Version 1.0

Namal University, Mianwali

Department of Electrical Engineering

EE-342 (L) – Computer Communication Networks (Lab)

Complex Engineering Problem

Report

Subnetting Scheme Design for Namal University

Name	Khurram Shehzad
Roll No	NIM-BSEE-2021-20
INSTRUCTOR	Instructor: Dr. Ahmed Salim Lab Engineer: Engr. Misbah Batool

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Problem Statement:

SCENARIO:

You are the network administrator for a small institution called "Namal University" The institution is rapidly expanding, and you need to design a subnetting scheme to accommodate the increasing number of devices while optimizing IP address utilization. Namal University currently has a Class C IP address block with an IP address range of 192.168.1.0 to 192.168.1.255.

Namal University has the following network requirements:

- BBA Department: 5 hosts
- Computer Science Department: 5 hosts
- Engineering Department: 5 hosts
- Mathematics Department: 5 hosts
- Guest Wi-Fi: 10 hosts
- Chagda Hostel: 7 hosts
- Additionally, you need to reserve some subnets for future expansion.

Introduction:

In this complex engineering Problem we have to do Subnetting of Namal University. Subnetting scheme to accommodate the increasing number of devices while efficiently utilizing IP addresses. In this CEP report provides a concise overview of the subnetting plan, addressing the host requirements for each department and network, future expansion considerations, and the calculated subnet masks, network addresses, and usable IP address ranges for each subnet.

Subnetting:

Minimum Number of Bits Required:

To determine the minimum number of bits required to satisfy the host requirements for each department ,Chugda Hostel and the guest Wi-Fi network, we need to some calculations:

→ In given scenario

- Required Host for BBA : 5host

→ Now for to Calculate minimum bit required for BBA department.

- $2^n \geq$ number of require host
- $2^3 \geq 5$
- $8 \geq 5$ (minimum 3bits needed)

Similarily:-

-For CS Department = 5 hosts ($2^3=8$)(min 3 bits)

-For EE Department = 5 hosts ($2^3=8$)(min 3 bits)

-For MATH Department = 5 hosts ($2^3=8$)(min 3 bits)

-For GUEST WiFi = 10 hast ($2^4=16$)(min 4 bits)

-For CHUGDA Hostel = 7 hosts ($2^3=8$)(min 3 bits)

Subnetting Plan:

To optimize IP address utilization and accommodate departmental growth, we can allocate subnets with appropriate subnet masks for each department, Chugda Hostel and the guest Wi-Fi network. I will also add To future expansion in network.

→As department grow in future So to accomodate the higher number of Host.

⊙ $2^4=16$ (we use 4bit for [redacted] Department

→Find bits used for network.

= Total no. of Bits − Use bits.

= 32 − 4

= $\boxed{\text{28 bits are of network}}$

Subnet Mask Finding Calculations:-

As I use "4" bits for Host and Remaining 28 bits used for networ So Subnet mask is.

Subnet Mask (In Binary) = 11111111.11111111.11111111.11110000

Subnet Mask (In Decimal) = 255.255.255.240

As I will use same number of bits for each department & network So Subnet Mask is same.

Total No of Subnet → **16**

So, Total Subnet I make from this networkis 16 out of that 6 I use for departments ,Chugda Hotel and Guest Wi-Fi. Three Subnet I use for Future expansion and other Remaining seven I use for Routing between two Routers.

IP Addresses Calculation:

Given IP : 192.168.1.0/28

Class C :

Subnet = 11111111.11111111.11111111.11110000

Subnet = 255.255.255.240.

→ First IP address:

IP → 11000000.10101000.00000001.00000000

AND

Subnet → 11111111.11111111.11111111.11110000

(In binary) → 11000000.10101000.00000001.0

(In Decimal) → 192.168.1.0 (1st IP address reserved for network)

$\boxed{192.168.1.1}$ 1st Host

→ Last IP address:

IP → 11000000.10101000.00000001.00000000

~~AND~~ OR

(~Subnet) → 00000000.00000000.00000000.00001111

(In binary) → 11000000.10101000.00000001.00001111

(In Decimal) → 192.168.1.15 (BroadCast IP)

Now I will give Same number of bits all other department & Guest wifi and Chugda Hostel.
After finding first Subnetting Calculation I will Simply add next 16 to next department.

→ BBA Department → 192.168.1.15 (last IP)
→ CS Department → 192.168.1.16 (First IP)
→ 192.168.1.31 (last IP)
usable IP address (192.168.1.17 — 192.168.1.30)

→ Engineering Department Electrical :-
Subnet Mask → 255.255.255.240
Network IP → 192.168.1.32
Usable IP Range → (192.168.1.33 — 192.168.1.47)

→ Math Department :-
Subnet Mask → 255.255.255.240
Network IP → 192.168.1.48
Usable IP Range → 192.168.1.49 — 192.168.1.

Guest Wifi :-

Network IP → 192.168.1.64

Subnet Mask → 255.255.255.240

Usable IP Range → (192.168.1.65 – 192.168.1.78)

Ghugda Hostel :-

Subnet Mask → 255.255.255.240

Network IP → 192.168.1.80

Usable IP Range → (192.168.1.81 – 192.168.1.94)

Future Expansion 1 :-

Subnet Mask → 255.255.255.240

Network IP → 192.168.1.96

Usable IP Range → 192.168.1.97 – 192.168.1.110

Future Expansion 2 :-

Subnet Mask :- 255.255.255.240

Network IP :- 192.168.1.112

Usable IP Range :- (192.168.1.113 192.168.1.126)

After that I will use Next 7 Same Subnet use for Connection b/w two Routers.

Topology Use:

I will use **Ring Topology** to make this network of Namal University.

Ring Topology:

Ring topology is a type of network configuration where devices are connected in a circular manner, forming a closed loop. In this setup, each device is connected to exactly two other devices, creating a continuous pathway for data transmission.

Here some advantages of Ring Topology.

1.Reliability: Ring topologies offer inherent redundancy, as data can flow in both directions. If a device or link fails, the network can still function, ensuring continuous connectivity. This makes ring topologies highly reliable in situations where uninterrupted network access is critical.

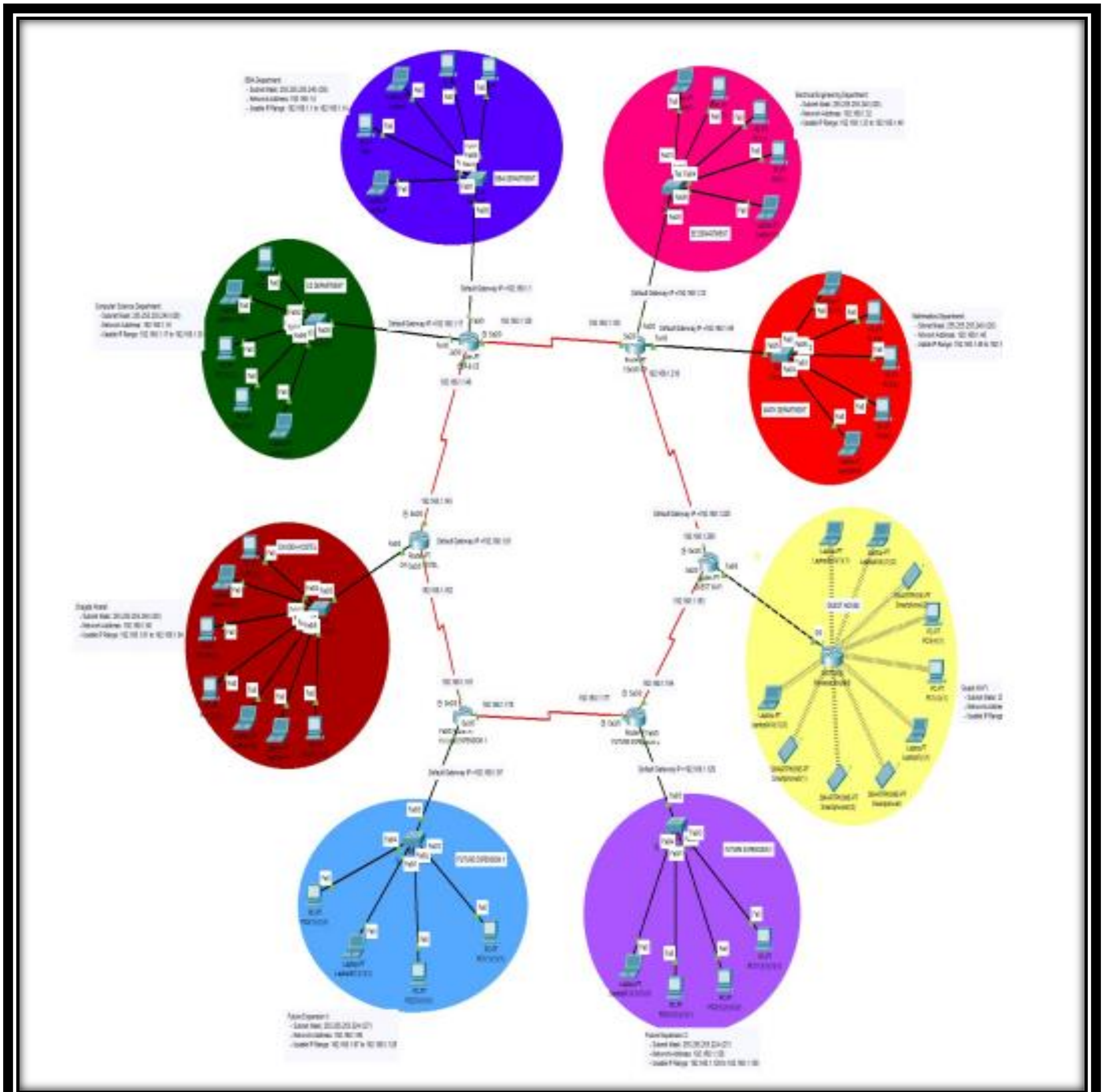
2. Efficient Data Transmission: In a ring topology, data travels in a unidirectional manner, preventing data collisions and improving the efficiency of data transmission

3. Cost-Effective: Ring topologies often require fewer cables and network ports compared to other topologies like bus or star. This can make them cost-effective in terms of installation

4. Easy Troubleshooting: Ring topologies make troubleshooting relatively straightforward. Since data travels in a predictable direction, identifying and isolating faults or problematic devices becomes easier compared to other topologies

But there also some limitation in Ring Topolgy

Network Pic:



Ping Command:

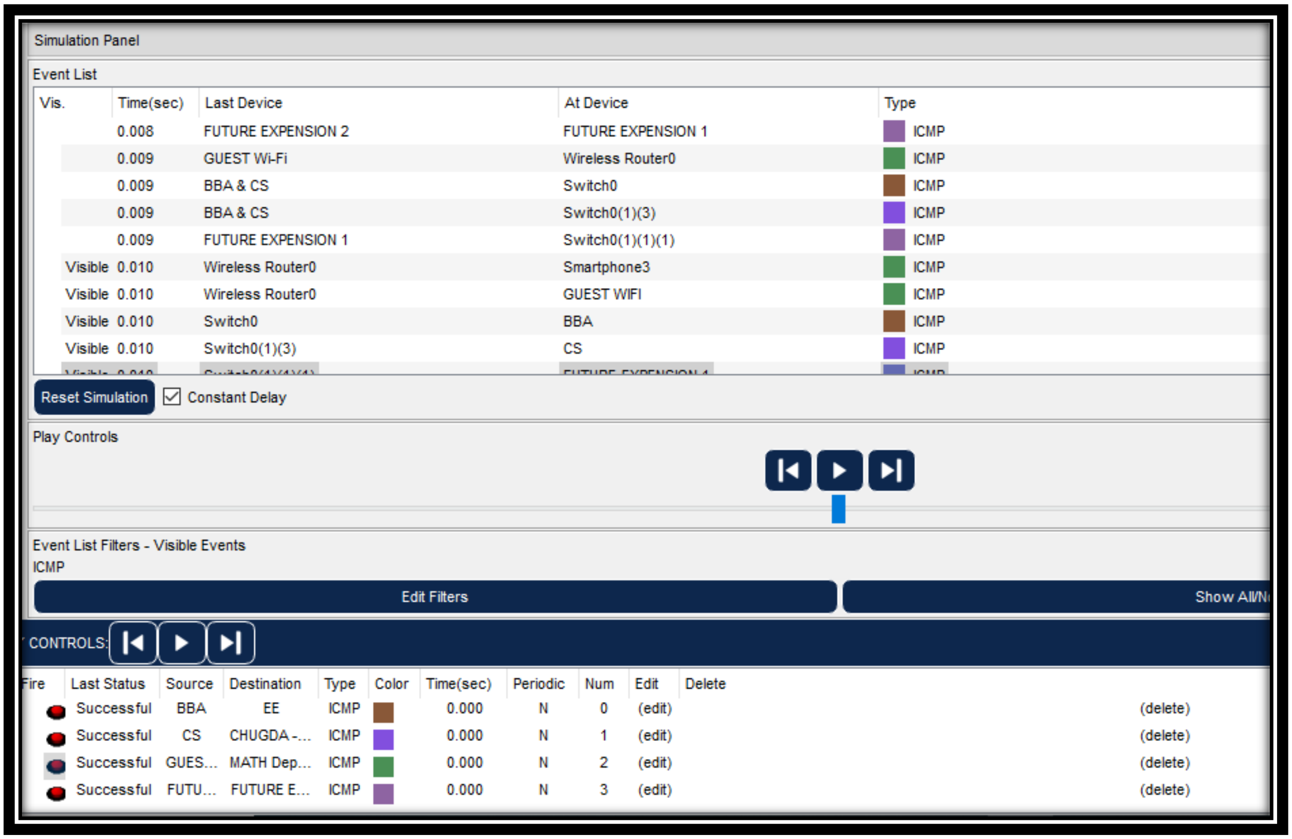
Here, I do Ping commands to see connection between to subnets.

```
C:\>ping 192.168.1.17

Pinging 192.168.1.17 with 32 bytes of data:

Reply from 192.168.1.17: bytes=32 time=2ms TTL=255
Reply from 192.168.1.17: bytes=32 time<1ms TTL=255
Reply from 192.168.1.17: bytes=32 time<1ms TTL=255
Reply from 192.168.1.17: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.1.17:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>ping 192.168.1.34

Pinging 192.168.1.34 with 32 bytes of data:

Reply from 192.168.1.34: bytes=32 time=11ms TTL=126
Reply from 192.168.1.34: bytes=32 time=12ms TTL=126
Reply from 192.168.1.34: bytes=32 time=2ms TTL=126
Reply from 192.168.1.34: bytes=32 time=11ms TTL=126

Ping statistics for 192.168.1.34:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 12ms, Average = 9ms

C:\>ping 192.168.1.50

Pinging 192.168.1.50 with 32 bytes of data:

Reply from 192.168.1.50: bytes=32 time=2ms TTL=126
Reply from 192.168.1.50: bytes=32 time=17ms TTL=126
Reply from 192.168.1.50: bytes=32 time=1ms TTL=126
Reply from 192.168.1.50: bytes=32 time=12ms TTL=126

Ping statistics for 192.168.1.50:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
```

```
C:\>ping 192.168.1.81

Pinging 192.168.1.81 with 32 bytes of data:

Reply from 192.168.1.81: bytes=32 time=2ms TTL=254
Reply from 192.168.1.81: bytes=32 time=2ms TTL=254
Reply from 192.168.1.81: bytes=32 time=2ms TTL=254
Reply from 192.168.1.81: bytes=32 time=1ms TTL=254

Ping statistics for 192.168.1.81:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>ping 192.168.1.98

Pinging 192.168.1.98 with 32 bytes of data:

Reply from 192.168.1.98: bytes=32 time=63ms TTL=125
Reply from 192.168.1.98: bytes=32 time=11ms TTL=125
Reply from 192.168.1.98: bytes=32 time=11ms TTL=125
Reply from 192.168.1.98: bytes=32 time=4ms TTL=125

Ping statistics for 192.168.1.98:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 63ms, Average = 22ms
```

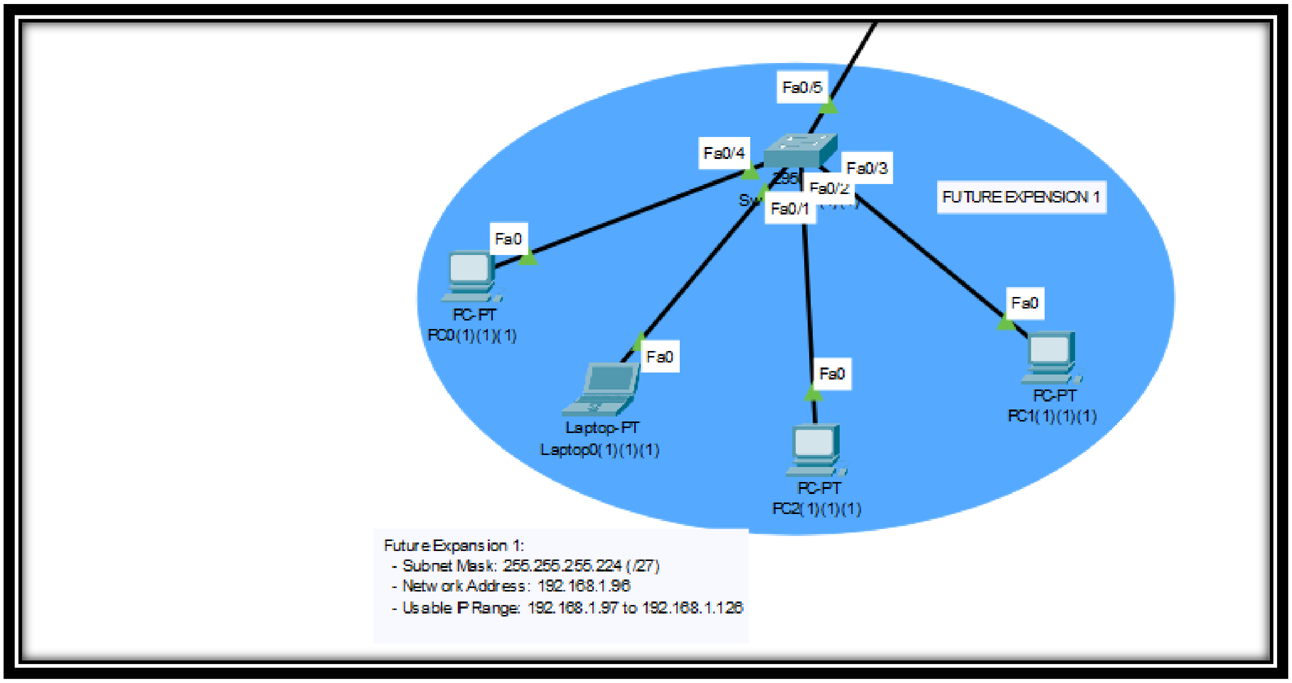
Successful PDU Sending:

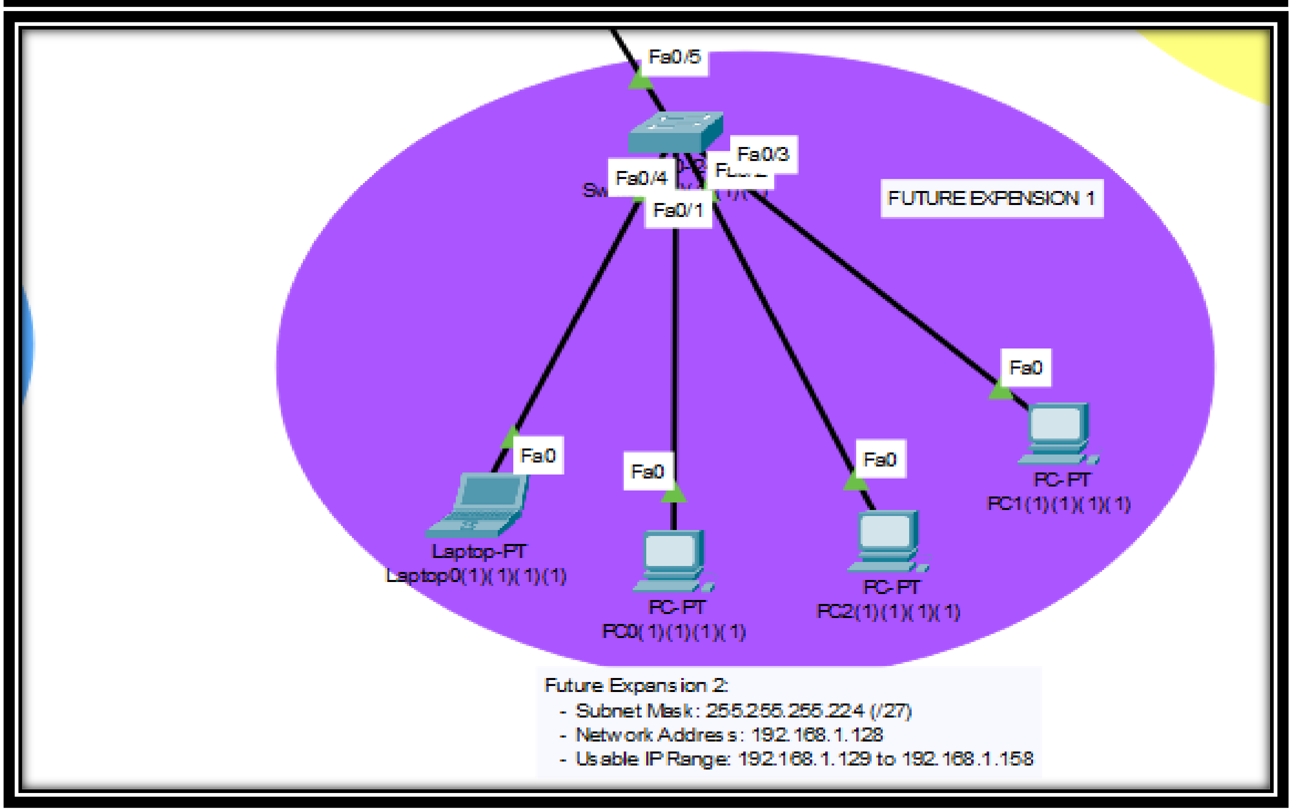
Here, I add a Picture of some successful PDU send between different departments and O there network



Future Expansion Planning:

Here in this network I add two Future Expansion and also one reserved subnet for future expansion.





Conclusion:

In this complex Engineering Problem I designed subnetting scheme for Namal University because to optimizes IP address utilization and accommodates the host requirements for each department and network. By allocating appropriate subnet masks, network addresses, and usable IP address ranges, we ensure efficient utilization of the available Class C IP address block.

CEP Rubrics

- **Method of Evaluation**: Reports submitted by students on QOBE.
- **Measured Learning Outcomes**:

CLO 1: Follow instructions to implement local networks and analyze their performance on the simulator.
CLO 2: Present and analyze the network with effective and timely submitted reports.
CLO 3: Produce and design networks to demonstrate various networking protocols and applications.

Assessment tool/ weightage/ (CLO, PLO)	Excellent 10	Good 9-7	Satisfactory 6-4	Unsatisfactory 3-1	Poor 0	Marks Obtained
Viva (15%) (CLO1, PLO5)	Lab instructions followed correctly and implemented without error.	Lab instructions followed correctly however implementation has minor errors.	Instructions followed in lab manual however implementation not done correctly.	Lab instructions were not followed however managed to implement the given network.	Could not follow the instructions in lab manual and failed to complete the given network.	
Report (7%) (CLO2, PLO10)	Pertinent and coherent paragraphs, with proper grammar, punctuation marks, and formatting.	Pertinent and coherent paragraphs, with minor grammar, punctuation marks, and formatting errors.	Non-pertinent and non-coherent paragraphs, with minor grammar, punctuation marks, and formatting errors.	Non-pertinent and non-coherent paragraphs, with major grammar, punctuation marks, and formatting errors.	Report not submitted	
Simulation (8%) (CLO3, PLO4)	All tasks completed correctly. All the given networks designed correctly with understanding.	Most tasks completed correctly. Most of the given network designed correctly with understanding.	Some tasks completed correctly. Some of the given networks designed correctly with partial understanding.	Most tasks incomplete or incorrect. Most of the given networks designed incorrectly with partial understanding.	All tasks are incomplete or incorrect. None of the networks given correctly designed or not designed.	
Total						

Note: Tasks have sixty and report has forty percent contributions towards this lab total score.