6 class IDs allowed for the adapter
/setclassid6	Modifies the DHCPv6 class ID

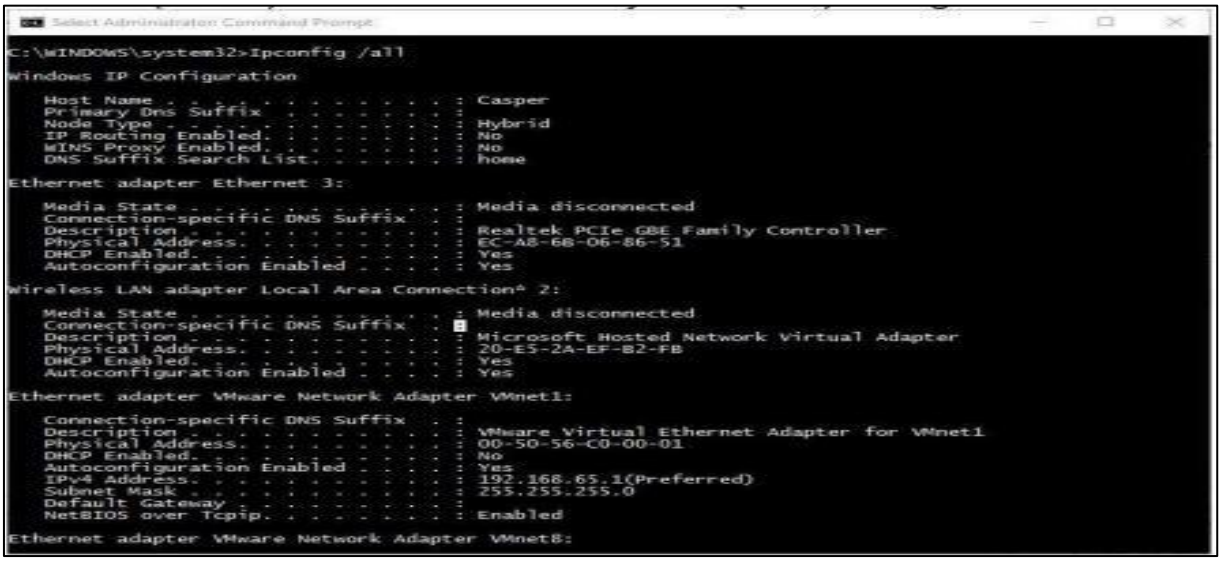

Fig.No. 15.1. Output screen of command C:\>ipconfig/all

❖ Ping Command

PING (Packet Internet groper): The ping command is the basic troubleshooting tool for TCP/IP.

It is a command used to verify the network connectivity of a computer. It uses a special protocol called the Internet Control Message Protocol (ICMP) to determine whether the remote machine (website, server, etc.) can receive the test packet and reply. This command is used to test a machine's connectivity to another system and to verify that the target system is active.

Usually, this command is the first step to any troubleshooting if a connectivity problem is occurring between two computers. The Ping utility executes an end-to-end connectivity test to other devices and obtains the round-trip time between source and destination device. Ping uses the ICMP Echo and Echo Reply packets to test connectivity. Excessive usage may appear to be a denial of service (DoS) attack.

Syntax: ping <ip address>

ping [-t] [-a] [-n count] [-l size] [-f] [-i TTL] [-v TOS][-r count] [-s count] [[-j host-list] | [-k host-list]][-w timeout] [-R] [-S srcaddr] [-c compartment] [-p][-4] [-6] target_name

Following table shows use of ping command with different options

Parameter	Description
-t	Pings the specified host until interrupted (press Ctrl+C to stop sending).
-a	Resolves addresses to hostnames.
-n *count*	Indicates the number of Echo Requests to send.
-l *size*	Sends a specific size of data. If this size is greater than the local network can handle, the sender will generate fragmented packets directly on the network.
-f	Sets the Don _t Fragment flag in the packet.
-i *TTL*	Sets the Time to Live value in the packet.
-v*TOS*	Sets the type of service in the packet.
-r *count*	Indicates that the Ping process should record the route for the number of count hops specified.
-s *count*	Indicates that the Ping process should maintain Timestamp information for the number of count hops specified.
-j *host_list*	Indicates that the Ping process should follow a loose source route path along the host_list path
-k *host_list*	Indicates that the Ping process should follow a strict source route along the host_list path.
-w *timeout*	Indicates the number of milliseconds the host should wait for each reply.
-R	Use the router header to test the reverse route as well (IPv6 only).
-S *srcaddr*	What address to use to source ping from.
-p	Ping yper-V Network Virtualization provider address.
-4	Use IPv4 specifically.
-6	Use IPv6 specifically.

- Example 1

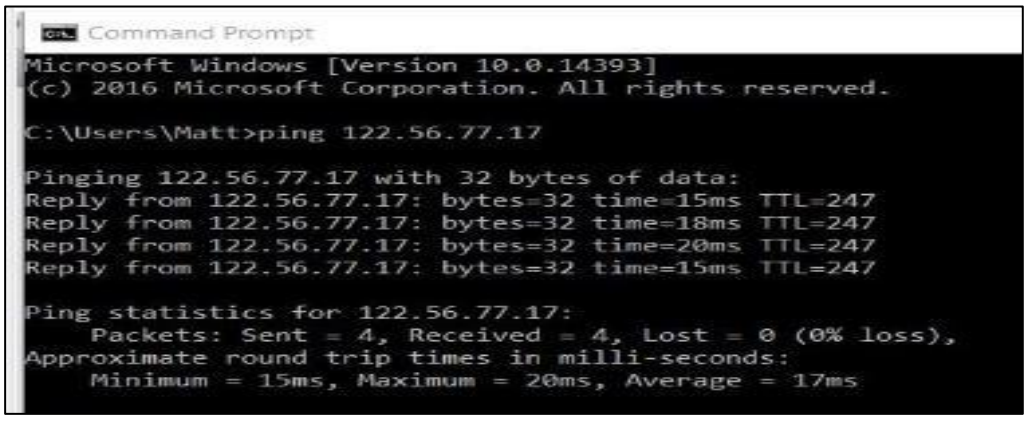

Fig.No. 15.2. Output screen of command C:\>ping

- Example 2

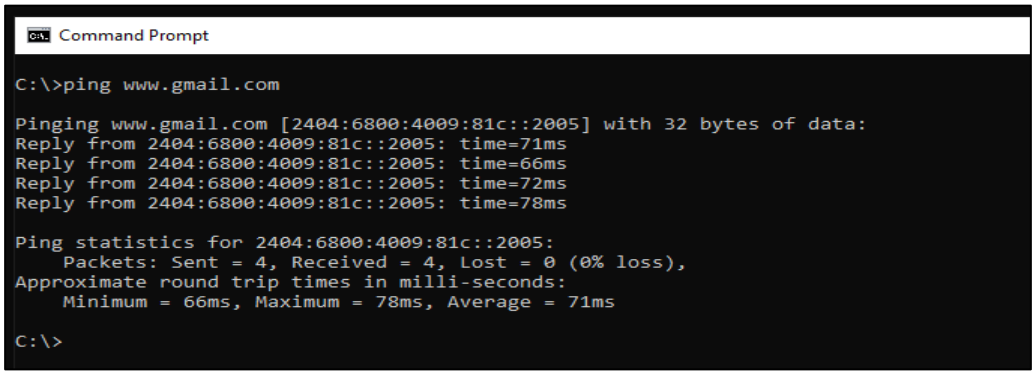

Fig.No. 15.3. Output screen of command C:\>ping

If the connection is successful, you will see a series of responses displaying the round-trip time, indicating that your internet connection is working. To stop pinging we should use ctrl+c otherwise it will keep on sending packets.

Here,

- **min:** minimum time to get a response
- **avg:** average time to get responses
- **max:** maximum time to get a response

❖ **Tracert (traceroute)**

In the internet, data packets travel through a series of routers before reaching their destination. Tracert is a command that allows you to trace this path.

It traces the route taken by your data, revealing each hop (router) it encounters and the time it takes to reach it.

Syntax: tracert<ip address>

tracert [-d] [-h maximum_hops] [-j host-list] [-w timeout] [-R] [-S srcaddr] [-4] [-6] target_name

Following table shows use of tracert command with different options.

Parameter	Description
-d	Tells the system not to resolve addresses to host names
-h *maxHops*	Specifies the maximum number of hops to search for target
-w *timeout*	Specifies the number of milliseconds to wait for each reply
-4	Specifies to use IPv4 specifically
-6	Specifies to use IPv6 specifically
-R	Trace round-trip path (IPv6-only).
-S srcaddr	Source address to use (IPv6-only).

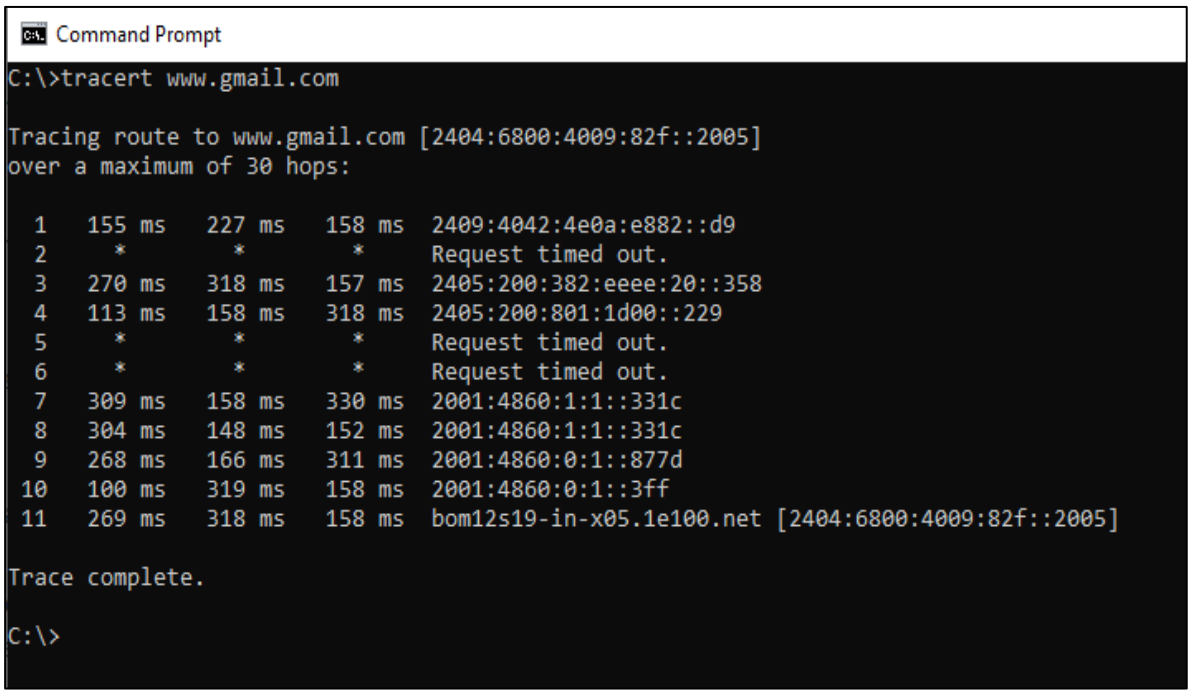

Fig.No. 15.4. Output screen of command C:\>tracert

After running the Tracert command, you'll be presented with a list of hops, each showing the time taken for your data to travel.

VII **Recourses Required:**

- Computer / Networked Computers

VIII **Precautions to be followed:**

1. Handle Computer system and peripherals with care.
2. Follow safety Practices

IX **Procedure**

1. Open Command Prompt
2. Run Utilities with options

X **Conclusion**

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XI Practical related questions

1. What is a purpose of TCP/IP utilities. Give the use of connectivity utility and also write 2 examples of it.

2. Give the name of commands to find out hostname and MAC address of computer.

3. Which are the different things are checked using ping command?

4. Give a syntax of tracert command.

5. What is a use of "/release" and "/renew" option used in lpconfig?

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1. https://www.geeksforgeeks.org /How to Use the Tracert (Traceroute) Command in Windows? - GeeksforGeeks

2. https://www.pluralsight.com/blog/it-ops/top-7-tcpip-utilities-every-networking-pro-should-know

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 16: *Execute TCP/IP network commands: netstat, pathping, route

I **Practical Significance**

Student should be able to study and run basic TCP/IP utilities and networking commands: netstat, pathping, route.

II **Industry / Employer Expected Outcome(s)**

1. Run TCP/IP Utilities: netstat, pathping, route
2. Able to trace travelling route of transmitted message or data packet.
3. Able to display network statistics

III **Course Level Learning Outcomes(s)**

CO4 - Configure different TCP/IP services

IV **Laboratory Learning Outcome(s)**

LLO 16.1 Troubleshoot computer network using commands.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Netstat (network statistics) Command:**

Netstat displays protocol statistics and current TCP/IP network connections. netstat allows users to display network-related information and diagnose various networking issues. The command has several options that can be combined to retrieve specific details.

Syntax:

netstat [-a] [-b] [-e] [-f] [-n] [-o] [-p proto] [-r] [-s] [-t] [-x] [-y] [interval]

Following table shows use of netstat command with different options

Option	Description
-a	Displays all connections and listening ports.
-b	Displays the executable involved in creating each connection or listening port. In some cases, well-known executables host multiple independent components, and in these cases the sequence of components involved in creating the connection or listening port is displayed. In this case the executable name is in [] at the bottom, on top is the component it called, and so forth until TCP/IP was reached. Note that this option can be time-consuming and will fail unless you have sufficient permissions.
-e	Displays Ethernet statistics. This may be combined with the -s option.
-f	Displays Fully Qualified Domain Names (FQDN) for foreign addresses.
-n	Displays addresses and port numbers in numerical form.
-o	Displays the owning process ID associated with each connection.
-p proto	Shows connections for the protocol specified by proto; proto may be any of: TCP, UDP, TCPv6, or UDPv6. If used with the -s option to display per-protocol statistics, proto may be any of: IP, IPv6, ICMP, ICMPv6, TCP, TCPv6, UDP, or UDPv6.
-q	Displays all connections, listening ports, and bound nonlistening TCP ports. Bound nonlistening ports may or may not be associated with an active connection.
-r	Displays the routing table.
-s	Displays per-protocol statistics. By default, statistics are shown for IP, IPv6, ICMP, ICMPv6, TCP, TCPv6, UDP, and UDPv6; the -p option may be used to specify a subset of the default.
-t	Displays the current connection offload state.
-x	Displays Network Direct connections, listeners, and shared endpoints.
-y	Displays the TCP connection template for all connections. Cannot be combined with the other options.
interval	Redisplays selected statistics, pausing interval seconds between each display. Press CTRL+C to stop redisplaying statistics. If omitted, netstat will print the current configuration information once.

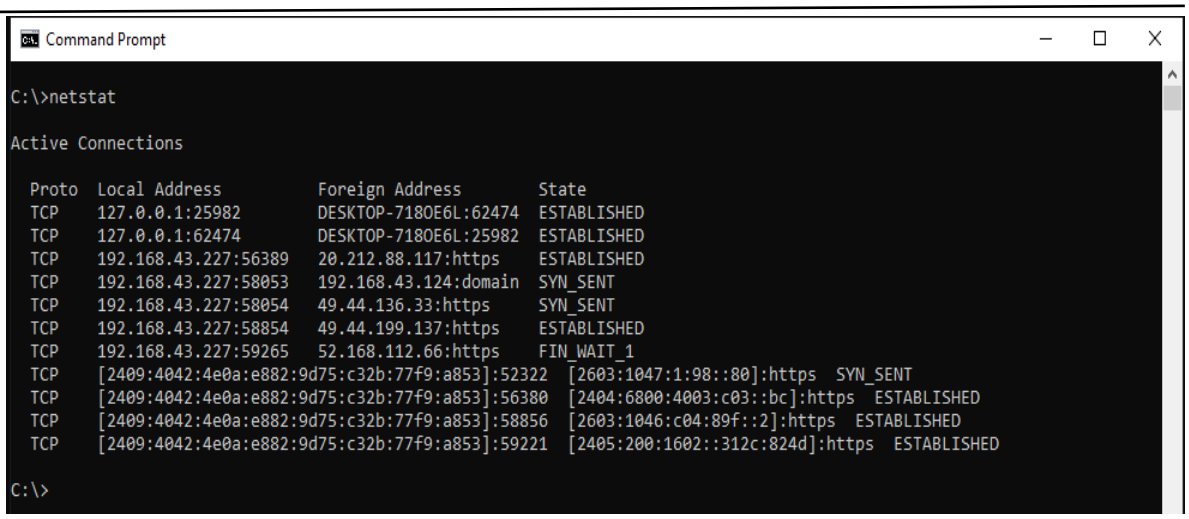

Fig.No. 16.1. Output of netstat command

❖ Pathping Command:

This network utility is a more advanced version of the Ping tool, which performs a ping to each hop along the route to the destination (unlike Ping, which just pings from the originating device to the destination device). It is extremely useful in diagnosing packet loss, and can help with diagnosing slow speed faults.

Pathping is a TCP/IP based utility (command-line tool) that provides useful information about network latency and network loss at intermediate hops between a source address and a destination address. It does this by sending echo requests via ICMP and analyzing the results.

Syntax:

pathping [-g host-list] [-h maximum_hops] [-i address] [-n] [-p period] [-q num_queries][-w timeout][-4] [-6] target_name

Following table shows use of pathping command with different options

Option	Description
-g <host-list>	Loose source route along host-list.
-h <maximum_hops>	Maximum number of hops to search for target
-i <address>	Use the specified source address.
-n	Do not resolve addresses to hostnames.
-p <period>	Wait period milliseconds between pings.
-q <num_queries>	Number of queries per hop.
-w <timeout >	Wait timeout milliseconds for each reply.
-4	Force using IPv4.
-6	Force using IPv6.

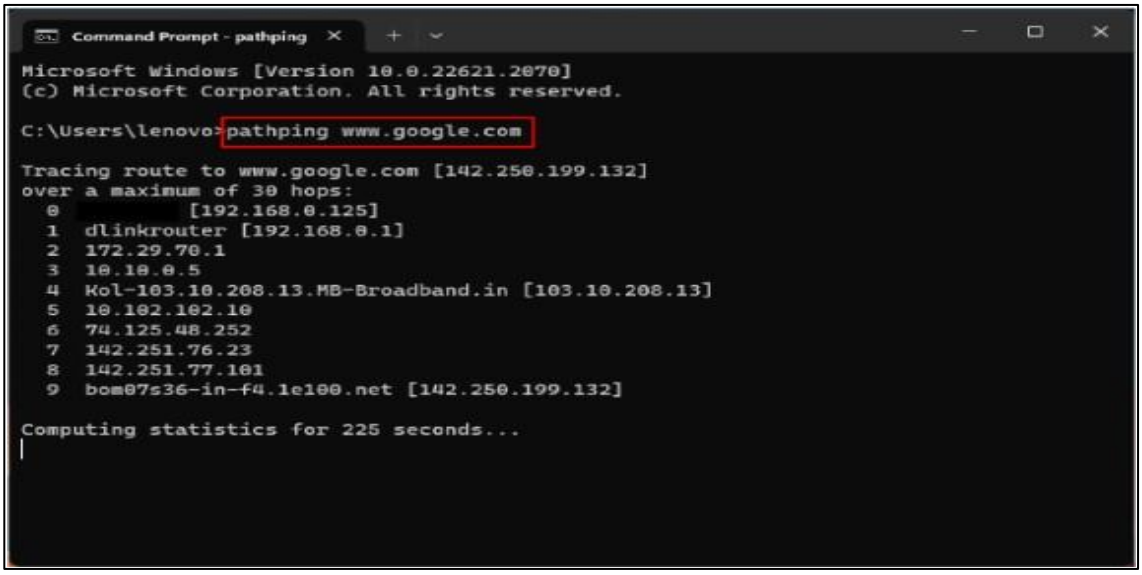

Fig.No. 16.2. Output of pathping command

Note:You can interrupt PathPing at any time by holding down the **CTRL** key, and pressing **C** on your keyboard.

❖ **Route Command:**

This command manipulates network routing tables.

Route command is only available if the TCP/IP protocol is installed as a component in the properties of a network adapter.

Route command displays or modifies the computer's routing table information. For a typical computer that has a single network interface and is connected to a local area network (LAN) that has a router, the routing table is pretty simple. If user facing trouble in accessing other computers or other networks, user can use the route command to investigate bad entry that affect in the computer's routing table.

For a computer with more than one interface and that's configured to work as a router, the routing table is often a major source of trouble. Setting up the routing table properly is a key part of configuring a router to work.

Earlier tracert command is used to trace the travel of packet from source to destination over a network. This command is capable to modify routing table entries hence the route command is established. To display the routing table (both IPv4 and IPv6) in Windows, use the route print command.

Syntax:

route [-f] [-p] [-4|-6] command [destination][MASK netmask] [gateway] [METRIC metric] [IF interface]

Route command syntax finds and displays following information for each entry in the routing

table, five items of information are listed:

• **The destination IP address**, this is the address of the destination subnet, and must be interpreted in the context of the subnet mask.

• The **subnet mask** that must be applied to the destination address to determine the destination subnet

• The **IP address of the gateway** to which traffic intended for the destination subnet will be sent

• The **IP address of the interface** through which the traffic will be sent to the destination subnet

• The **metric**, which indicates the number of hops required to reach destinations via the gateway

Option	Description
-f	Clears the routing table
-P	When used with the ADD command, makes a route persistent across boots of the system. By default, routes are not preserved when the system is restarted. Ignored for all other commands, which always affect the appropriate persistent routes.
Command	The command to run (add, change, delete, print)
-4	Force using IPv4
-6	Force using IPv6
Destination	Network destination of the route
mask Netmask	The netmask (subnet mask) associated with the network destination
Gateway	Specifies gateway
metric Metric	specifies the metric, ie. cost for the destination.
Interface	the interface number for the specified route.
/?	Command help

Most of the times this command syntax is used with print option like Route print command.

syntax

route print [-f] [-p] [-4|-6] [Command [Destination] [mask Netmask] [Gateway] [metric Metric]] [if Interface]] >

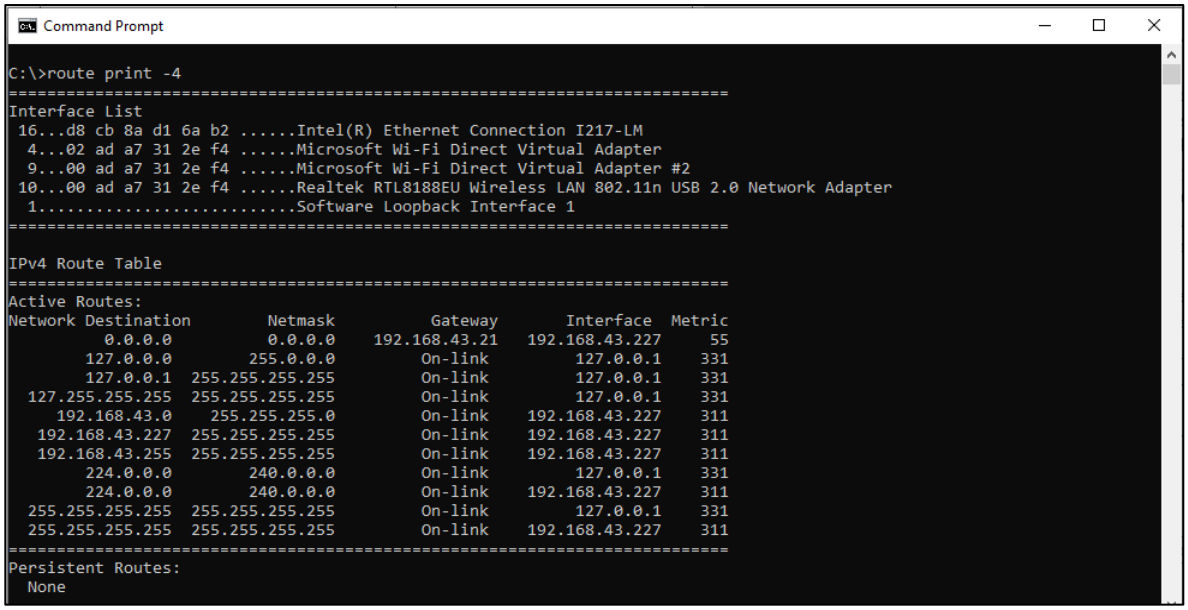

Fig.No. 16.3. Output of route command

VII **Recourses Required:**

- Computer / Networked Computers (With Internet connectivity)

VIII **Precautions to be followed:**

1. Handle Computer system and peripherals with care.
2. Follow safety Practices

IX **Procedure**

1. Open Command Prompt
2. Run Utilities with options

X **Conclusion**

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XI **Practical related questions**

1. Which are different statistics display for TCP using Netstat utility?
2. What is a use of pathping command?
3. Execute the syntax of Route command with any two options
4. Give syntax of commands for adding, deleting IP addresses from routing table.

Space for Answer

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XII References:

1. https://www.clouddirect.net/knowledge-base/KB0011455/using-traceroute-ping-mtr-and-pathping
2. https://www.geeksforgeeks.org/how-to-add-a-static-route-to-windows-routing-table/
3. https://en.wikipedia.org/wiki/Route_(command)

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 17: *Install Wireshark and configure as packet sniffer - i) Capture IP, TELNET, FTP packets using Wireshark

I Practical Significance

Wireshark is a free and open-source packet analyzer. It is used for network troubleshooting, analysis, software and communications protocol development, and education. Student should be able to install and configure as a packet sniffer.

Industry / Employer Expected Outcome(s)

II

1. Able to install and configure Wireshark.
2. Able to Capture IP, TELNET and FTP packets

III Course Level Learning Outcomes(s)

CO4 - Configure different TCP/IP services

IV Laboratory Learning Outcome(s)

LLO 17.1 Use Wireshark packet sniffer software.

V Relevant Affective Domain related Outcomes

- Follow safely Measures
- Follow ethical practice

VI Relevant Theoretical Background

❖ **Wireshark**

Wireshark is a network packet analyzer. A network packet analyzer presents captured packet data in as much detail as possible. Wireshark is completely free and open source. This packet analyzer is used for a variety of purposes like to troubleshoot network problems, to examine security problems, to verify network applications, to debug protocol implementations, to learn network protocol internals etc.

Wireshark is the most often-used packet sniffer in the world. A packet sniffer is also known as a packet analyzer, protocol analyzer or network analyzer is a piece of hardware or software used to monitor network traffic.

The original name of Wireshark was Ethereal which was changed in 2006.Wireshark is a cross-platform software, it can be run on Linux, windows, mac, and any other operating system.

❖ **IP Packet**

In most computer networks, data is broken down into small units called packets and sent between devices. The same holds true on the internet. Each packet has a specific structure, defined by a protocol, that allows the recipient to understand the packet's contents. An IP packet is a unit of data in a network that contains information about the source and destination addresses and other control information needed to transport the packet over a network.

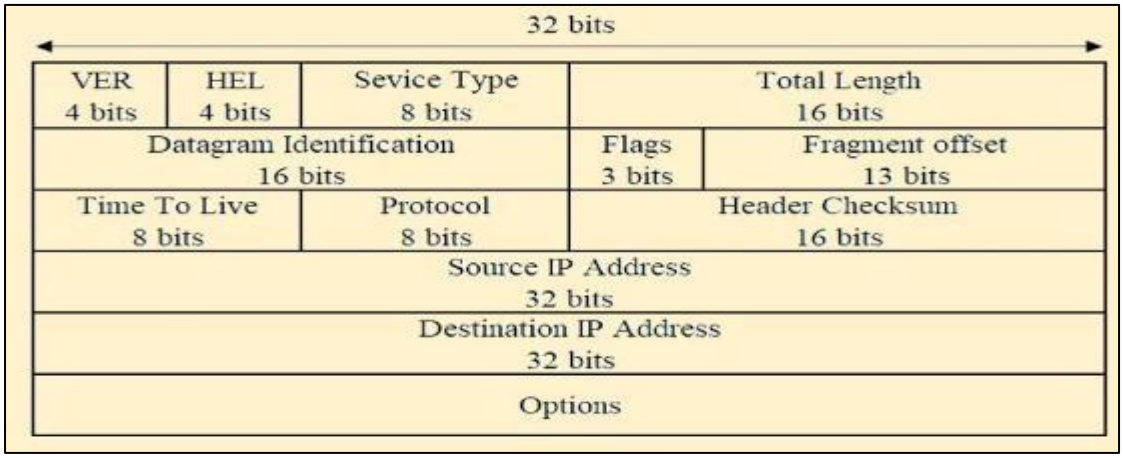

Fig. No. 17.1. IPv4 Header format

❖ **Telnet Packet**

Telnet (short for "teletype network") is a client/server application protocol that provides access to virtual terminals of remote systems on local area networks or the Internet. It follows a user command TCP/IP networking protocol that creates remote sessions.

❖ **FTP**

FTP (File Transfer Protocol) is a network protocol for transmitting files between computers over Transmission Control Protocol/Internet Protocol (TCP/IP) connections. Within the TCP/IP suite, FTP is considered an application layer protocol.

❖ **Steps to install Wireshark on Windows:**

Follow the below steps to install Wireshark on Windows:

1. Open the web browser.
2. Search for '**Download Wireshark**' or Visit Official Wireshark website

https://www.wireshark.org/download.html.

3: Click on Download, a new webpage will open with different installers of Wireshark.

4. Downloading of the executable file will start shortly.

5. Now check for the executable file in downloads in your system and run it.

6. It will prompt confirmation to make changes to your system. Click on Yes.

7. Setup screen will appear, click on Next.

8. The next screen will be of License Agreement, click on Noted.

9. Next screen is for choosing components, all components are already marked so don‘t change anything just click on the Next button.

10. Next screen is of choosing shortcuts like start menu or desktop icon along with file extensions which can be intercepted by Wireshark, tick all boxes and click on Next button.

11. The next screen will be of installing location so choose the drive which will have sufficient memory space for installation.

12. Next screen has an option to install Npcap which is used with Wireshark to capture packets. *pcap* means packet capture so the install option is already checked don‘t change anything and click the next button.

13. Next screen is about USB network capturing so it is one‘s choice to use it or not, click on Install.

14. After this installation process will start.

15. This installation will prompt for Npcap installation as already checked so the license agreement of Npcap will appear to click on the *I Agree* button.

16. Next screen is about different installing options of *npcap*, don‘t do anything click on Install.

17. After this installation process will start which will take only a minute.

18. After this installation process will complete click on the Next button.

19. Click on Finish after the installation process is complete.

20. After this installation process of Wireshark will complete click on the Next button.

21. Click on Finish after the installation process of Wireshark is complete.

Wireshark is successfully installed on the system and an icon is created on the desktop as shown below:

Fig. No.17.2. Wireshark icon

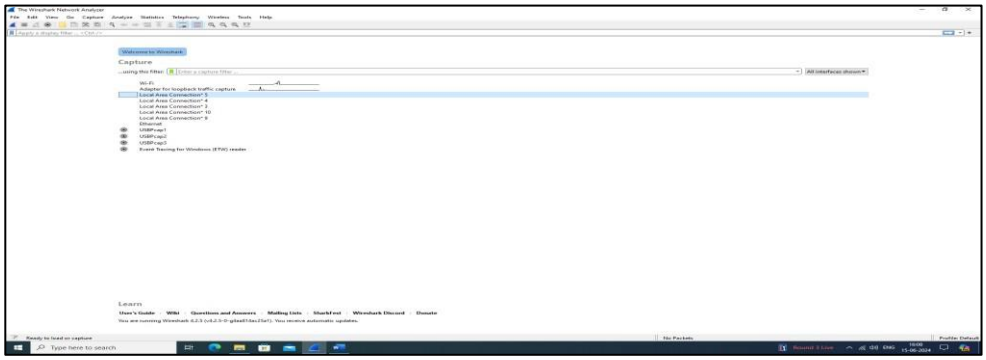

Fig. No.17.3. Wireshark software

VII **Recourses Required:**

- Computer / Networked Computers (with internet connectivity)
- Wireshark Software (Open-source software)

VIII **Precautions to be followed:**

1. Handle Computer system and peripherals with care.
2. Follow safety Practices

IX **Procedure Select a Network Interface to Capture Packets through.**

1. Start the Wireshark application.
2. List of network interfaces is available on the screen
3. select network interface to capture packets.

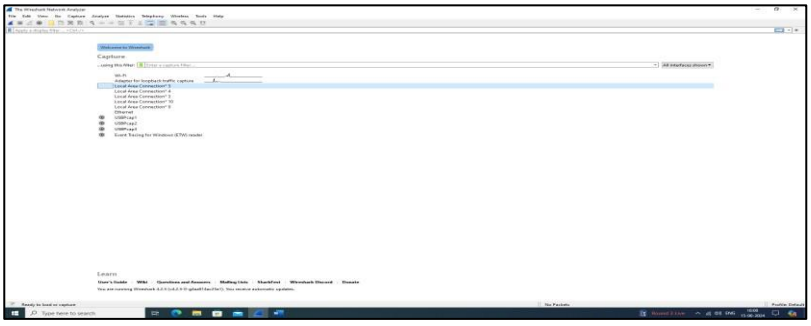

Fig. No.17.4. Selection of Network interface

- **To capture network traffic by using Wireshark:**

To capture network traffic, click the Start button for the network interface you want to capture traffic on.

Fig No.17.5.Start button to capture Network traffic

Generate some network traffic with a Web Browser. Your Wireshark window should show the packets, and now look something like

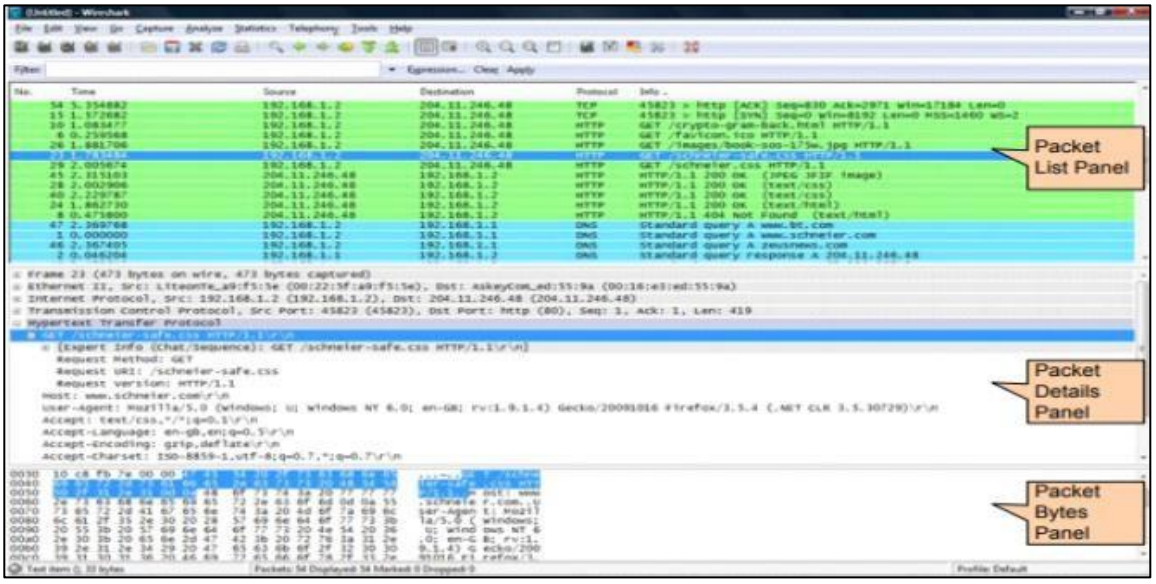

Fig. No.17.6. Wireshark software shows packets by using three panels

The capture is split into 3 parts:

1. Packet List Panel – This is a list of packets in the current capture. It colors the packets based on the protocol type. When a packet is selected, the details are shown in the two panels below.

2. Packet Details Panel – This shows the details of the selected packet. It shows the different protocols making up the layers of data for this packet. Layers include Frame, Ethernet, IP, TCP/UDP/ICMP, and application protocols such as HTTP.

3. Packet Bytes Panel – shows the packet bytes in Hex and ASCII encodings.

To stop the capture

Select the Capture->Stop menu option, Ctrl+E, or the Stop toolbar button. What you have

created is a Packet Capture, which you can now view and analyse using the Wireshark interface, or save to disk to analyse later.

Wireshark Display Filters.

Wireshark automatically generates a Display Filter, and applies it to the capture. The filter is shown in the Filter Bar, below the button toolbar. The window should be similar to that shown in Fig.No.17.7.

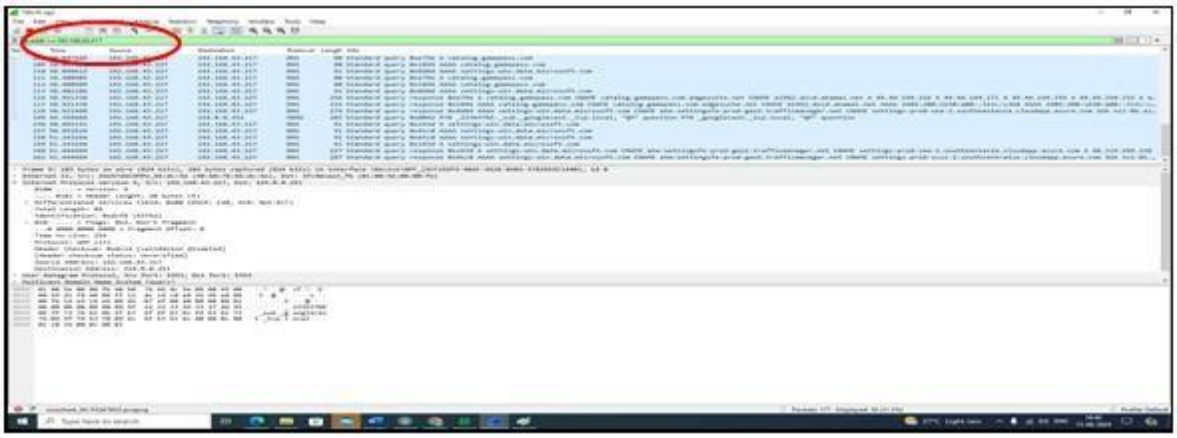

Fig. No.17.7.Display filter in Wireshark software

- **Capture IP packets using Wireshark**

IP Filtering is a simple mechanism or process that defines which kinds of IP Datagrams are running on your system, like a source IP address is coming and a Destination IP is outgoing.

Description	***Filter Expression***
Capture only traffic to or from IP address 192.168.43.227:	ip.addr ==192.168.43.227
Capture only traffic from source IP address 192.168.43.227:	ip.src ==192.168.43.227
Capture only traffic to destination IP address 192.168.43.227:	ip.dst ==192.168.43.227

Steps to Capture only traffic to or from IP address 192.168.43.227:

1. go to display filter
2. type ip.addr ==192.168.43.227 and press enter

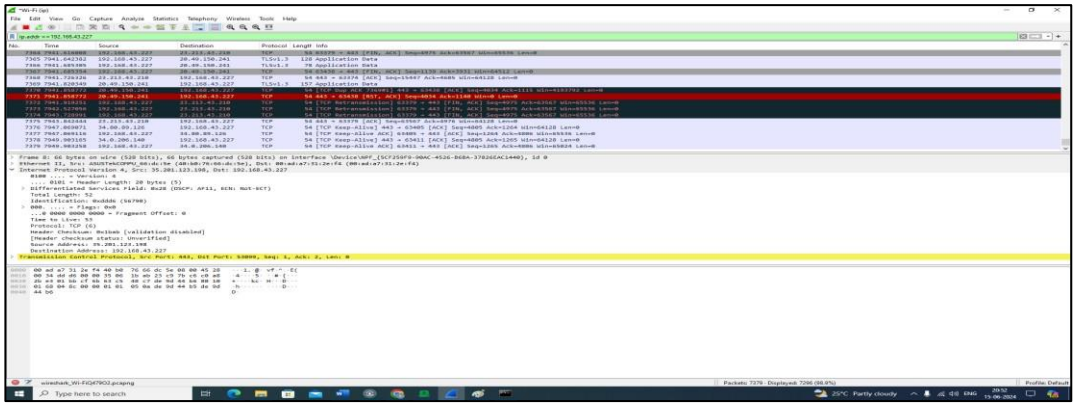

Fig. No.17.8. Capture IP packets by using Wireshark software

- **To check IP header information**

1. Go to Wireshark => type "http" in display filter => start capturing packets
2. Go to browser => Visit any website
3. In Wireshark, stop capturing packets

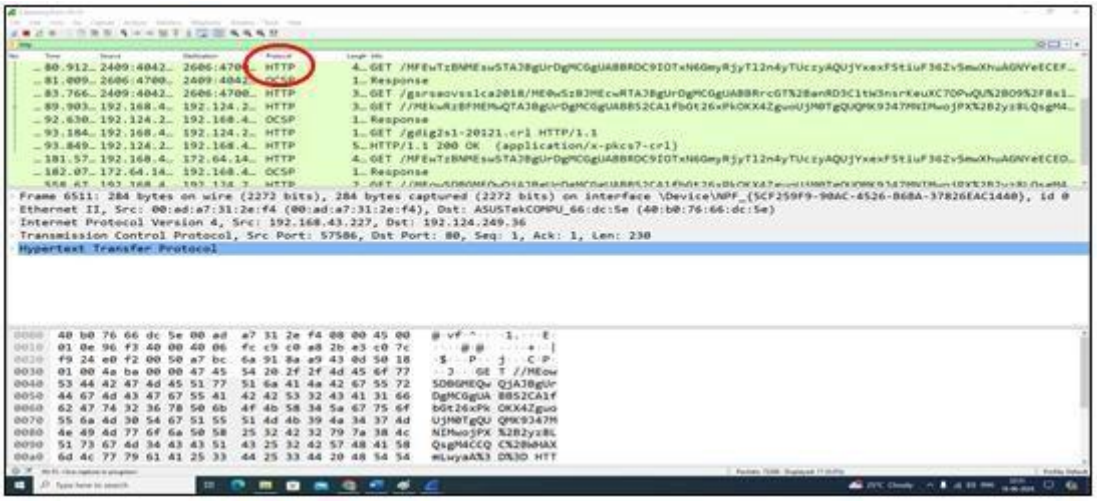

Fig. No. 17.9. HTTP packet

4. Double click on "http" as shown in above fig

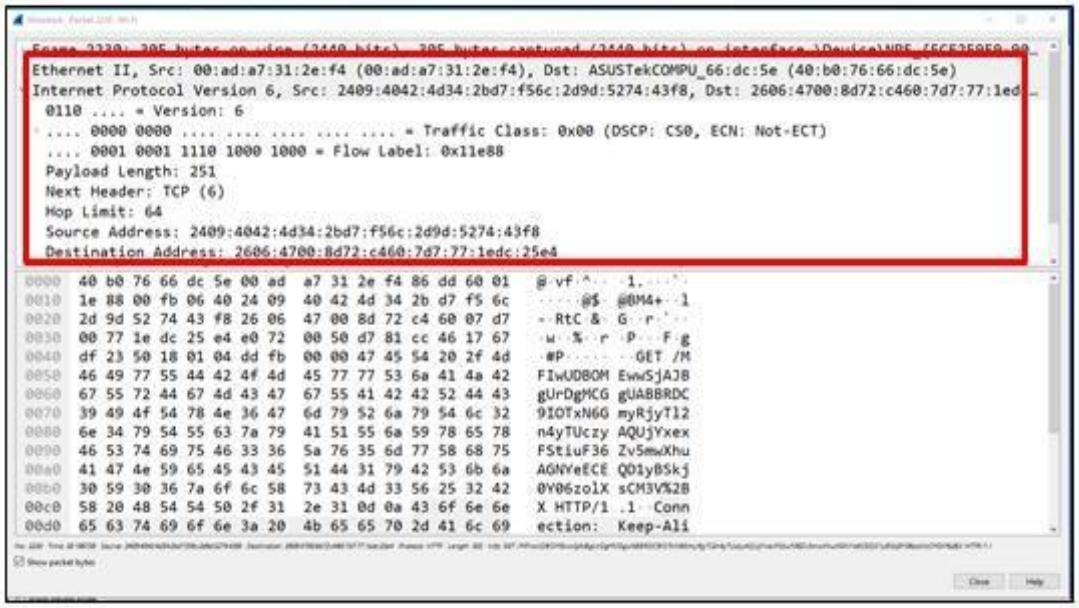

Fig. No.17.10. IP Header Information

X **Conclusion**

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XI **Practical related questions**

1. What is wireshark?
2. Write usage of wireshark.
3. What is use of Npcap software? Is it necessary to install for wireshark? Why?
4. State any four Wireshark Capture Options.
5. What is "Display filter" and "Capture filter"?

Space for Answer

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XII References:

1. https://www.geeksforgeeks.org/how-to-install-wireshark-on-windows/
2. https://wiki.wireshark.org/CaptureFilters
3. https://youtu.be/AgAE8zkBoHk?si=ekhlrDg8PLn2lx-6
4. https://www.youtube.com/watch?v=AWERzjGEyRU

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 18: Capture TCP and UDP packet using Wireshark

I **Practical Significance**

Transmission Control Protocol is a connection-oriented protocol for communications that helps in the exchange of messages between different devices over a network. User Datagram Protocol (UDP) is a Transport Layer protocol. UDP is a part of the Internet Protocol suite, referred to as UDP/IP suite. Unlike TCP, it is an unreliable and connectionless protocol. Student should be able to capture TCP and UDP Packet using Wireshark.

II **Industry / Employer Expected Outcome(s)**

1. Able to capture TCP and UDP Packet using Wireshark.

III **Course Level Learning Outcomes(s)**

CO4 - Configure different TCP/IP services

IV **Laboratory Learning Outcome(s)**

LLO 18.1 Measure various types of Delay by using Wireshark.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **TCP**

TCP (Transmission Control Protocol) is one of the main protocols of the Internet protocol suite. The position of TCP is at the transport layer of the OSI model. Transmission Control Protocol is a connection-oriented protocol for communications that helps in the exchange of messages between different devices over a network. The Internet Protocol (IP), which establishes the technique for sending data packets between computers, works with TCP. TCP also helps in ensuring that information is transmitted accurately by establishing a virtual connection between the sender and receiver.

Working of Transmission Control Protocol (TCP)

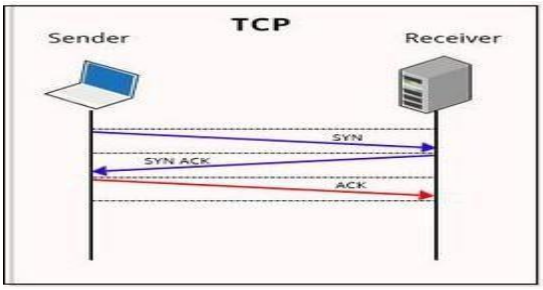

Fig. No.18.1. Working of TCP

When a user requests a web page on the internet, somewhere in the world, the server processes that request and sends back an HTML Page to that user. The server makes use of a protocol called the HTTP Protocol. The HTTP then requests the TCP layer to set the required connection and send the HTML file.

Now, the TCP breaks the data into small packets and forwards it toward the Internet Protocol (IP) layer. The packets are then sent to the destination through different routes.

The TCP layer in the user's system waits for the transmission to get finished and acknowledges once all packets have been received.

Transmission Control Protocol (TCP) provides a secure and reliable connection between two devices using the 3-way handshake process. TCP uses the full-duplex connection to synchronize (SYN) and acknowledge (ACK) each other on both sides. There are three steps for both establishing and closing a connection. They are − SYN, SYN-ACK, and ACK

Step 1 (SYN): In the first step, the client wants to establish a connection with a server, so it sends a segment with SYN (Synchronize Sequence Number) which informs the server that the client is likely to start communication and with what sequence number it starts segments with

Step 2 (SYN + ACK): Server responds to the client request with SYN-ACK signal bits set. Acknowledgement (ACK) signifies the response of the segment it received and SYN signifies with what sequence number it is likely to start the segments with

Step 3 (ACK): In the final part client acknowledges the response of the server and they both establish a reliable connection with which they will start the actual data transfer

TCP Header Format:

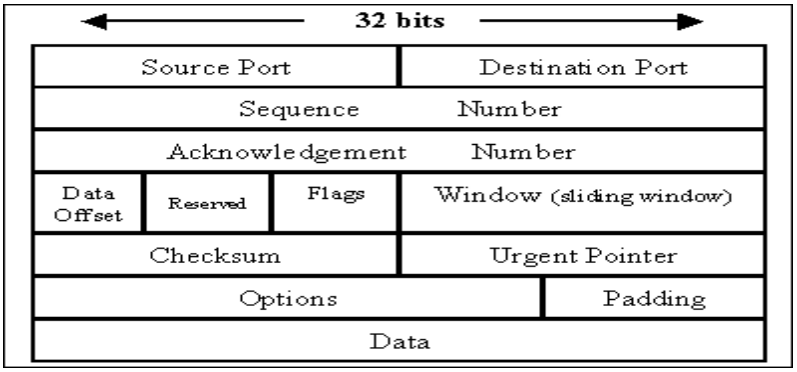

Fig. No.18.2. TCP Header Format

❖ **UDP**

User Datagram Protocol (UDP) is a Transport Layer protocol. UDP is a part of the Internet Protocol suite, referred to as UDP/IP suite. Unlike TCP, it is an **unreliable and connectionless protocol.** So, there is no need to establish a connection before data transfer. The UDP helps to establish low-latency and loss-tolerating connections over the network. The UDP enables process-to-process communication.

Working of User Datagram Protocol (UDP)

UDP uses IP to get a datagram from one computer to another. UDP gathers data in a UDP packet and adds its own header information to the packet. This data consists of the source and destination ports on which to communicate, the packet length and a checksum. After UDP packets encapsulate in an IP packet, it sends packets off to their destinations. However, unlike other protocols such as TCP, UDP simplifies data transfer by sending packets directly to the receiver without first establishing a two-way connection. UDP does not indicate the transmission order for its datagrams or even confirm their arrival.

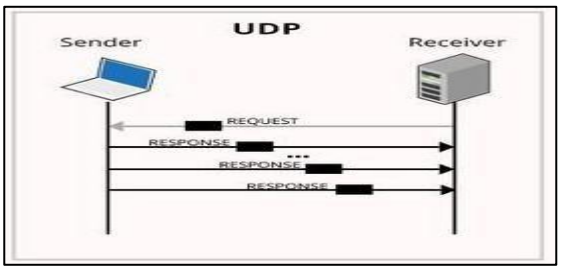

Fig. No.18.3. Working of UDP

UDP Header Format:

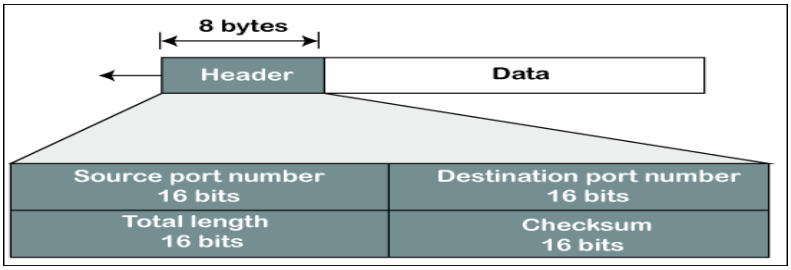

Fig.No.18.4.UDP Header format

VII **Recourses Required:**

- Computer / Networked Computers (with internet connectivity)
- Wireshark Software (Open-source software)

VIII Precautions to be followed:

1. Handle Computer system and peripherals with care.
2. Follow safety Practices

IX Procedure

Steps to Capture TCP packets

1. Go to display filter
2. Type "tcp " and press enter

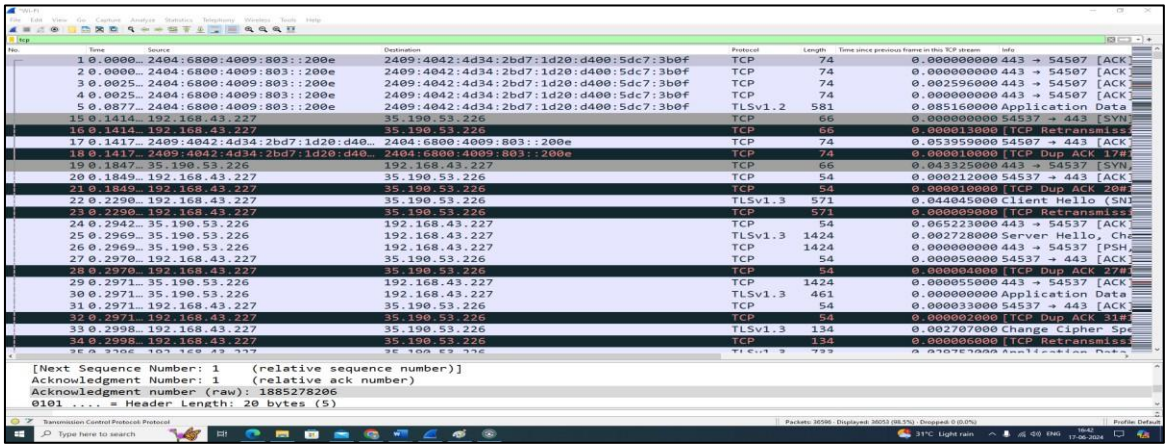

Fig. No.18.5. Capture TCP Packets

To check TCP Header information:

1. Go to display filter => Type "tcp" and press enter

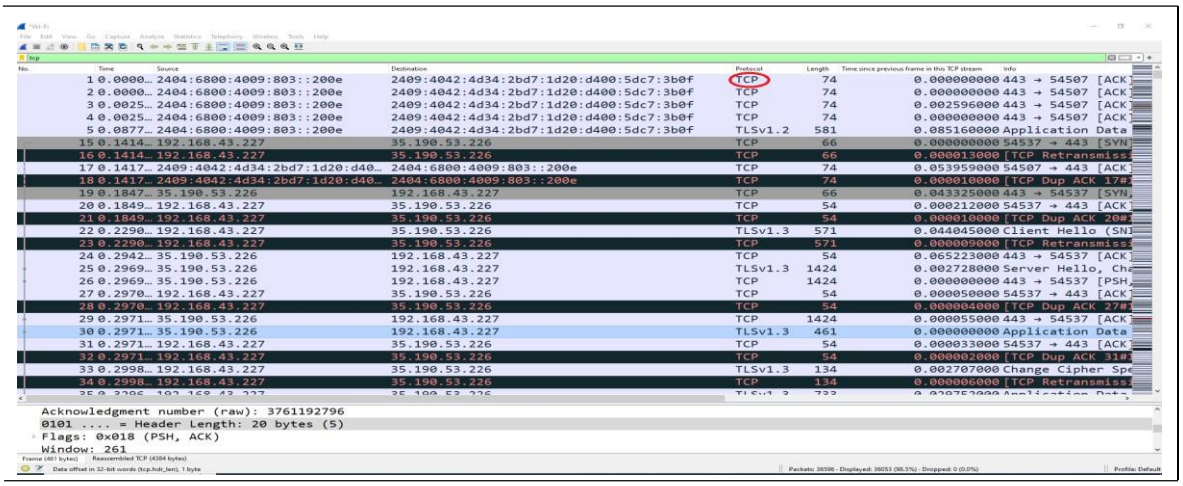

Fig.No.18.6.TCP packets

2. Double click on tcp as shown in fig. 18.6. Now TCP Header information will be available as shown in fig. 18.7

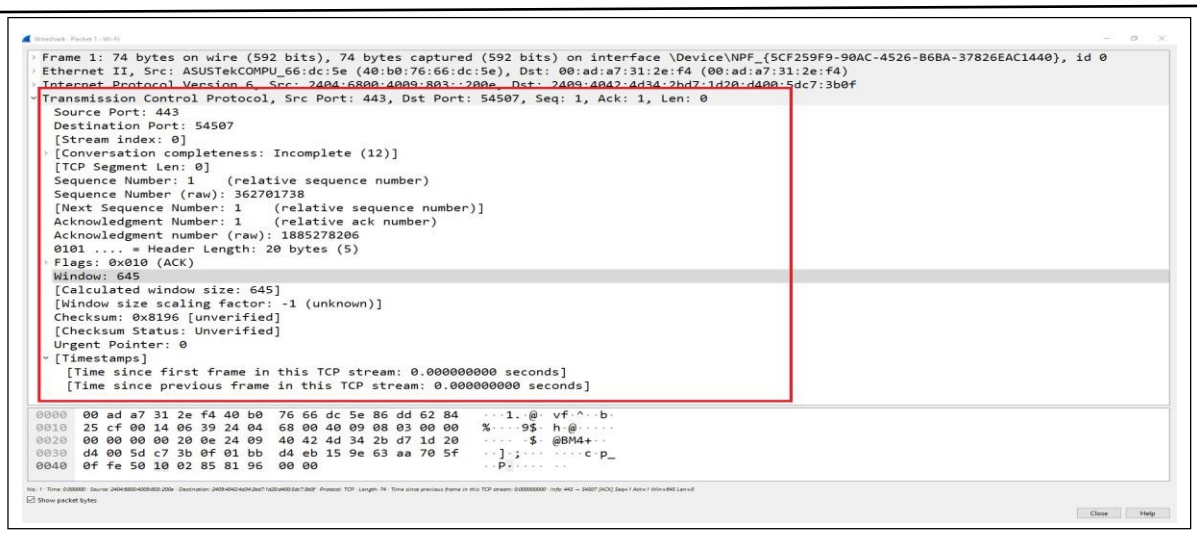

Fig.No.18.7.TCP Header information

Steps to Capture UDP packets

1. Go to display filter
2. Type "udp" and press enter

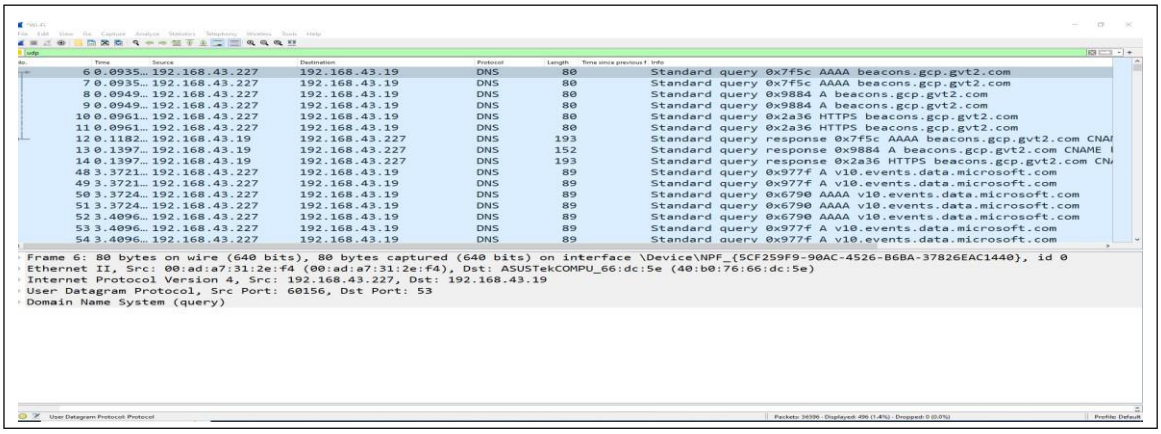

Fig. No.18.8. Capture UDP Packets

UDP Header information look like fig. no.18.9

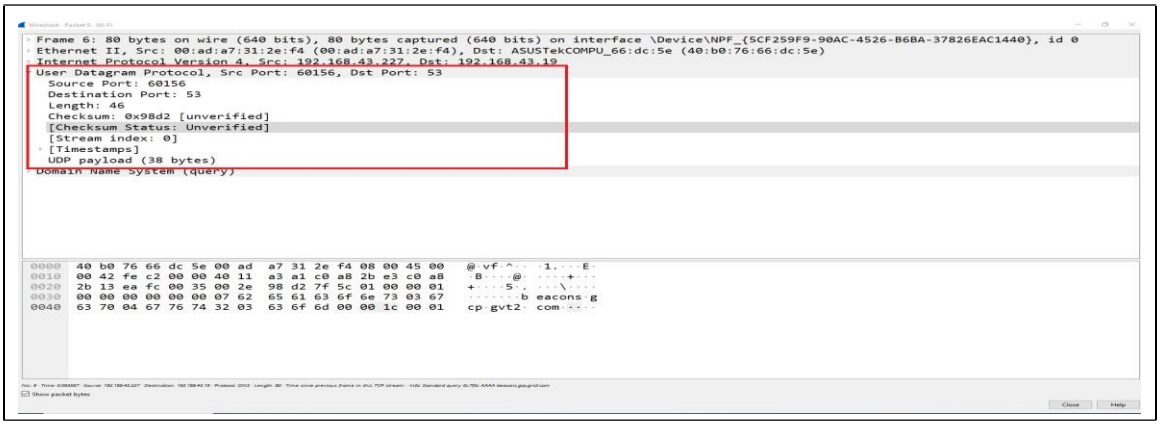

Fig.No.18.9. UDP Header Information

X **Conclusion**

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XI **Practical related questions**

1. How to capture TCP and UDP both packet at a time by using Wireshark?
2. Compare TCP and UDP
3. What is TCP 3-way handshake process? Write the Procedure to capture TCP 3-way handshake process by using Wireshark?
4. Write the Applications of TCP and UDP.

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XII References:

1. https://www.geeksforgeeks.org/tcp-3-way-handshake-process/
2 https://youtu.be/AgAE8zkBoHk?si=ekhlrDg8PLn2lx-6
3. https://youtu.be/EFxDXA9J-hk?si=Ad7iY82i4xF4Zyg4

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 19: Capture ARP and ICMP packet using Wireshark

I **Practical Significance**

ARP (**Address** Resolution Protocol) is one of the most important protocols which is responsible to find the hardware address of a host from a known IP address. ICMP (Internet Control Message Protocol) is used for reporting errors and management queries. Student should be able to capture ARP and ICMP Packet using Wireshark.

II **Industry / Employer Expected Outcome(s)**

1. Capture ARP and ICMP packet Traffic using Wireshark

III **Course Level Learning Outcomes(s)**

CO4 - Configure different TCP/IP services

IV **Laboratory Learning Outcome(s)**

LLO 19.1 Filter ARP and ICMP packet Traffic using Wireshark.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background :** ARP takes the IP address of a host as input & gives its corresponding physical address as the output. ARP sends the IP broadcast message to all the computer on the network. The computer whose IP address matches the broadcast IP address sends a reply and along with, its physical address to the broadcasting computer. All other computers ignore the broadcast message

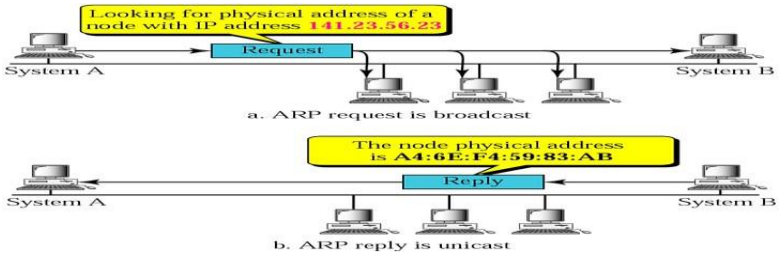

Fig. No . 19.1. ARP

Fig.No.19.2. ARP Header Format

❖ **ICMP**

The ICMP stands for **Internet Control Message Protocol**. It is a network layer protocol. It is used for error handling in the network layer, and it is primarily used on network devices such as routers. As different types of errors can exist in the network layer, so ICMP can be used to report these errors and to debug those errors. The ICMP protocol requires no handshakes or formal connections. Instead, it operates as a connectionless protocol. And the data you get back is in numeric form. You'll need to decode it to make sense of it.

The ICMP messages are usually divided into two categories: error reporting messages and Query messages

The **error-reporting message** means that the router encounters a problem when it processes an IP packet then it reports a message. Various types of Messages are used under this category like destination unreachable, source quench, Time exceeded, parameter problem and redirection.

The **query messages** are those messages that help the host to get the specific information of another host. For example, suppose there are a client and a server, and the client wants to know whether the server is live or not, then it sends the ICMP message to the server. Various types of Messages are used under this category like echo request or reply and Timestamp request or reply.

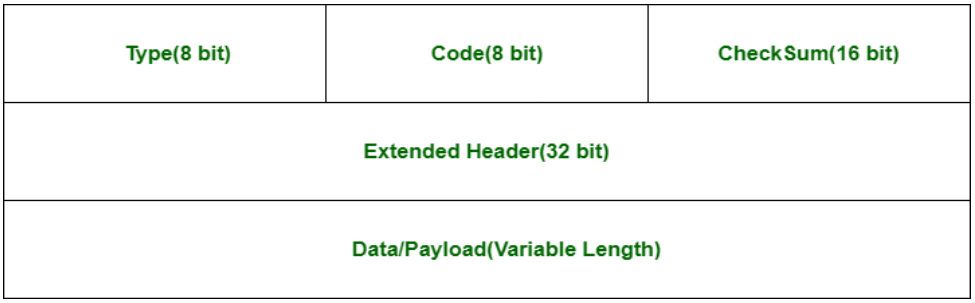

Fig.No.19.3. ICMP packet format

VII **Recourses Required:**

- Computer / Networked Computers (with internet connectivity)
- Wireshark Software (Open-source software)

VIII **Precautions to be followed:**

1. Handle Computer system and peripherals with care.
2. Follow safety Practices

IX **Procedure**

Steps to Capture ARP packets

1. Go to display filter
2. Type "arp" and press enter

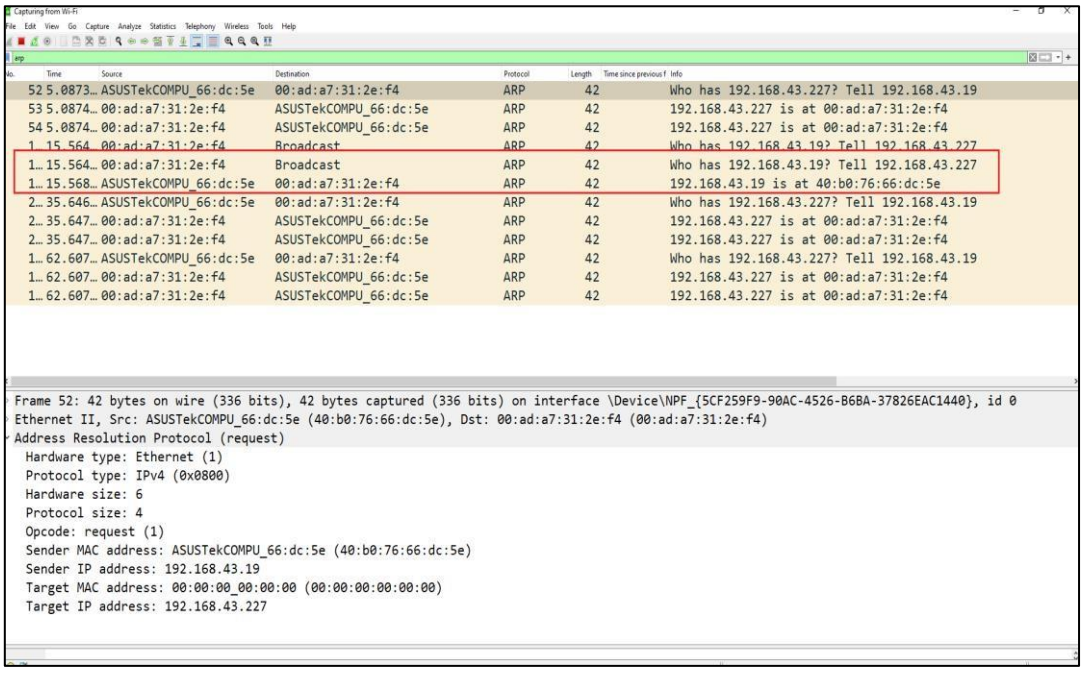

Fig. No.19.4. Capture ARP Packets

ARP Request and Reply packets

- Above Fig.No 19.4. shows ARP packet including request packet as well as reply packet.
- **Analysed ARP Request Packet:**
  Double click on ARP request Packet as shown in fig. 19.4. Now ARP Request packet header information will be available as shown in fig. 19.5 including IP address, MAC address of sender and IP address of Target and other information.

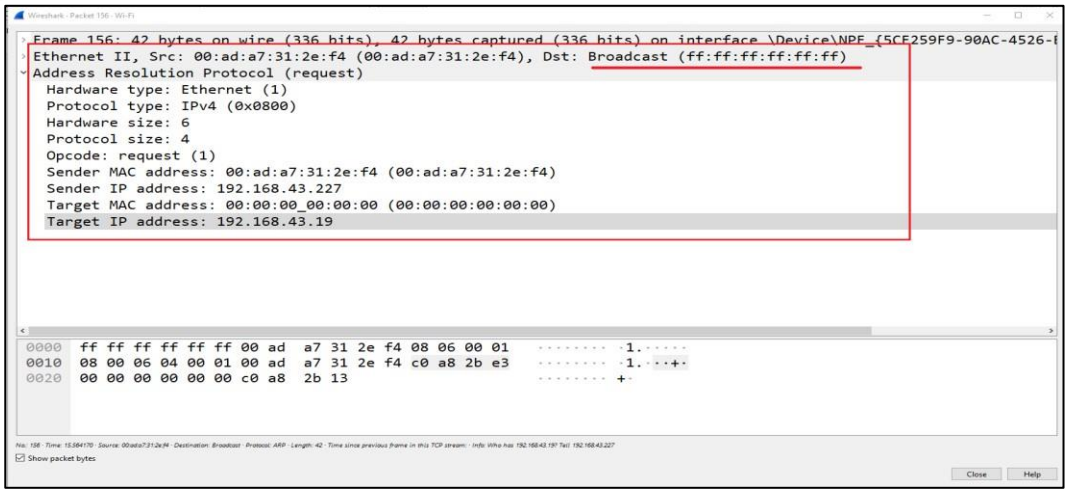

Fig. No.19.5.ARP Broadcast Packet header information

- **Analysed ARP Replay Packet:**
  Double click on ARP Replay Packet as shown in fig. 19.4. Now ARP Reply packet header information will be available as shown in fig. 19.6 including IP address, MAC address of sender, IP address, MAC Address of Target and other information.

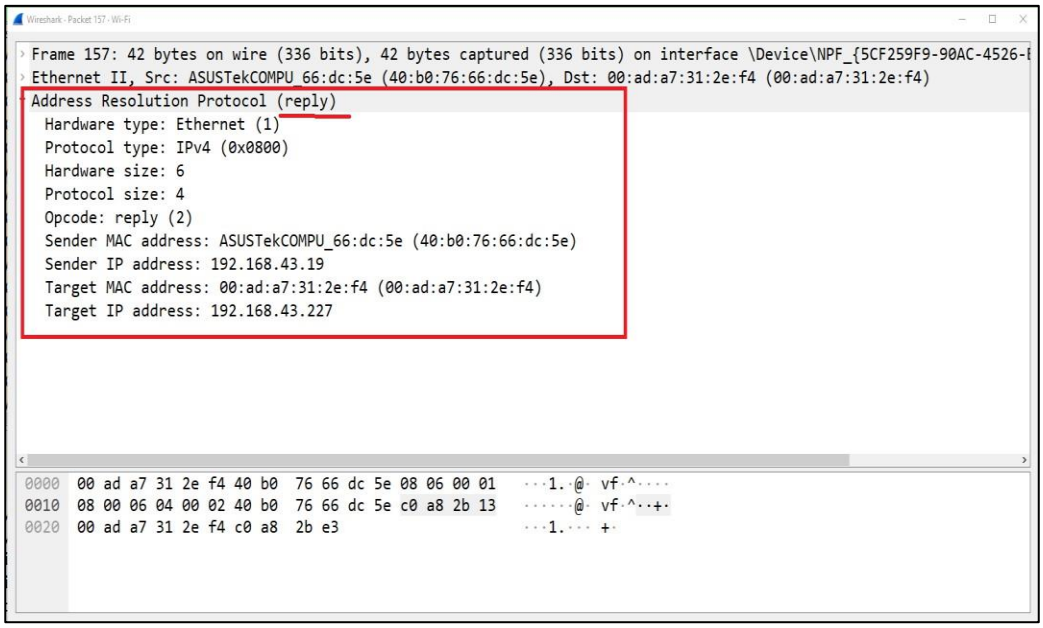

Fig. No.19.6. ARP Reply Packet header information

Steps to Capture ICMP packets:

1. Go to display filter
2. Type "icmp" and press enter
3. Go to command prompt and execute ping command

   C:\>ping www.msbte.org.in

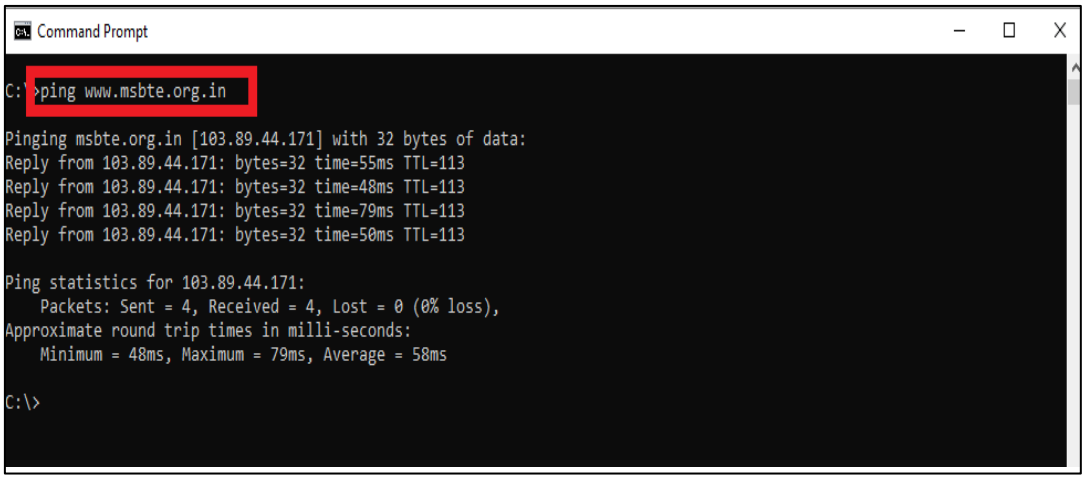

Fig. No.19.7. Ping Command

5. Go to Wireshark. All ICMP packets are captured by Wireshark.

6. Click on ICMP Request Packet as shown in fig. No.19.8. Now ICMP Request packet header information will be available.

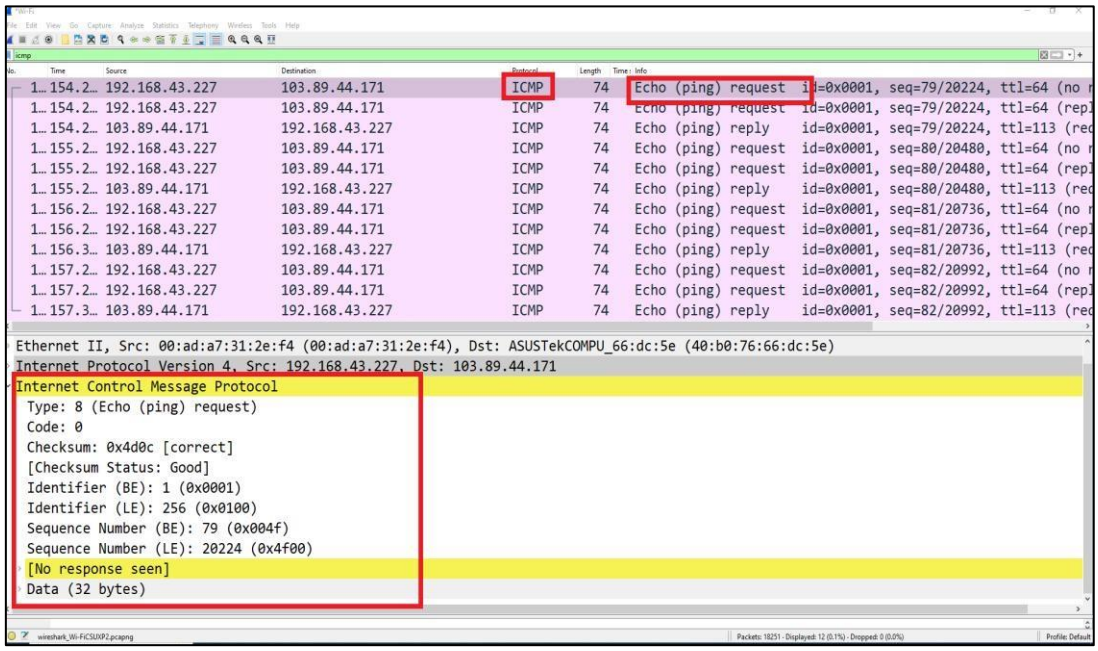

Fig. No.19.8. ICMP Request packet header information

7. Click on ICMP Reply Packet as shown in fig. No.19.9. Now ICMP Reply packet header information will be available.

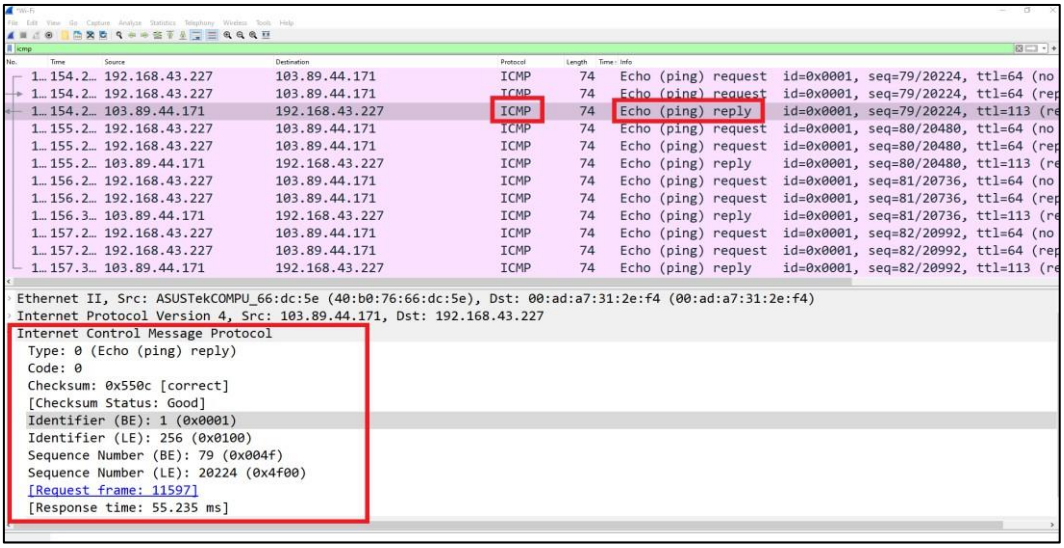

Fig. No.19.9. ICMP Reply packet header information

X Conclusion

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XI Practical related questions

1. What is the use of ARP?
2. Write down steps to check ARP Request and ARP Reply packet format by using Wireshark.
3. What is the size of an ARP request and ARP Reply packet?
4. At which layer do ICMP works?
5. What are the various ICMP Messages.

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1. https://www.geeksforgeeks.org/how-address-resolution-protocol-arp-works/
2. https://www.hackers-arise.com/post/network-basics-for-hackers-address-resolution-protocol-or-arp
3. https://www.youtube.com/watch?v=BEUrxiiD7_w&list=PLTS-Jel4E3gX2tNXyXVImwdW2NaV-dR6U&index=4
4. https://www.youtube.com/watch?v=rEtp2Cgkpno&t=7s

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 20: Install Operating System Linux/Windows/Any other Server 2019

I **Practical Significance**

Student should be able to install windows server 2019 Operating system

II **Industry / Employer Expected Outcome(s)**

1. Understand working of Windows 2019 server.
2. Compare the server based/ Network operation system with Desktop Operating System.

III **Course Level Learning Outcomes(s)**

CO1 - Analyze the functioning of Data Communication and Computer Network.

IV **Laboratory Learning Outcome(s)**

LLO 20.1 Install server operating system

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **Network Operating System**

An Operating system, which includes software and associated protocols to communicate with other autonomous computers via a network conveniently and cost-effectively, is called Network Operating System. It allows devices like a disk, printers, etc., shared between computers. The individual machines that are part of the Network have their operating system and the Network Operating System resides on the top of the individual machines.

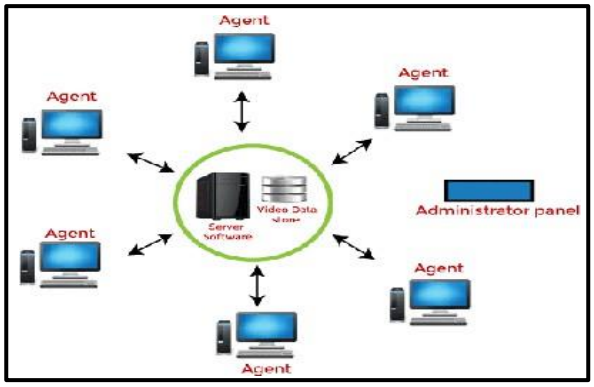

Fig.No. 20.1. Network Operating System

❖ **Windows server 2019 Edition**

Windows Server 2019 is for the time being the latest version of the server operating system released by Microsoft. Generally available since October 2018, Windows Server 2019 is built on the strong foundation of Microsoft‘s previous release, Windows Server 2016. The functionality of the 2019 release offers new opportunities when it comes to hybrid cloud environments, storage, security, and administration. Additionally, Windows Server 2019 comes with a user-friendly interface and comprehensive documentation, making it suitable for students who are new to server administration.

Windows Server 2019 has three editions: Essentials, Standard, and Datacenter. As their names imply, they are designed for organizations of different sizes, and with different virtualization and datacenter requirements. Windows Server 2019 Essentials perfectly suits the needs of a small infrastructure, while the Datacenter edition provides the widest range of functions among all the other server operating systems from Microsoft.

VII **Recourses Required:**

Processor – 1.4 GHz 64-bit processor

- RAM – 512 MB
- Disk Space – 32 GB
- Network – Gigabit (10/100/1000 based) Ethernet adapter
- Optical Storage – DVD drive (if installing the operating system from DVD media)
- Video – Super VGA (1024 x 768) or higher -resolution
- Input Devices – Keyboard and mouse
- Internet – Broadband access

VIII **Precautions to be followed:**

Selection of any drive for installation must be done carefully so as not to delete any useful data

IX **Procedure: Installation steps for Network operating system windows server 2019**

1. BOOT your Computer System from OS Media
2. When the Computer Starts, press any key if you asked for you like to BOOT from the disc by pressing any key
3. On the first screen, select installation language, Time and keyboard layout the click “**Next**”

Fig.No.20.2. Select Language, Time and keyboard layout

4. Start the installation by clicking on "**Install Now**"

Fig.No. 20.3. Click on Install Now

5. Select the Windows Server 2019 edition to install and click "**Next"**

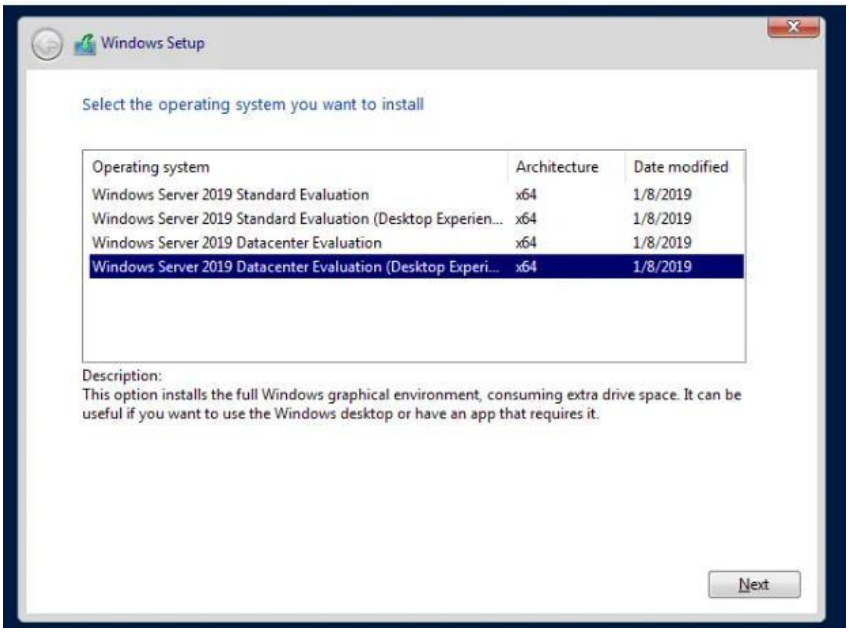

Fig. No .20.4. Selection of Windows Server 2019

6. Read the License terms and agree to them to start the installation by checking the box **"I accept the license terms "**

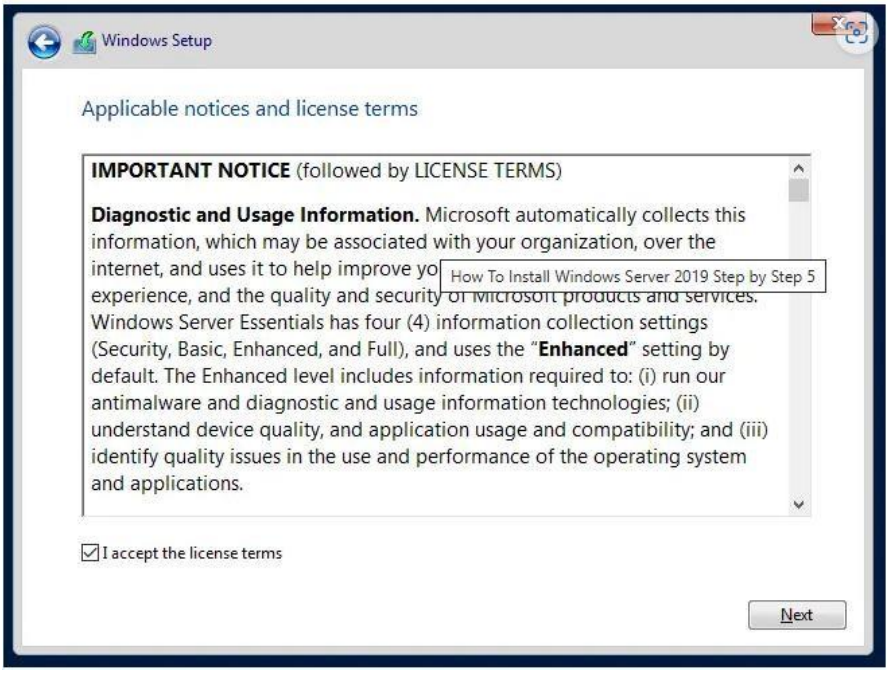

Fig. No. 20.5. Notices And License Terms

7. if this is the first installation of Windows Server 2019 on the server, select custom installation only

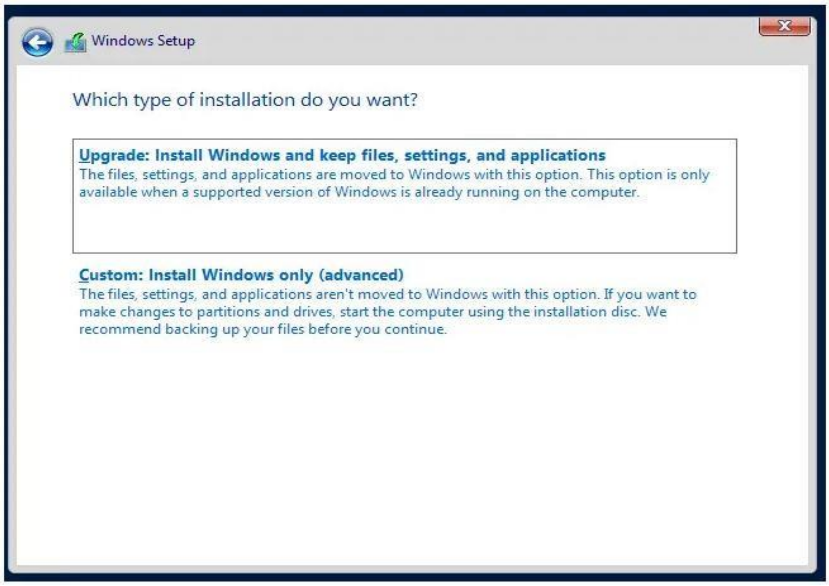

Fig. No .20.6. Selection of type of installation

8. Select a partition to install Windows Server, you can optionally create new one from available or use total available size by clicking "**Next**".

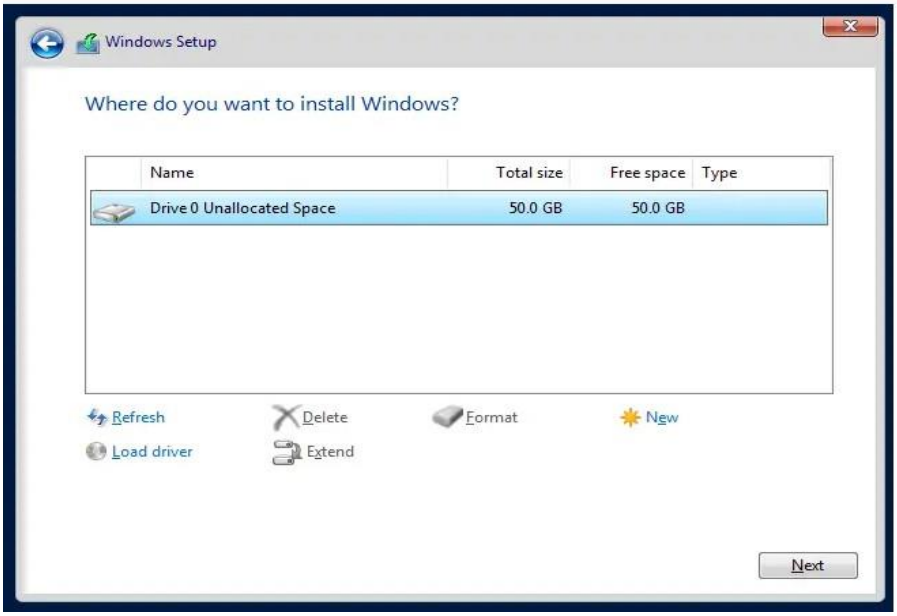

Fig.No. 20.7. Select drive

9. The installation should start, wait for it to finish.

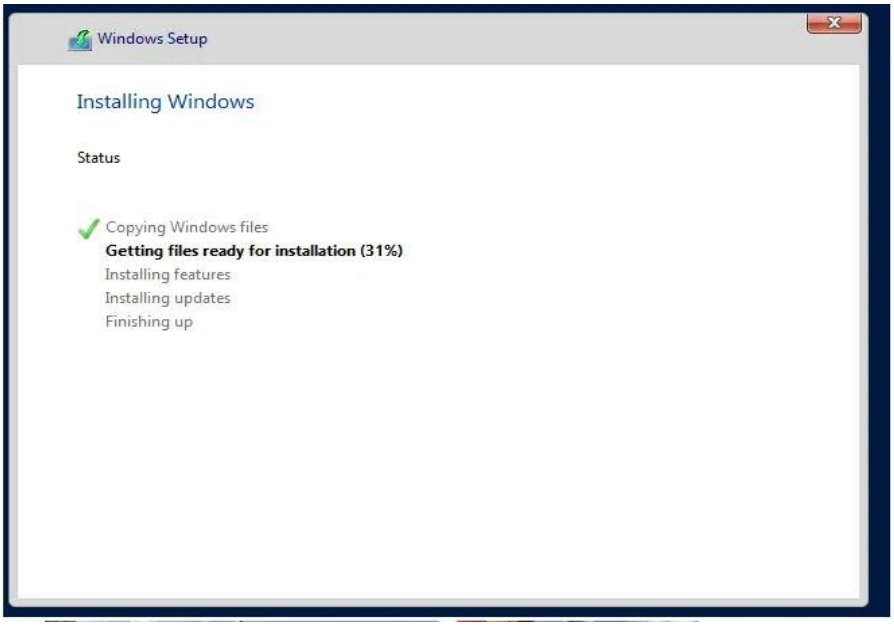

Fig.No.20.8. Installing Windows

10. The system should automatically reboot after the installation. Set Administrator password when prompted on the next screen.

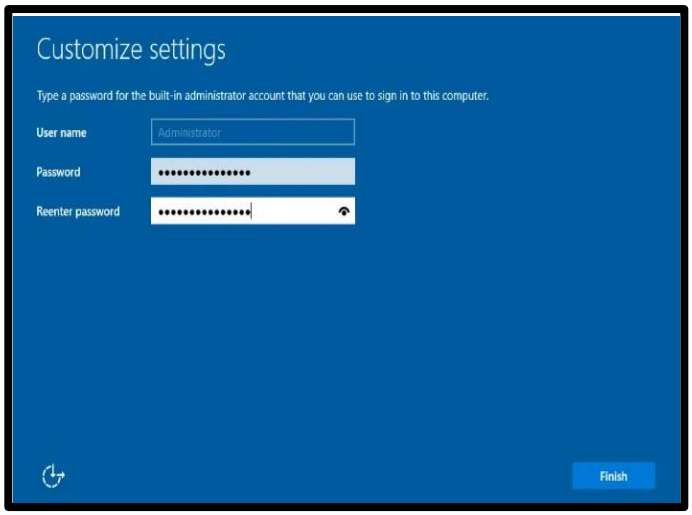

Fig.No. 20.9. Assign Username and Password to account

11. Click **Finish** to complete the installation. To login with the Administrator user, use

Ctrl+Alt+Del key combination.

12. Provide your Administrator Password and hit Enter

Fig.No. 20.10. Administrator Login

13. Access to Server Manager **Local Server** section should also give you some details about Windows Server 2019 installation.

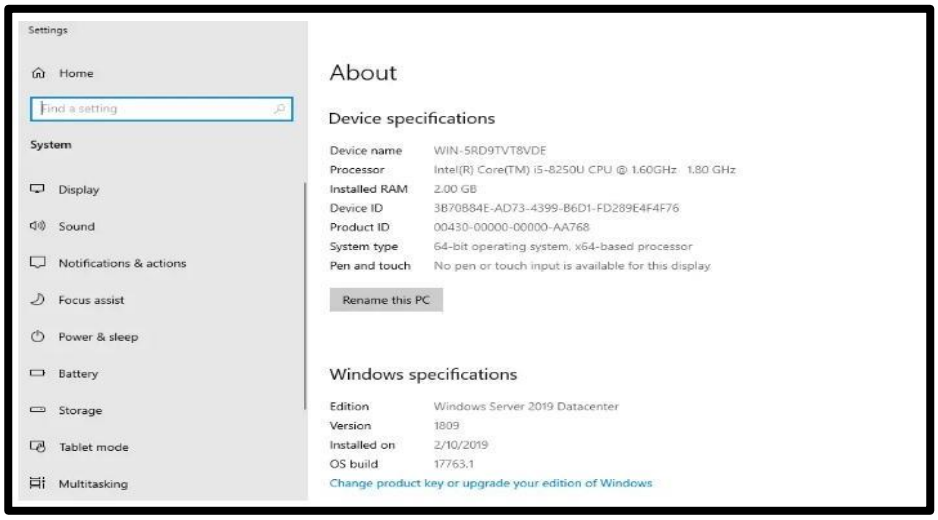

Fig. No. 20.11. Setting of server manager Local server

X **Conclusion**

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XI Practical related questions

1. What is main purpose to use server?
2. How much editions are available in windows server 2019?
3. List down advantage of Windows server 2019
4. Compare the features of different Network Operating Systems
5. Explain types of Installation of windows server

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XII References:

1. How To Install Windows Server 2019 Step by Step | ComputingForGeeks
2. Windows Server 2019 | Microsoft Evaluation Center
3. windows server 2019 versions list - Search (bing.com)

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 21: Use FTP protocol to transfer file from one system to another system

I Practical Significance

In any organization, it is required to share files and resources as it simplifies the access to these resources from anywhere. It also reduces the cost of equipment as they are shared among multiple users. By sharing files, it reduces the storage cost. The student will be able to share files using File transfer protocol

II Industry / Employer Expected Outcome(s)

1. Able to Set up FTP client server
2. Able transfer files using FTP

III Course Level Learning Outcomes(s)

CO4 - Configure different TCP/IP services.

IV Laboratory Learning Outcome(s)

LLO 21.1 Create FTP Server

V Relevant Affective Domain related Outcomes

- Follow safely Measures
- Follow ethical practice

VI Relevant Theoretical Background

The file transfer protocol (FTP) is a standard network protocol used to transfer computer files between a client and server on a computer network. FTP is a client-server protocol and it relies on two communication channels between the client and the server.

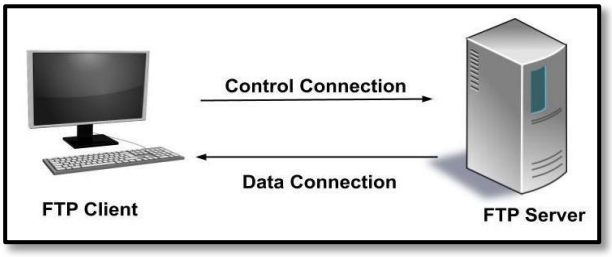

Fig No. 21.1.FTP

1. **Control Connection:** The FTP client sends a connection request usually to server port number 21. This is the control connection. It is used for sending and receiving commands and responses.

2. **Data Connection:** For transferring the files and folder we use a separate connection called data connection.

In order to reach an FTP server, a connection through an FTP client first needs to be established. This FTP client creates a TCP connection to the control port of the server (normally port 21) and is then able to send commands that the server subsequently answers. Following this, the data is transferred through another port. At this point, it_s important to differentiate between two **different types of transfer modes**. In active mode, the client, which uses port 1023, signals its IP address through port 21 during connection buildup. This process informs the server which port the client can be reached on. In passive mode, the server does not receive an IP address from the client (due to a firewall, for example) and offers the client a port through which a connection can be established.

There are many FTP programs currently available on the market like Cyberduck, FileZilla, FireFTP, Fresh FTP, SmartFTP, WinSCP, WISE-FTP.

VII **Recourses Required:**

- Computer (Standard Specifications with internet connection)
- Filezilla software (Open-Source Software) or any other relevant software

VIII **Precautions to be followed:**

1. Handle Computer system and network devices with care.
2. Follow safety Practices

IX **Procedure**

Filezilla is a powerful tool and a free software for transferring files over the internet

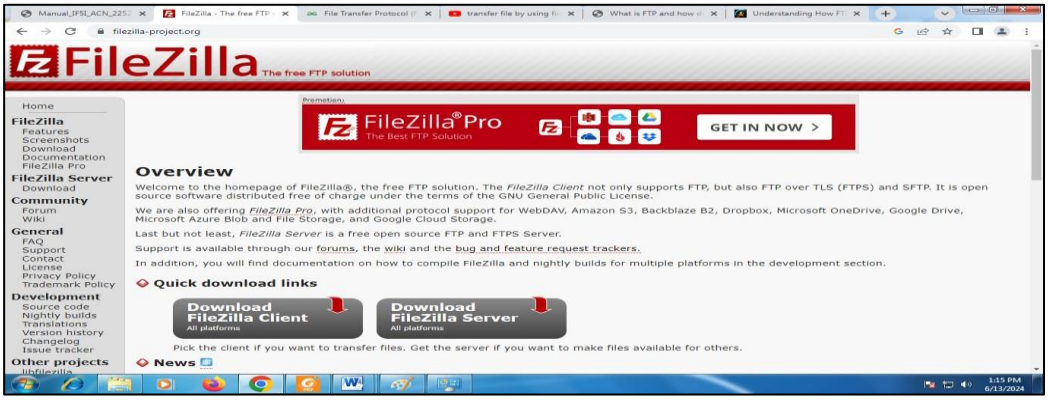

Fig No. 21.2. Filezilla client download

Procedure to use Filezilla to transfer files

1. download and activate FileZilla client software on your computer**.**

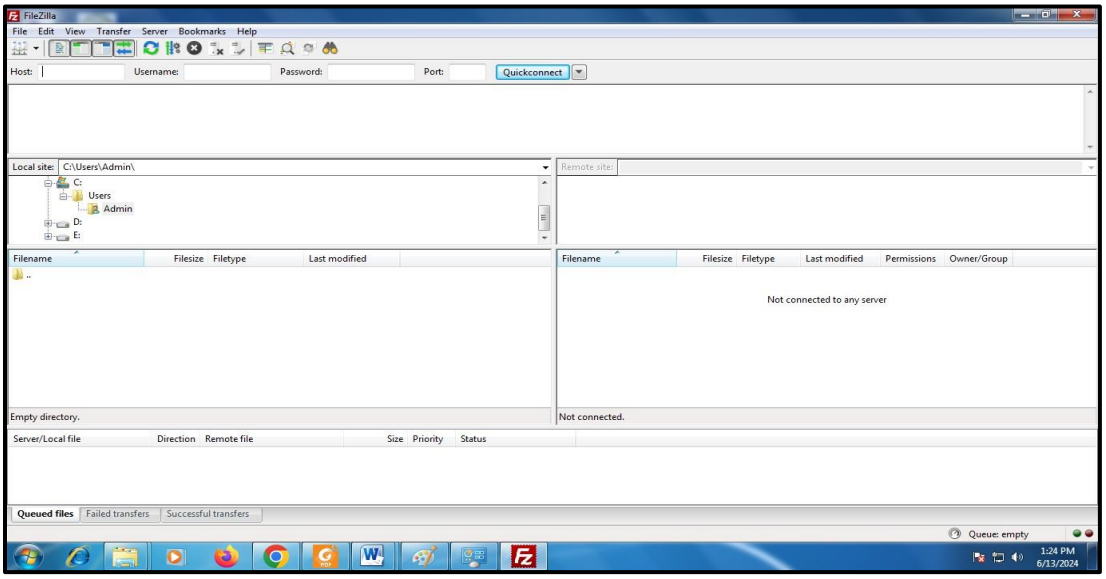

Fig No.21.3. FileZilla client software

2. Enter domain name in the **Host** field or one can use the account's IP address. The **username** and the **password** that has to be entered are the same as that which used to log in. The **FTP port** is 21. Then, to connect, press the **Quickconnect** button.

Fig No.21.4. enter details to connect to hosting account

3. The user will get connected to hosting account and on the right side of the FTP client window a list of all the files and folders on your account will be displayed.

Fig No.21.5. left panel (local PC) and Right Panel (server files)

4. From the right panel of the FTP client navigate to the folder on the account in which the new files are to be uploaded

5. Then, select one or more files from the left side panel (from the computer from which files are to be transferred) to be uploaded and right click on them. From the menu that shows up, click the **Upload** button.

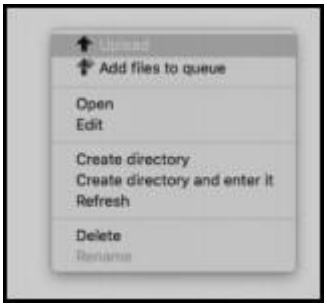

Fig No.21.6. Upload Files

6. The transfer will automatically be initiated, which will be indicated at the bottom panel of the application.

7. Wait for the upload to complete, after which the uploading of these files will be logged in the **Successful Transfers** tab at the bottom panel.

X **Conclusion**

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XI Practical related questions

1. What is FTP?
2. Draw a diagram for FTP
3. Which Port numbers are used for FTP?
4. How does an FTP client connect to an FTP server?
5. What‘s the difference between active and passive mode in FTP?

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XII References:

1. https://afteracademy.com/blog/what-is-ftp-and-how-does-an-ftp-work/
2. https://www.cloudwards.net/what-is-ftp/
3. https://youtu.be/_9NWIkrMIp4?si=MCXtzM-tV54W49iB

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 22: Create IPv6 environment in a small network using simulator

I **Practical Significance**

Student Should Create IPv6 environment in s small network Using Simulator

II **Industry / Employer Expected Outcome(s)**

1. To study IPV6 concepts.
2. To set network using a simulator

III **Course Level Learning Outcomes(s)**

CO4 - Configure different TCP/IP services.

IV **Laboratory Learning Outcome(s)**

LLO 22.1 Implement IPv6 addressing scheme on a network.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

Proposition 1: IPV6 Addressing

IPv6 was developed by Internet Engineering Task Force (IETF) to deal with the problem of IPv4 exhaustion. IPV6 stand for Internet Protocol Version 6. IPv6 is a 128-bits address having an address space of 2^{128}, which is way bigger than IPv4. IPv6 use Hexa-Decimal format separated by colon (:).

Components in Address format:

1. There are 8 groups and each group represents 2 Bytes (16-bits).
2. Each Hex-Digit is of 4 bits (1 nibble)
3. Delimiter used – colon (:)

Data is transmitted to many computers via the internet using the Internet Protocol (IP). There will be at least one IP address assigned to each network interface or computer on the internet, which is used to identify that computer uniquely. An IP address is given to each computer or other device that connects to the internet. Because of this, the IETF developed the new IPv6 standard in response to concerns over the IP address capacity of IPv4.

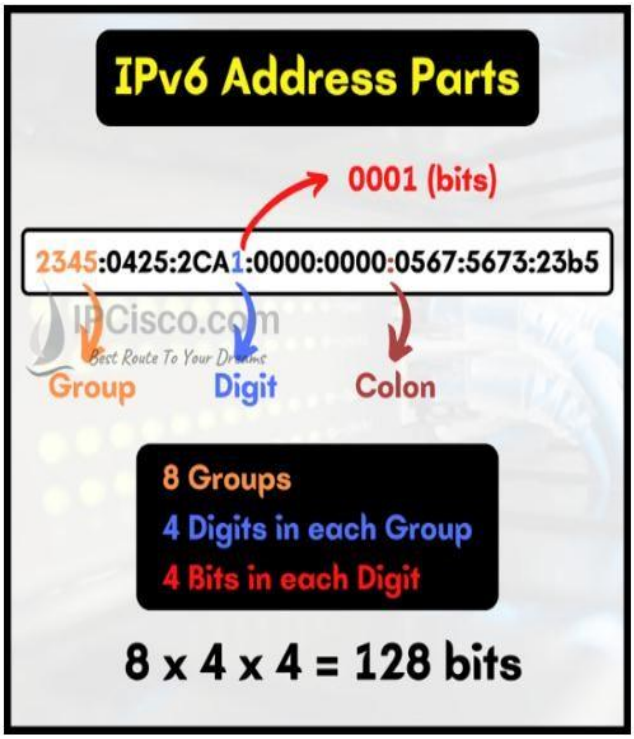

Fig.No. 22.1. Representation of IPv6 Address

IPv6 is supported by operating systems (OSes) such as Windows 10, macOS, and Ubuntu. Presently, different address types are used. As of now, devices use IPv6 or IPv4. Since 2008, domain name systems have supported IPv6.

VII **Recourses Required:**

- Any desktop or laptop computer with basic configuration
- CISCO Packet Simulator.

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure**

1. Install CISCO Packet Tracer simulator on your computer system
2. First open the Cisco packet tracer on desktop and create a network topology like below figure and an IPv6 addressing given below table.

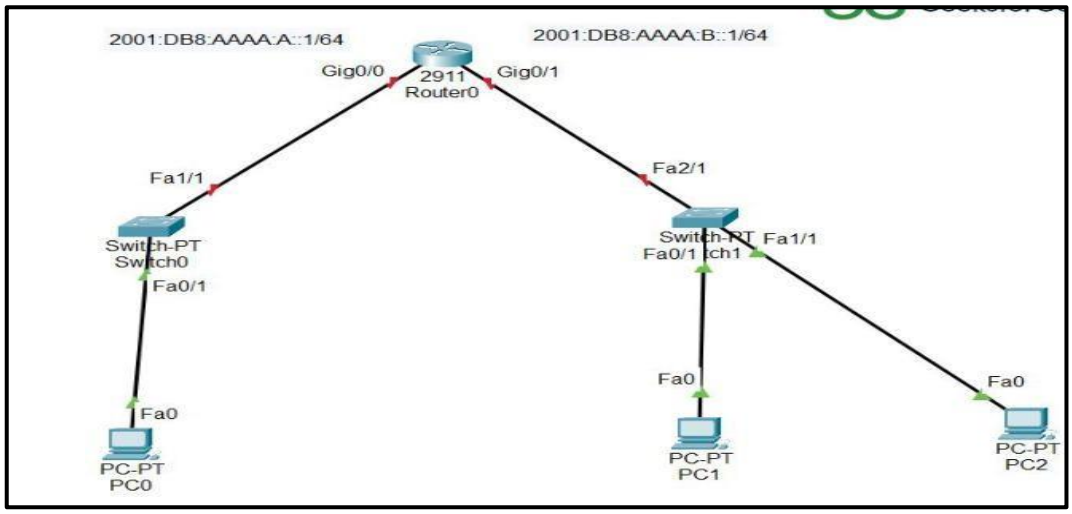

Fig. No. 22.2 .Layout of Network

S.NO	Device Name	Model-Name	Link-Local-Address	Default-Gateway
1.	PC	PC	FE80::207:ECFF:FEA3:EB56	FE80::1
2.	Switch	PT-switch	FE80::207:ECFF:FEB9:862A	FE80::1
3.	Router	2911	FE80::250:FFF:FE6C:B21	FE80::1
4.	cable	Automatic connecting cable	nil	nil

Fig.No .22.3. IPv6 addressing Table

S.NO	Interface	IPv6 Address
1.	Gig0/0	2001:DB:AAAA:A::1/64
2.	Gig0/1	2001:DB:AAAA:B::1/64

Fig.No. 22.4 IP addresses of interface

3. Configuring the GigabitEthernet Interfaces.
4. First, we will configure the **GigabitEthernet0/0** using CLI.
5. Click on **router0** and go to CLI and type the commands are given below:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ipv6 unicast-routing
Router(config)#int Gig0/0
Router(config-if)#ipv6 address FE80::1 link
Router(config-if)#ipv6 address FE80::1 link-local
Router(config-if)#no shut
```

Fig.No.22.4. Configuration of GigabitEthernet0/0

- Now we will configure the **GigabitEthernet0/1** Interface.
- Click on **router0** and go to CLI and type the commands are given below:

```
Router(config-if)#int Gig0/1
Router(config-if)#ipv6 address FE80::1 link-local
Router(config-if)#no shut
```

Fig.No. 22.5. Configuration of GigabitEthernet0/1

- Then, both the interfaces will be active now

3. Configuring Ipv6 address in both Interfaces using CLI:

- CLI commands to configure IPv6 address in GigabitEthernet0/0 and GigabitEthernet0/1 ports are given below:

```
Router#en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int Gig0/0
Router(config-if)#ipv6 address 2001:DB8:AAAA:A::1/64
Router(config-if)#no shut
Router(config-if)#int Gig0/1
Router(config-if)#ipv6 address 2001:DB8:AAAA:B::1/64
Router(config-if)#no shut
Router(config-if)#
Router(config-if)#
```

Fig.No.22.6 .Configure IPv6 Address to Ipv6

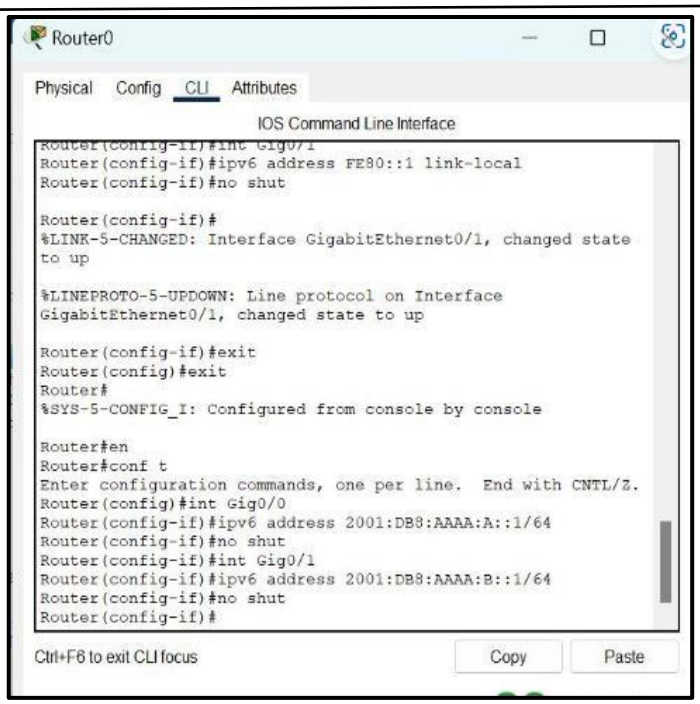

Fig.No. 22.6. IOS Command line Interface

4. We have configured the router now change the settings of hosts in IPv6 configuration:

- First, click on PC0 and go to desktop then IP configuration.
- Now find the IPv6 configuration.
- Change the settings from static to automatic and then after a few seconds, the IPv6 address and default gateway are displayed.

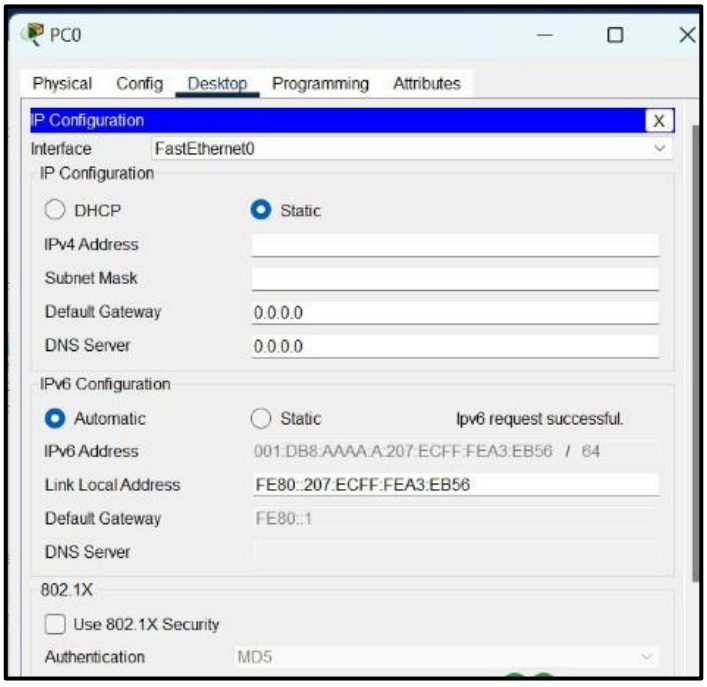

Fig.No. 22.7. Configure PC0

- Similarly, repeat this procedure with PC1 and PC2

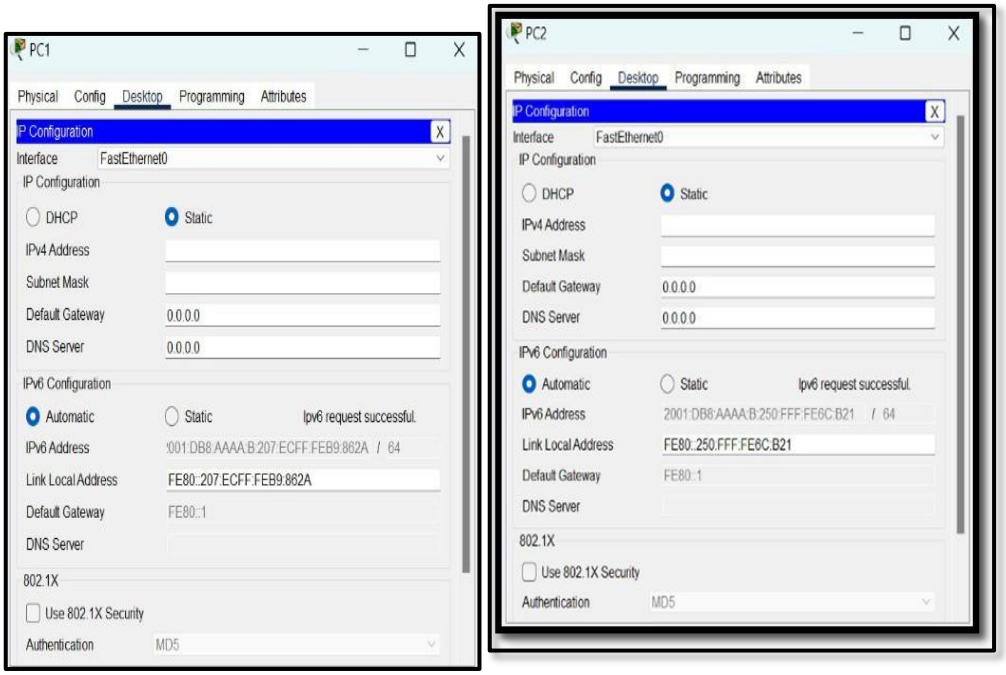

Fig.No.22.8 .Configure PC1, PC2

5. Now we have to verify the connection by pinging the IPv6 address of PC0 in PC1.

- First, click on PC1 and go to the command prompt, and type ping <ipv6 address>

Command: ping 2001:DB8:AAAA:A:20D:BDFF:FE1A:D121

- As we can see in the below image, getting replies from PC0 means the connection is established successfully.

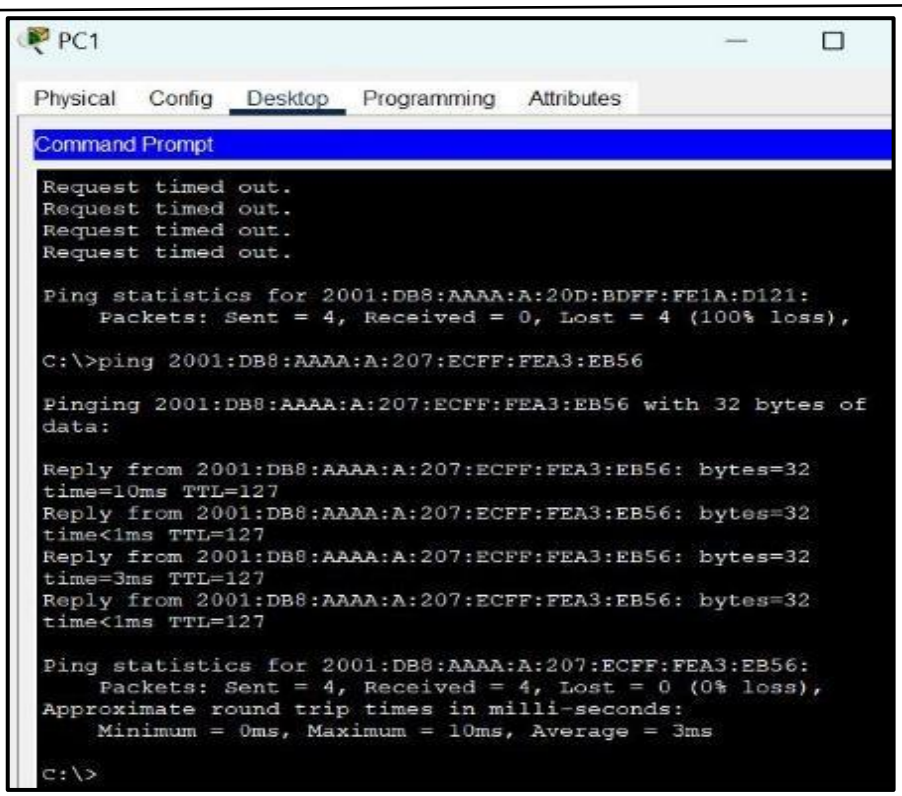

Fig.No. 22.8 .Connection Established Successfully

X Conclusion

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XI Practical related questions

1. Write a difference Between IPv4 and IPv6
2. Explain Features of IPv6.
3. How IPv6 is represent (notification if IPV6 explain with example.
4. Explain TPV6 Header Format

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XII References:

1. How to Configure IPv6 on CISCO Router? - GeeksforGeeks
2. What is IPv6: Important Features and Uses (spiceworks.com)

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 23: *Create HTTP server

I **Practical Significance**

The HTTP Server provides many security features that help you control access to data and files. Performance in a Web server environment is influenced by many components. student should crate HTTP server

II **Industry / Employer Expected Outcome(s)**

1. Understand the concept of HTTP Server
2. Implement HTTP Server

III **Course Level Learning Outcomes(s)**

CO5 - Implement relevant Network Topology using Networking Devices.

IV **Laboratory Learning Outcome(s)**

LLO 23.1 Configure HTTP server on given operating system.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **HTTP server**

In computing, a **s**erver is a computer program or a device that provides functionality for other programs or devices, called clients. The functionalities, or services, that a server can provide are multiple and go from sharing data or resource among multiple clients to performing computation for client. The web server or HTTP server is a server software (or hardware dedicated to running a server software) that implements the request/response model using the World Wide Web and the HTTP (protocol.) The HTTP server processes incoming network requests from the clients over the HTTP protocol and serves contents over the internet.

The HTTP or **Hypertext Transfer Protocol** is an application layer protocol that is used to virtually transmit files and other data on the World Wide Web, whether they‘re HTML files, image files, query results, or anything else.

In simpler words,
The HTTP is a universally-spoken language with a simple grammar that "translates" the communication between the client and the server by specifying how the information must be requested and how the responses are formed. Usually, HTTP is based on the TCP/IP protocols so it takes place through TCP/IP sockets.

- **working of HTTP Server**

The primary function of the HTTP server is to store, process and deliver web pages to clients using the Hypertext Transfer Protocol. A client, or better said a user agent which is a software acting on behalf of a user (commonly represented by a web browser), initiates communication by making a request for a specific resource using HTTP to the server, an application running on a computer hosting a website.

The server, which provides resources such as HTML files and other content, or performs other functions on behalf of the client, returns a response message to the client. The response served by the server contains completion status information about the request and may also contain requested content in its message body, or an error message if it is unable to serve the content. The primary function of the HTTP server is to serve content, its implementation can also include ways of receiving content from clients**.** This feature is used for example for submitting web forms, including uploading of files. The HTTP server can generate HTML documents dynamically (on-the-fly) as opposed to returning documents **s**tatically. Or it could merge and serve both. These decisions are made based on configuration options and programs written in languages like PHP.

VII **Recourses Required:**

1. Network Computer system
2. Microsoft Internet Information Services (IIS) web server software package

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure:**

Install an Apache HTTP Server:

Step 1:

Navigate to Apache Website - (httpd.apache.org)

1. Click on "*Download*" link for the latest stable version
2. After being redirect to the download page, Select: "*Files for Microsoft Windows*"
3. Select one of the websites that provide binary distribution (for example: ***Apache Lounge***)
4. After being redirect to "Apache Lounge" website (https://www.apachelounge.com/download/), Select: Apache x.x.xx Win64 link

After downloaded, unzip the file httpd-x.x.xx-Win64-VC15.zip into C:/

Step 2:

1. Open a command prompt: *Run as Administrator*
2. Navigate to directory c:/Apache24/bin
3. Add Apache as a Windows Service: **httpd.exe -k install -n "Apache HTTP Server"**

4. In the event of the following error follow **Step 3** otherwise jump to **Step 4**: "*The program can't start because VCRUNTIME140.dll is missing from your computer. Try reinstalling the program to fix this problem*"
5. If after configuring Apache as a Windows service it fails to start and reports this error "Windows could not start the Apache HTTP Server on Local Computer." It is likely that Apache is not able to use the default port (normally 80) because another process is using the same port. Open an administrative command prompt and issue the command "netstat -anbo".

6. If another process is using the port which Apache is configured to listen on, modify the Listen port in the httpd.conf file of the Apache installation to use a port that is not already taken by another process. Or alter the process holding the port to use a different port so Apache can listen on this port.

Step 3:

1. At Apache Lounge website, check the section "*Apache 2.4 VC15 Windows Binaries and Modules*" on the main page
2. Download the file from the link **vc_redist_x64** (I.e https://aka.ms/vs/15/release/VC_redist.x64.exe)
3. Install Visual C++ 2017 files
4. Repeat **Step 2**

Step 4:

1. Open Windows Services and start Apache HTTP Server
2. Open a Web browser and type the machine IP in the address bar and hit Enter

3. The message "It works!" should be seen.

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Conclusion

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XI Practical related questions

1. Explain Working of Web Server
2. Explain application of HTTP server
3. Explain Working of HTTP server

Space for Answer

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XII References:

1. How to install Apache HTTP Server on Windows Server? - Progress Community
2. http-server - npm (npmjs.com)
3. What is a web server - Working and Architecture - GeeksforGeeks

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 24: *Connect computers using Star topology with wired media

I **Practical Significance**

A Star topology is a type of network topology in which all the devices or nodes are physically connected to a central node such as a router, switch, or hub. Student should be able to connect computers of laboratory in star topology using transmission media and network control devices.

II **Industry / Employer Expected Outcome(s)**

1. Understand concept of topology and its type.

2. Able to create Local area Network using star topology.

III **Course Level Learning Outcomes(s)**

CO5 - Implement relevant Network Topology using Networking Devices.

IV **Laboratory Learning Outcome(s)**

LLO 24.1 Use star topology for a given situation.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

Network Topology refers to layout of a network. How different nodes in a network are connected to each other and how they communicate is determined by the network's topology.

Types of Topologies

Following are different types of topologies which mainly used to connect computers with each other to form a network.

1. Bus Topology
2. Ring Topology
3. Star Topology
4. Mesh Topology
5. Tree Topology
6. Hybrid Topology

❖ **Star Topology**

In this type of topology all the computers are connected to a single hub/switch through a cable. This hub/switch is the central node and all others nodes are connected to the central node. Every node has its own dedicated connection to the hub/switch. Hub/switch acts as a repeater for data flow

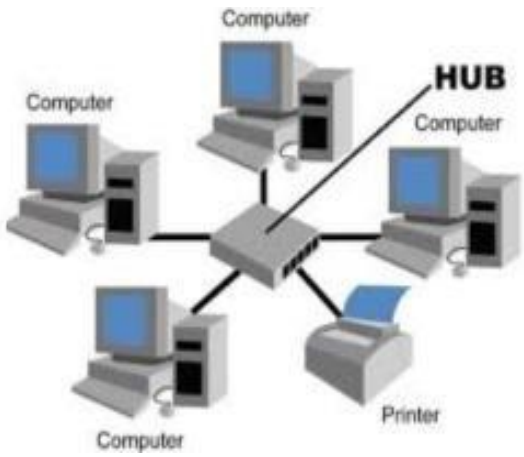

Fig:24.1. Star Topology

Advantages of Star Topology

1. Fast performance with few nodes and low network traffic.
2. Easy to troubleshoot.
3. Easy to setup and modify.
4. Only that node is affected which has failed, rest of the nodes can work smoothly.

Disadvantages of Star Topology

1. If the hub/switch fails then the whole network is stopped because all the nodes depend on the hub.

VII **Recourses Required:**

- Computers with updated configuration
- Switch/Hub
- Wired Transmission Media and Connector

VIII **Precautions to be followed:**

1. Handle Computer system and network devices with care.
2. Follow safety Practices

IX **Procedure**

Teacher shall explain structure, advantage and disadvantage of each topology.

Procedure to create star topology:

1. Power on the computers that want to connect in star topology and confirm whether operating system and NIC card is properly worked.
2. Power on the central device i.e. switch or hub.
3. Take cable and connect one end of one cable to port of the switch or hub and connect the other end of the same cable to computer's NIC port.
4. The lights on port of the switch or hub.
5. This is the physical formation of star topology.
6. Check workgroup of computer or write name of workgroup under which all computers are connected to each other.

Set Up and Join a Workgroup in Windows 10

- Navigate to Control Panel, System and Security and System to access your computer details.
- Find Workgroup and select Change settings.
- Click on Change Button to 'To rename computer name or workgroup '.
- Type name of the computer and name of the Workgroup that you want to join and click on OK.

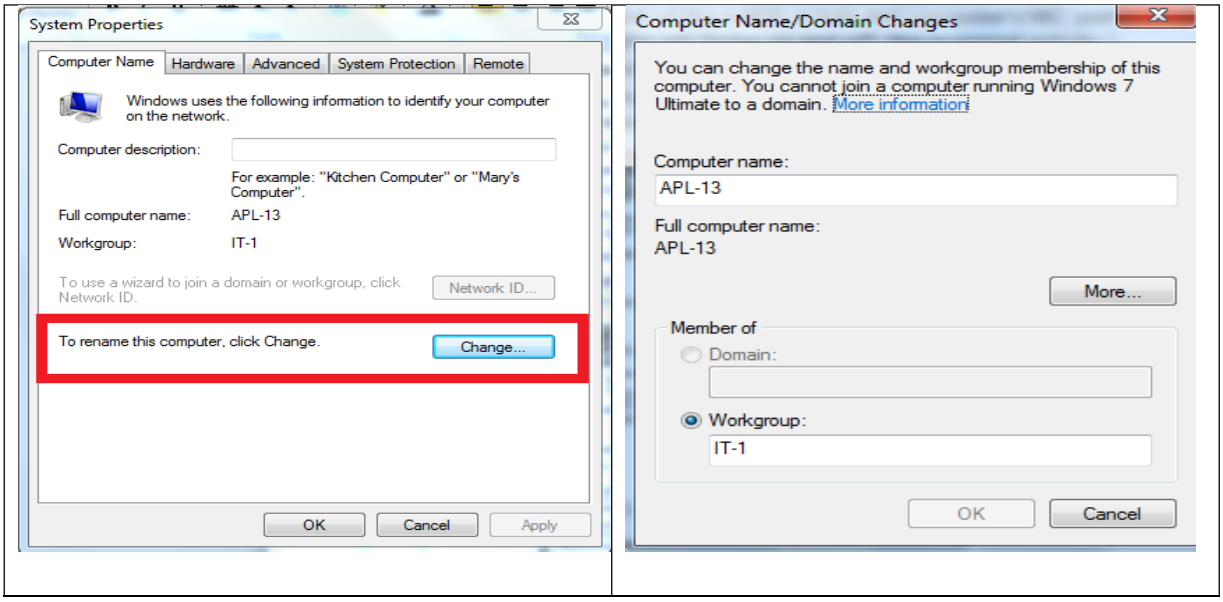

Fig 24.2. Set Up and Join A Workgroup

7. Assign IP address to computers using TCP/IP configuration.

- Click Start menu => control panel => Network and Internet => network and sharing center.
- Click on “Change Adapter Settings”. Right Click on “Local Area Connection” and then click on Properties

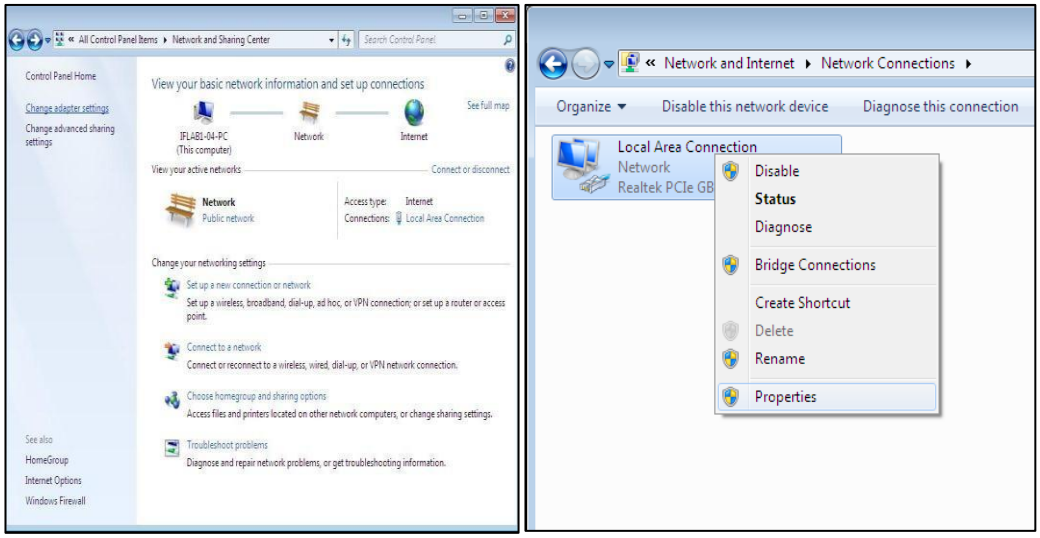

Fig 24.3 Local Area Connection and open its properties

- Then double click Internet Protocol Version 4 (TCP/IPv4).
- Select "Use the Following IP address": and type in the IP address, Subnet mask and Default gateway.
- Click OK to apply the settings.

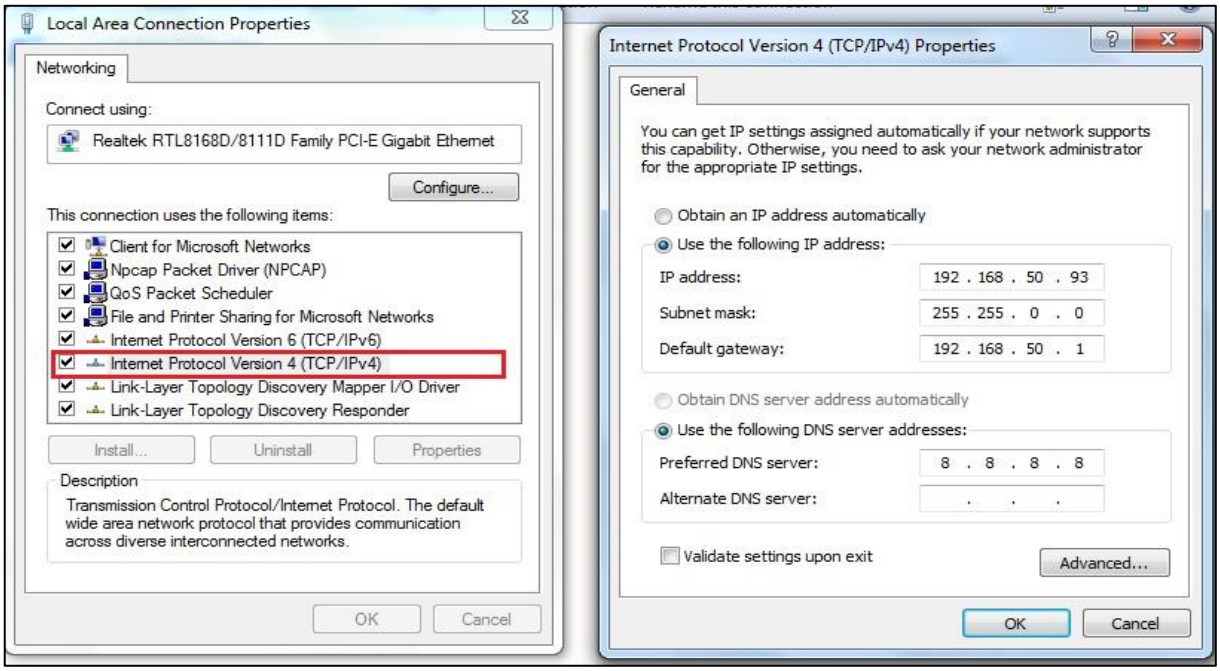

Fig 24.4. Assign IP address

8. Repeat the step no.6 and 7 on each computer that want to connect in star topology

Note:

1. The computers connected to switch or Hub must come under same workgroup.
2. IP address of each computer must be unique.

- Use ping command to check whether computer connected in network.
- Once whole network is formed, then go to Network and check whether All computers are connected in network or not.

X **Conclusion**

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XI **Practical related questions**

1. What is Network topology?
2. List Different types of Network topology?
3. Draw the Network Layout of your Laboratory.
4. State advantages and disadvantages of star topology.
5. List out names of Wired transmission media and network devices required to form star topology.
6. Compare Bus, Ring and Star topology.

Space for Answer

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XII References:

1. https://www.geeksforgeeks.org/advantages-and-disadvantages-of-star-topology/
2. https://www.youtube.com/watch?v=NSHj9BLnhj0

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Effective Practical Implementation with Specified time:40%	
2.	Effective Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 25: Create Tree topology using CISCO packet tracer software

I Practical Significance

Student should Create Tree Topology Network using CISCO packet Tracer Software

II Industry / Employer Expected Outcome(s)

1. Understand the Concept of Tree Topology
2. Understand how devices are connected in tree topology using CISCO Packet Tracer

III Course Level Learning Outcomes(s)

CO5 - Implement relevant Network Topology using Networking Devices.

IV Laboratory Learning Outcome(s)

LLO 25.1 Use Network simulator CISCO packet tracer.

V Relevant Affective Domain related Outcomes

- Follow safely Measures
- Follow ethical practice

VI Relevant Theoretical Background

❖ **Tree Topology**

In the tree topology of networking, the elements and devices are arranged like a tree structure and have branches of connections between the devices connected to each other. In a such type of topology, there is one central node and each node is connected to the central node through a single path. Nodes can be thought of as branches coming off of the trunk. Tree topologies are often used to create large networks.

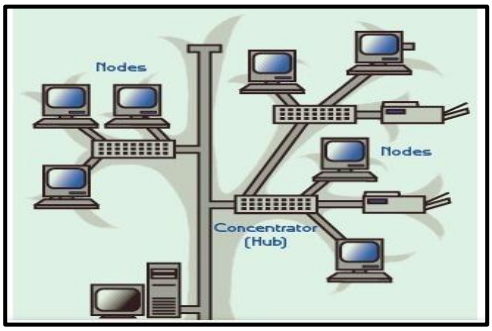

Fig.No. 25.1 Tree Topology

❖ **CISCO Packet Tracer**

Cisco Packet Tracer is a comprehensive, networking technology teaching and learning program that offers a unique combination of realistic simulation and visualization experiences, assessment and activity authoring capabilities, and opportunities for multiuser collaboration and competition.

VII **Recourses Required:**

- Desktop or laptop computer with basic configuration
- CISCO Packet Tracer Software

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure: Create Tree Topology using CISCO Packet Tracer**

1. Open the Cisco packet tracer desktop and select the devices given below:
   - Personal Computer (PC)
   - Switch
2. Configure Each Device or assign IP address to device

S.NO	Device	IPv4 Address	Subnet Mask
1.	pc0	192.168.0.1	255.255.255.0
2.	pc1	192.168.0.2	255.255.255.0
3.	pc2	192.168.0.3	255.255.255.0
4.	pc3	192.168.0.4	255.255.255.0
5.	pc4	192.168.0.5	255.255.255.0
6.	pc5	192.168.0.6	255.255.255.0

Fig.No. 25.2. Configuration of IP address

3. Then, create a network topology as shown below the image.
4. Use an Automatic connecting cable to connect the devices with others.

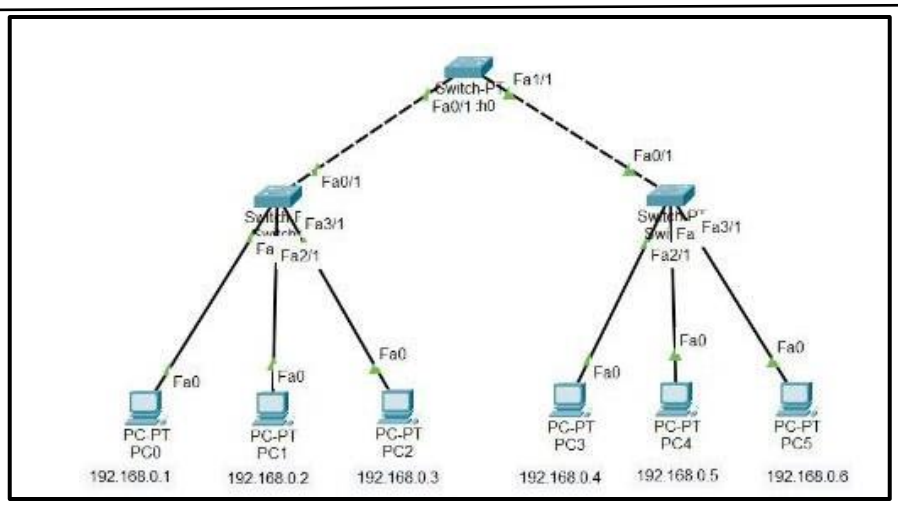

Fig.No. 25.3. Tree Topology Layout

5. Configure the PCs (hosts) with IPv4 address and Subnet Mask according to the IP addressing table given above.

- To assign an IP address in PC0, click on PC0.
- Then, go to desktop and then IP configuration and there you will IPv4 configuration.
- Fill IPv4 address and subnet mask

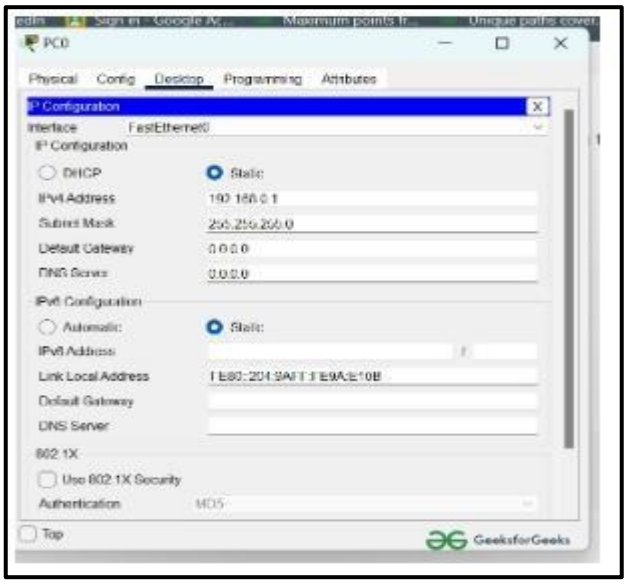

Fig.No. 25.4. IPV4 Configuration

- Assigning an IP address using the ipconfig command, or we can also assign an IP address with the help of a command.
- Go to the command terminal of the PC.
- Then, type ipconfig <IPv4 address><subnet mask><default gateway>(if needed)
- For Example: ipconfig 192.168.0.1 255.255.255.0

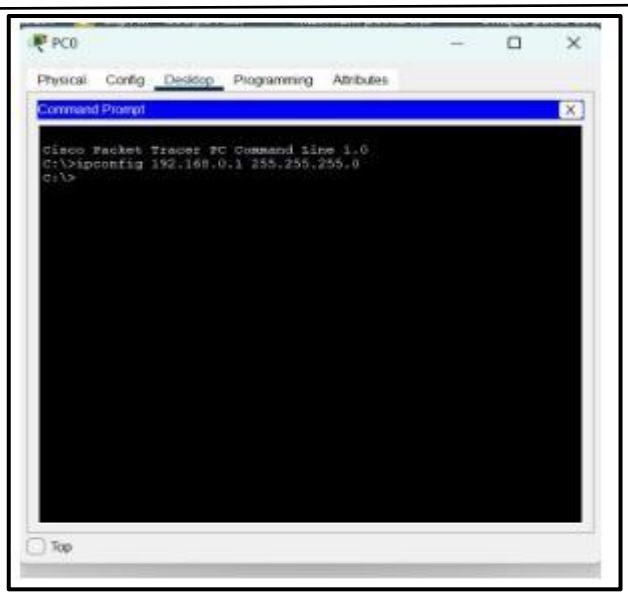

Fig.No. 25.5. Ipconfig command

- Repeat the same procedure with other PCs to configure them thoroughly.

6. Verify the connection by pinging the IP address of any host in PC0.

- Use the ping command to verify the connection.
- We will check if we are getting any replies or not.
- As we can see, we are getting replies from a targeted node on both PCs.
- Hence the connection is verified.
- ping <targeted node's IP address>

7. A simulation of the experiment is given below we have sent two PDU packets one targeted from PC0 to PC3 and another targeted from PC1 to PC5

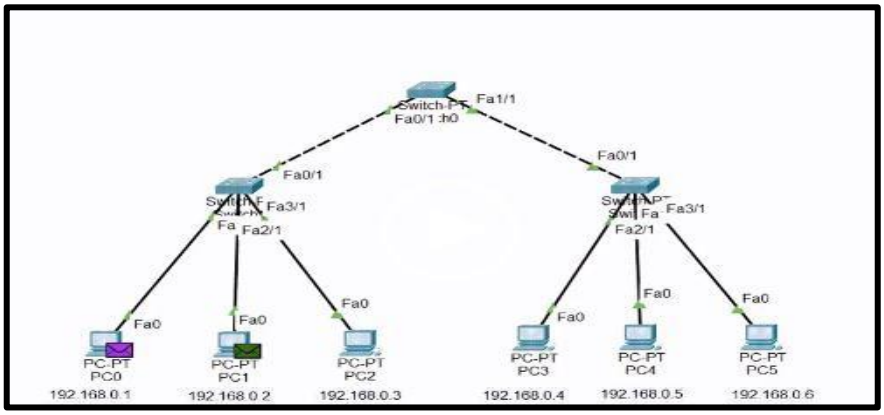

Fig.No. 25.6 Simulation Window

X **Conclusion**

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XI **Practical related questions**

1. Define Topology and Enlist types of Topologies.
2. Explain Tree Topology with Neat Diagram.
3. Explain Use of CISCO Packet Tracer simulator.
4. Write Difference Between Star and Tree Topology

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XII References:

1. Implementation of Tree Topology in Cisco - GeeksforGeeks
2. AI&ML scholarship student Vani Agarwal | Amazon Web Services (youtube.com)

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 26: Configure TELNET for remote login

I **Practical Significance**

Telnet short for "teletype network" is a client/server application protocol that provides access to virtual terminals of remote systems on local area networks or the Internet. Student should be able to configure TELNET for remote login.

II **Industry / Employer Expected Outcome(s)**

1. To gain knowledge about TELNET
2. To understand configuration of TELNET for remote login

III **Course Level Learning Outcomes(s)**

CO5 - Implement relevant Network Topology using Networking Devices.

IV **Laboratory Learning Outcome(s)**

LLO 26.1 Implement remote login feature.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical practice

VI **Relevant Theoretical Background**

❖ **TELNET**

TELNET stands for Teletype Network. It is a type of protocol that enables one computer to connect to the local computer. It is used as a standard TCP/IP protocol for virtual terminal service which is provided by ISO. The computer which starts the connection is known as the local computer. The computer which is being connected to i.e. which accepts the connection known as the remote computer. During telnet operation, whatever is being performed on the remote computer will be displayed by the local computer. Telnet operates on a client/server principle. The local computer uses a telnet client program and the remote computers use a telnet server program.

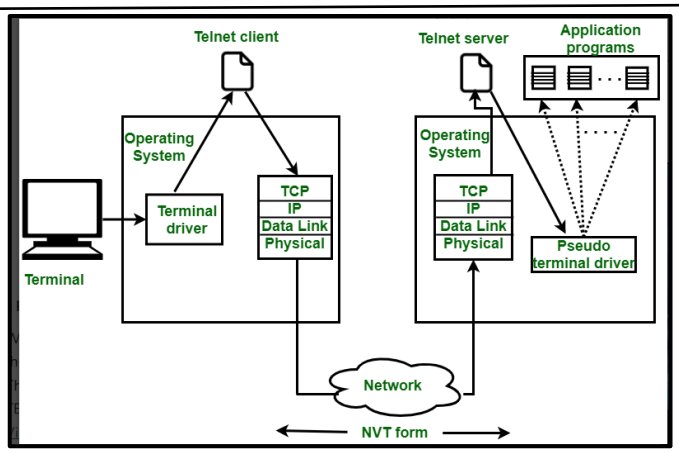

Fig.No. 26.1 Remote Login in Logging

Types of Logins

In TELNET, there are the following types of logins:

Local Login

This type of login occurs whenever a person logs into the local computer. The terminal driver accepts keystrokes that are entered by user when workstation is running a terminal emulator. Here, the terminal driver forwards these characters to the operating system that launches the required application software.

Remote Login

The user primarily transmits the keystroke to terminal driver, where the operating system only receives but does not understand characters. These characters are then transferred to client that converts these characters into Network Virtual Terminal (NVT) characters.
After conversion, the client converts them and sends them back to TCP/IP stack. The text in NVT form travels via the internet till it reaches TCP/IP protocol stack on a distant system. The erver converts these NVT characters into characters that remote machines can understand.

VII **Recourses Required:**

- Latest configuration Computer System

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure: Connect to remote Login / Server with the help of Telnet**

Telnet is a command line tool that is designed for administering remote servers through the Command Prompt. Unlike earlier versions of Windows, Windows (and its predecessors) does not come with the Telnet client installed. You will need to activate it before you can start using it.

- Open the Control Panel and go to "Programs and Features" > "Turn Windows features on or off". Enter your Administrator password if prompted.
- Find the "Telnet Client" entry in the list of available features and check the box next to it. Then, click OK.
- To use telnet, open Command Prompt, type telnet, and press Enter

1. **Open Control Panel.** By default, Telnet is not installed with Windows. It will need to be manually activated in order for you to use it. You can do so through the Control Panel; you'll find in the Start menu.

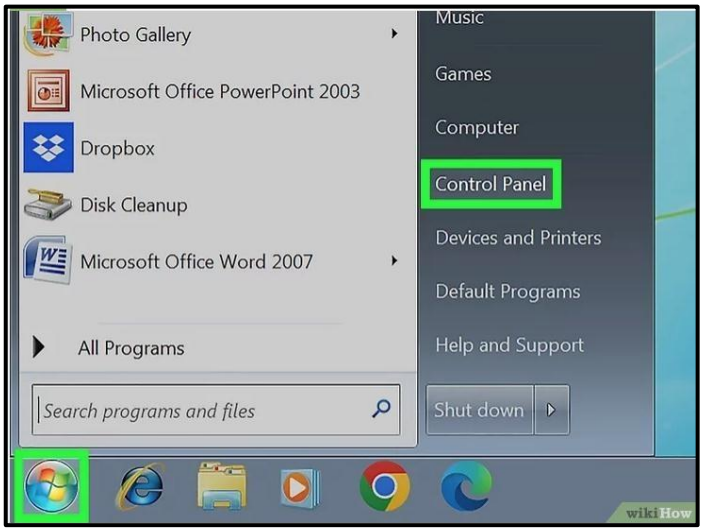

Fig.No. 26.2. How to active TELNET

2. **Open Programs and Features or Programs.** The option available to you will depend on whether your Control Panel is in Icon or Category view, but they both take you to the same place.

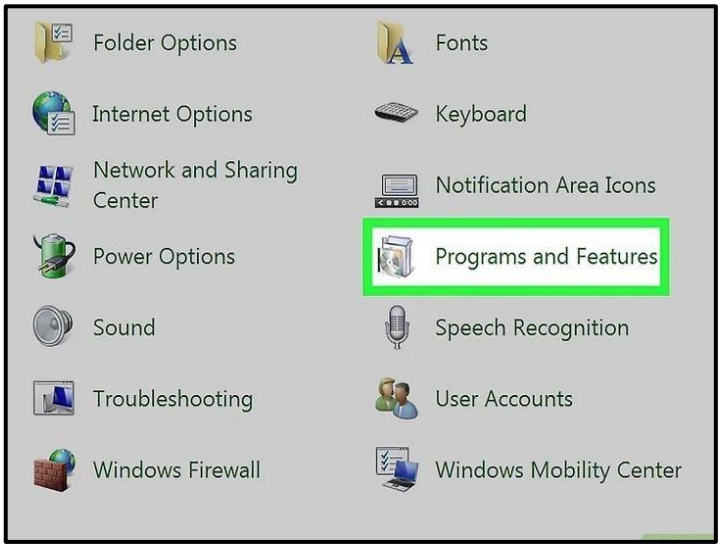

Fig.No. 26.3. Select Programs and Features

3. Click Turn Windows features on or off. You may be asked for the Administrator password.

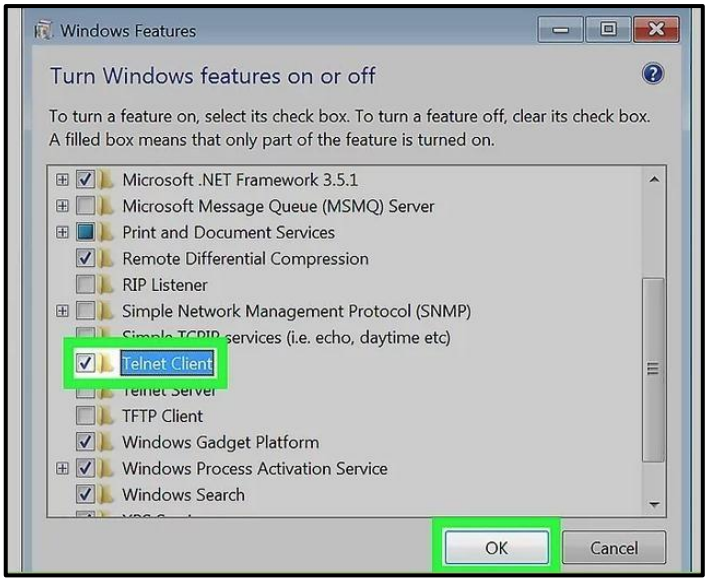

Fig 26.4. Turn Features on or off

4. Check the box next to "Telnet Client" and click OK. You may have to scroll down to find it. This installs and activates telnet.

- You may have to wait a minute or two for the client to be installed after selecting it.

Install Telnet through the command prompt (optional)

If you'd rather do everything through the Command Prompt, you can install Telnet with a quick command. First, open the Command Prompt by typing cmd into the Run box and pressing Enter. At the prompt, type pkgmgr /iu:"TelnetClient" and press Enter. After a moment, you will be returned to the command prompt.

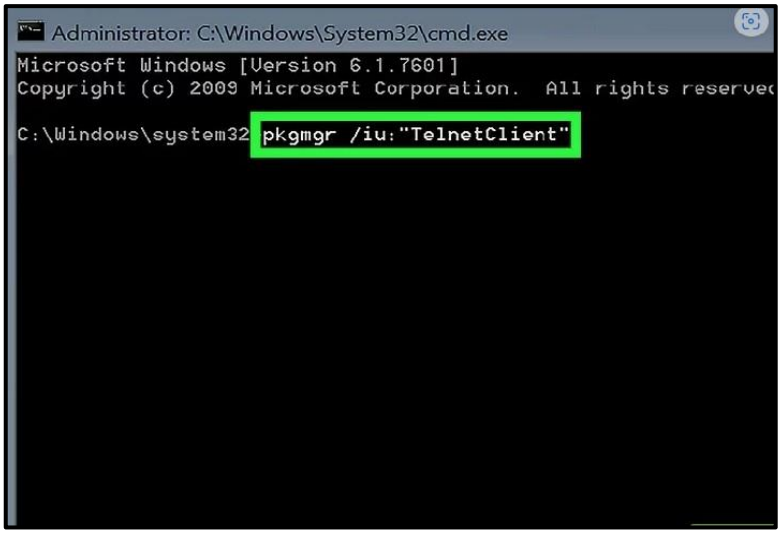

Fig.No. 26.5 Install Telnet with Command prompt

1. Open the Command Prompt. Telnet runs through the Command Prompt. You can access the command prompt by pressing Win, typing cmd, and clicking OK.

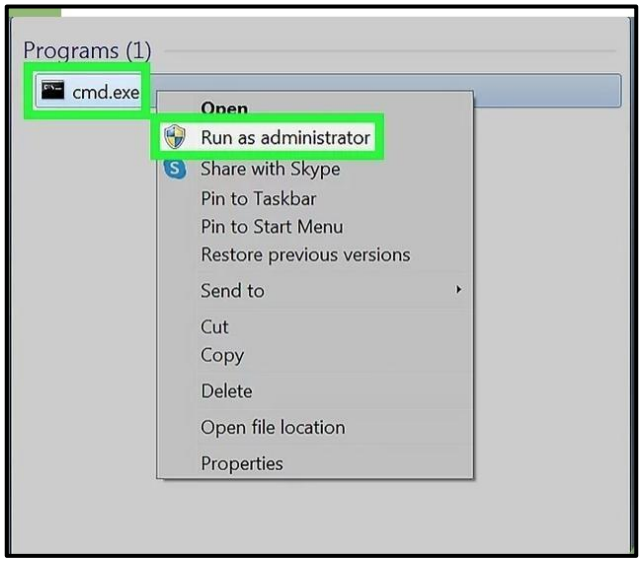

Fig.No. 26.6. Open CMD

2. Start the telnet client. Type telnet and press Enter. The Command Prompt will disappear, and you will be taken to the Telnet command line, displayed as Microsoft Telnet.

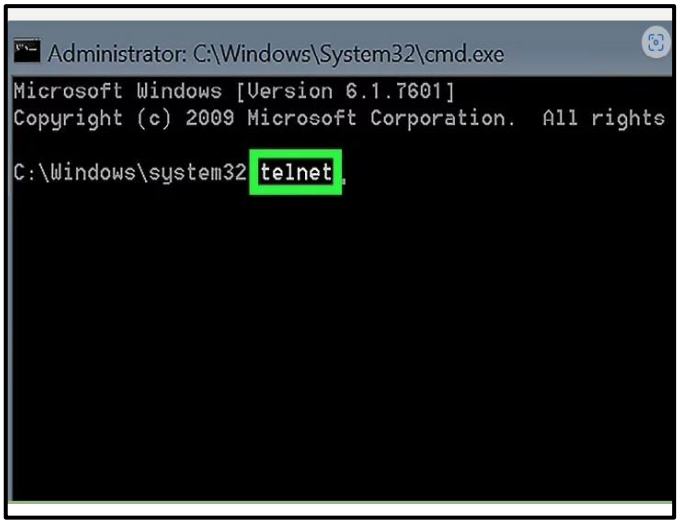

Fig.No.26.7. Connect to Server

3. Connect to a server. At the Telnet command lin type open serveraddress [port]. For some servers, you will not need to enter a port—telnet will default to port 23, the default TCP port for telnet servers. You have successfully connected to the server when you receive either a welcome message or are prompted for your username and password

- For example, to watch ASCII Star Wars, type open towel.blinkenlights.nl and press **Enter**.
- You can also start a connection directly from the Command Prompt by typing telnet serveraddress [port]

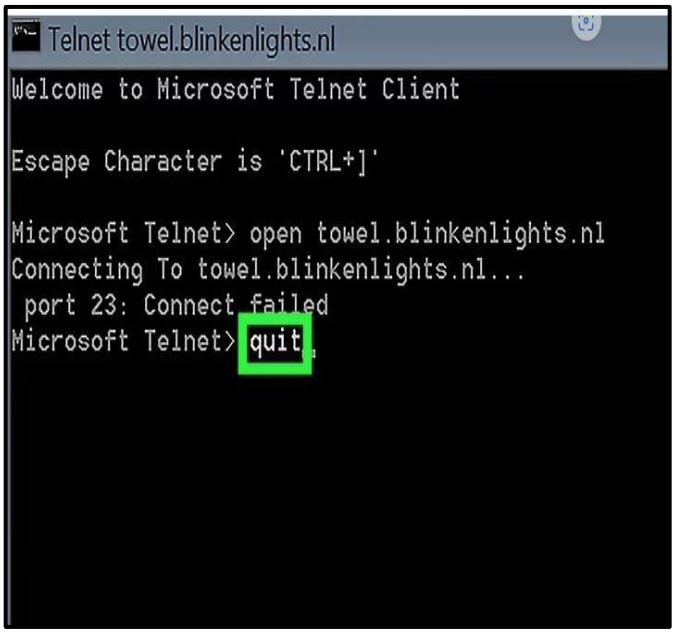

Fig.No. 26.8. Disconnect to Server with remote login

4. Close your Telnet session. Once you are finished, you should close your connection before closing the window. To do so, press Ctrl +], type quit, and then press Enter.

X **Conclusion**

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XI **Practical related questions**

1. Explain Use of TELNET
2. Explain Two types of logins use in TELNET
3. Explain which Command Use for to active TELNET

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XII References:

1. How to Activate Telnet in Windows 7 (w/ Pictures) (wikihow.com)
2. Starting a Telnet client session - Τεκμηρίωση IBM

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

**Practical No. 27: ***Visit your computer laboratory i) Identify the type of topology ii) Identify types of connecting devices with specifications iii) Identify types of cables with specifications iv) List the type of network applications commonly used in the laboratory iv) Draw the layout of installed network

I Practical Significance

This practical will enable the student to identify the various networking devices available in the lab and the way they are connected in the network.

II Industry / Employer Expected Outcome(s)

1. Understand the type of Topology
2. Identify types of cable with its specification
3. Understand and identify the network devices

III Course Level Learning Outcomes(s)

CO5 - Implement relevant Network Topology using Networking Devices.

IV Laboratory Learning Outcome(s)

LLO 27.1 Survey existing network infrastructure

V Relevant Affective Domain related Outcomes

- Follow safely Measures
- Follow ethical practice

VI Relevant Theoretical Background

❖ **Network Topology:** Topology defines the structure of the network of how all the components are interconnected to each other.

Types of Topologies:

1) Bus Topology
2) Star Topology
3) Ring Topology
4) Mesh Topology
5) Tree Topology
6) Hybrid Topology

❖ **Network device**

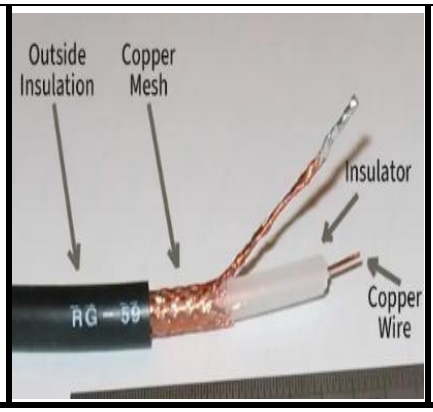
Network devices, also known as networking hardware, are physical devices that allow hardware on a computer network to communicate and interact with one another. For example, Repeater, Hub, Bridge, Switch, Routers, Gateway, and NIC, etc.

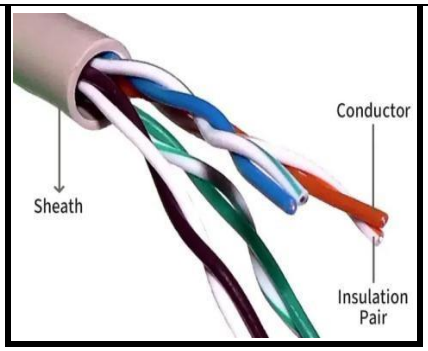
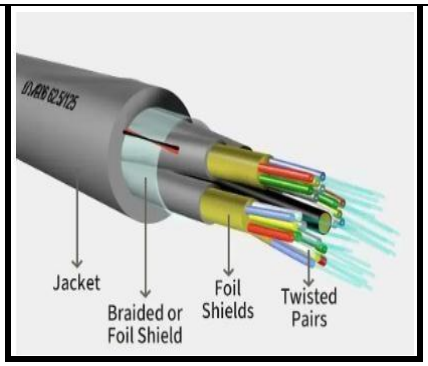
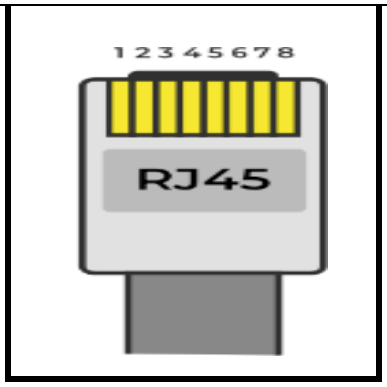
SR No	Device Name	Figure	Use
1.	Repeater		A repeater strengthens a signal and resends it to its destination.
2.	Hub		A hub is a physical device used to join multiple devices on the same LAN
3.	Switch		A network switch forwards data to its destination by examining an incoming frame's MAC address
4.	Router		Routers examine incoming packets to determine the appropriate destination IP address and then forward the packet to that destination.
5.	Gateway		A gateway is a network node that connects discrete networks or systems that use different protocols, enabling data to flow between the networks.

6.	Bridge		A network bridge acts as an interconnection between two or more LANs, essentially creating a single domain from separate LANs.
7.	Network Interface card		A circuit board installed on the computer to connect to the network. It works as an indispensable component for the network connection

❖ **Cable and Connector**

Cable allows the user to connect their devices such as computers, mobile phones, routers, etc, to a Local Area Network (LAN) that will allow a user to have internet access, and able to communicate with each other through a wired connection. It also carries broadband signals between devices connected through it. In this article, we are going to discuss different types of Ethernet cable used in local area networks for reliable internet connection.

Sr No	Cable and Connector Name	Figure	Use
1	Coaxial Cable		A coaxial cable is used to carry high-frequency electrical signals with low losses. It has a copper conductor in the middle that is surrounded by a dielectric insulator g enerally made of PVC or Teflon

2	Twisted Pair Cables		A twisted pair is a copper wire cable in which two insulated copper wires are twisted around each other to reduce interference or crosstalk. It uses RJ-45 connectors.
3.	Fiber Optic Cable		made of glass cores surrounded by several layers of covering material generally made of PVC or Teflon. It transmits data in the form of light signals due to which there are no interference issues in fiber optics
4.	Registered Jacks		The naming convention for Register jacks is RJ-xx, where xx is a two-digit number. The two digits indicate the type of interface and the area of its application.
5.	Coaxial Cables Connector		The most common type of connector used with coaxial cable is the Bayone-Neill-Concelman (BNC) connector

VII **Recourses Required:**

- Desktop Computer

- Networking Devices (Hub, Switch, Router, Repeater, NIC)
- Connecting Cable and Connectors

VIII **Precautions to be followed:**

1. Handle equipment with care
2. Follow safety Practices

IX **Procedure**

1. Identify network Topology use in your network lab
2. Identify Various Network devices available in lab
3. Observed standard specification on different cable and connector
4. Observed the type of cable use in out lab
5. Check the speed of data in your Lab
6. Observed your network lab and write observations in bellow table

Sr No	Part	Manufacturer	Specification
1	Network Device		
2	Type of Cable		
3.	Connector used		
4	Type of Topology used		

Draw the layout of installed network:

X **Conclusion**

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XI **Practical related questions**

1. Define Topology
2. Explain use of network device
3. Enlist the type of network applications commonly used in the laboratory
4. Explain types of cable use in network laboratory

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XII References:

1. Types of Network Topology - GeeksforGeeks
2. Network Topology Diagrams and Selection Best Practices for 2022 (spiceworks.com)
3. Understanding the Eight Different Network Devices (netwrix.com)
4. LAN Network Cable Media and Connectors | LAN Network Cable Media and Connectors | Pearson IT Certification

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	

Practical No. 28: Share folder and printer in a network

I **Practical Significance**

Student will learn how to share a printer and folder in network.

II **Industry / Employer Expected Outcome(s)**

1. Understand use of resource sharing.
2. Understand use of printer and folders in network.

III **Course Level Learning Outcomes(s)**

CO1 - Analyze the functioning of Data Communication and Computer Network.

IV **Laboratory Learning Outcome(s)**

LLO 28.1 Transfer a file from one computer to another.
LLO 28.2 Print documents from remote system in a network.

V **Relevant Affective Domain related Outcomes**

- Follow safely Measures
- Follow ethical Practice

VI **Relevant Theoretical Background**

❖ **Resources in Computer network**

A resource is any hardware or software accessible by a computer, network, or another object connected to a computer. For example, a printer connected to a network is an example of a shared resource. Another example of a resource may be a network server farm or cluster that allows users to access multiple computers to perform complicated tasks. It is a device or piece of information on a computer that can be remotely accessed from another computer transparently as if it were a resource in the local machine. Network sharing is made possible by inter-process communication over the network

❖ **Resource Shearing:**

In computing, a shared resource, or network share, is a computer resource made available from one host to other hosts on a computer network.it is a device or piece of information on a computer that can be remotely accessed from another computer typically via a local area network or an enterprises Intranet.

Example are shared file access also known as disk sharing or folder sharing; shared printer access is known as printer sharing. Shared scanner access, etc. Resource sharing means reduction in hardware costs.

Shared files mean reduction in memory requirement, which indirectly means reduction in file storage expense

A network share can become a security liability when access to the shared files is gained (often by devious means) by those who should not have access to them. many computer worms have

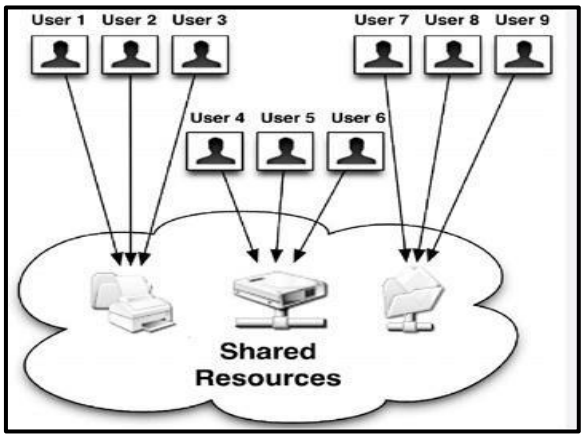

Fig.No.28.1. Resource Shearing

Proposition 3: Hardware Resource and Software resource shearing

There are two types of resource sharing: Hardware Resource and Software Resource

Hardware Resource shearing: Sharing of Printer, Scanner, fax machines in a network

Software Resource Shearing: include files, network connections and memory shearing

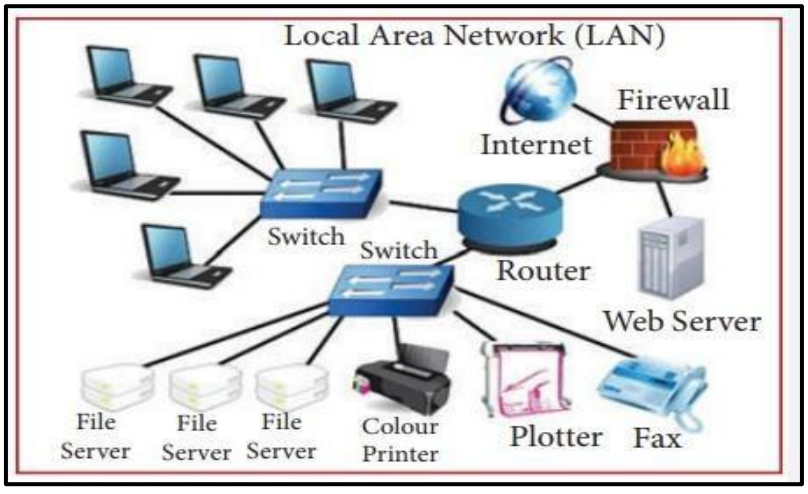

Fig. No. 28.2. Hardware and Software Resource Shearing

❖ **Printer and folder shearing**

Printer sharing is feature which allows you to access and use a printer from other computers in network. If there are employees in an organization, each having their own computer, they will require ten printers if they want to use the resource at the same time. Printer sharing allows accessing the computers that can be interconnected using a network, and just one printer can efficiently provide the services to all ten users.

Folder sharing is the public or private sharing of computer data or space in a network with various levels of access privilege. A user sitting at one computer that is connected to network can easily files present on another computers, provided he is authorized to do so. This saves him/her the hassle of carrying a storage device every time data needs to be transported form one system to another system.

VII **Recourses Required:**

1. Networked Computer
2. Printer

VIII **Precautions to be followed:**

1. Handle Computer system carefully

2. Follow safety Practices

IX **Procedure: Share a printer in network**

Note: The printer driver is installed and that the printer can print on the primary computer (the computer to which it is connected). Also, ensure that ALL the computers are connected to the same network or router.

1. Press the Windows + I key to launch Settings.
2. Select Bluetooth & devices on the left and then click Printers & scanners on the right.

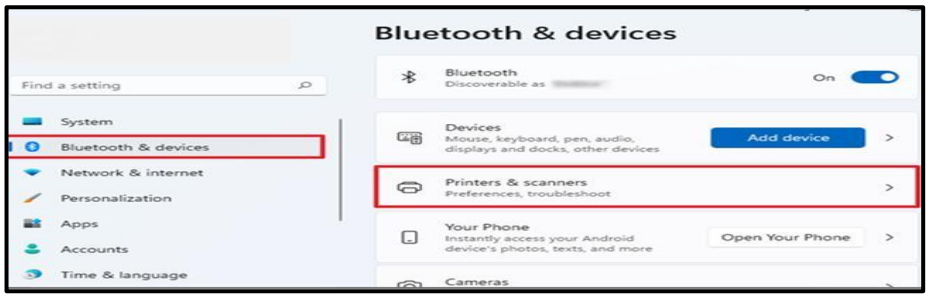

Fig.No. 28.3. Select Printer and scanner option

3. Identify the printer you want to share, then, select it.

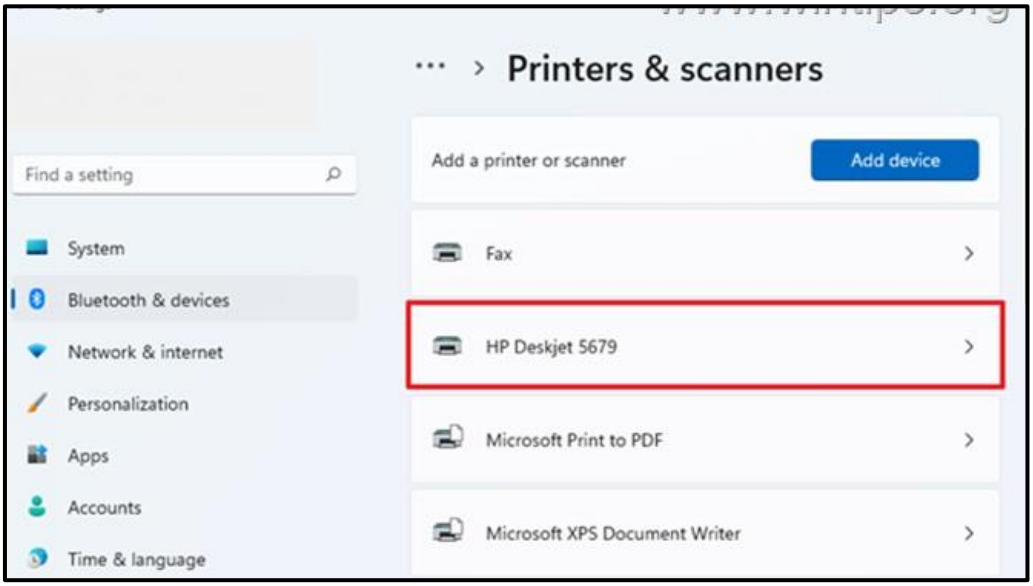

Fig.No 28.4.Identify name of Printer

4. Select Printer Properties from the available option.

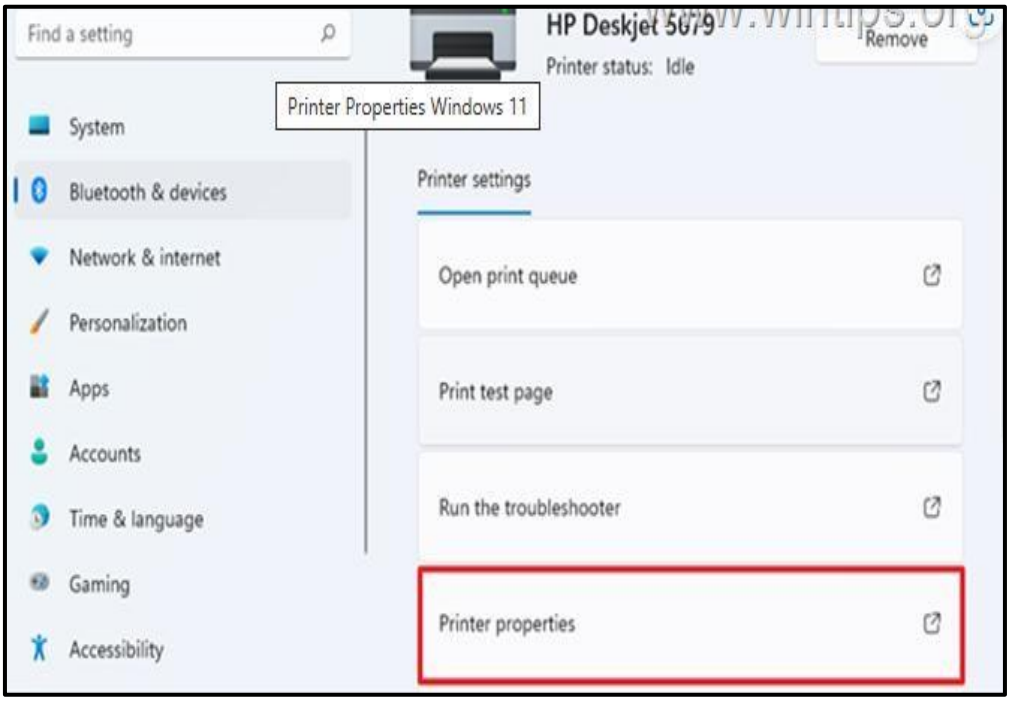

Fig.No. 28.5. Properties of Printer

5. At the Sharing tab, select Change Sharing Options.

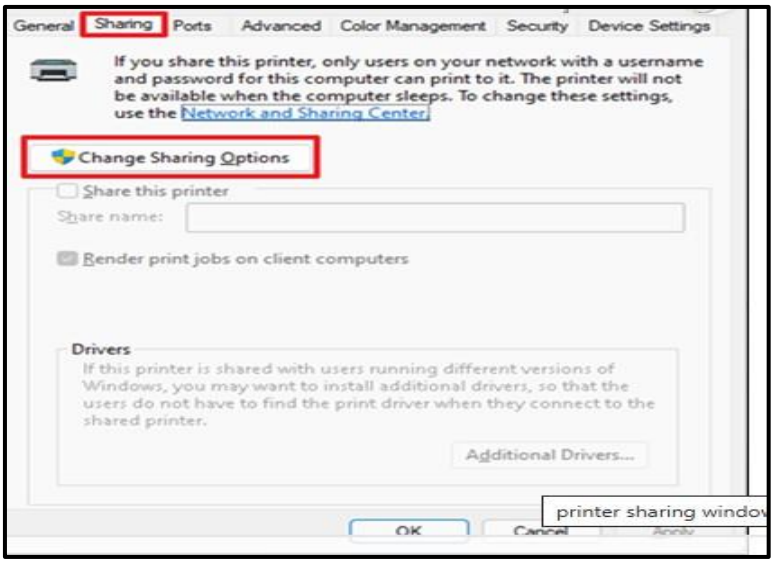

Fig.No. 28.6. Sharing Option

6. In printer sharing options

a. Check the box next to Share this printer.

b. Type a **Share name** that other computers will see when they want to connect to the printer.

c. When done, click Apply, then OK.

Procedure: Share a folder in network

1. Open File Explorer
2. Navigate to the folder you want to share
3. Right-click the folder and select the Properties option
4. Click the Sharing tab
5. Click the Advanced Sharing button.

Fig.No. 28.7. Select Sharing Tap

7. Check the Share this folder option

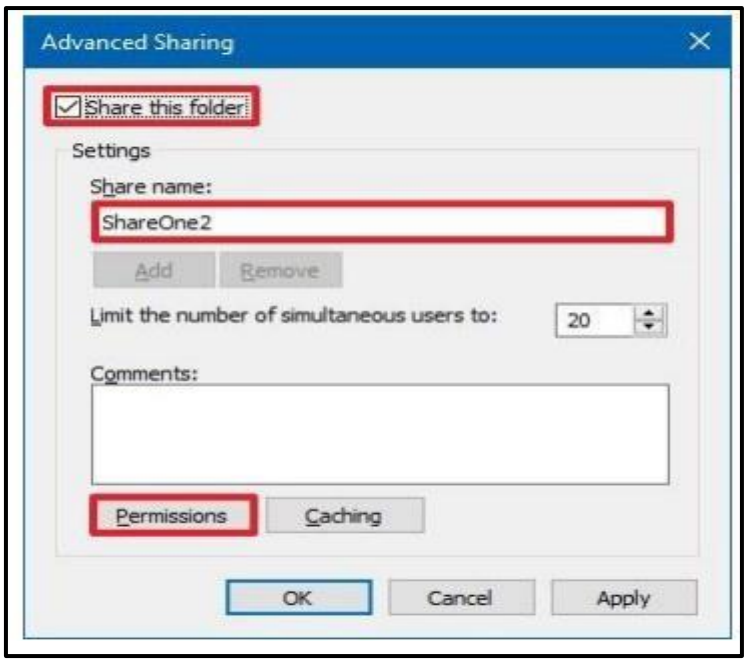

Fig.No.28.8. Advanced Sharing Properties

8. Click the Permissions button
9. Select the Everyone object if you want to share the folder to everyone or Add button to select specific users or group of users
10. Tick the permission boxes to assign users the permission to either read or read and write in the shared folder.

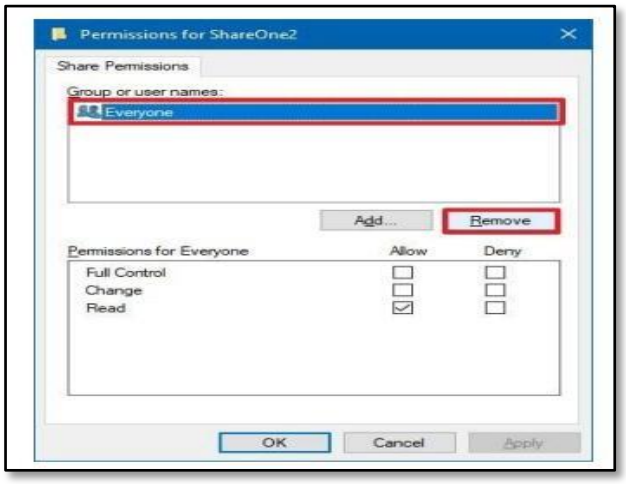

Fig.No. 28.8. Select Permission

11. Select Apply and then OK buttons.

12. Click OK to see the list of shared folders on your computer, see below:

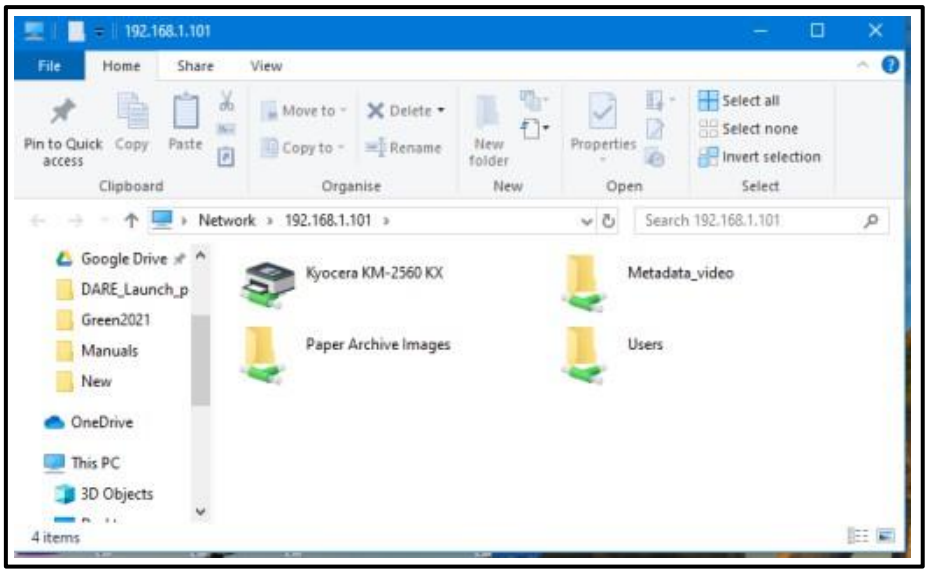

Fig.No. 28.9. Shared folder

X **Conclusion**

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XI **Practical related questions**

1. How to check is a printer or folder shared in a network.
2. Which are features of computer network?
3. Define resource sharing and state its needs.
4. Give advantages and disadvantages of folder sharing.
5. Enlist the different network devices use in laboratory.

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XII References:

1. Manual_CM4I_DCC_22414_120421.pdf**Cyclic Redundancy Code (CRC) in C - Naukri Code 360**
2. How to Share Printer with Other Computers in Windows 11. - WinTips.org

XIII Assessment Scheme (25 Marks)

S. No.	Weightage- Process related: 60%	Marks-15
1.	Practical Implementation with Specified time:40%	
2.	Handling of Network components:10%	
3.	Follow Ethical Practices:10%	
	Weightage- Product related: 40%	**Marks-10**
4.	Correctness of Practical:15%	
5.	Timely Submission:15%	
6.	Answer to Sample questions:10%	
	Total 25	
	Dated Signature of Course Teacher	