

**B.M.S. COLLEGE OF ENGINEERING BENGALURU**  
Autonomous Institute, Affiliated to VTU



Lab Record

**Computer Networks – 23CS5PCCON**

*Submitted in partial fulfillment for the 5<sup>th</sup> Semester Laboratory*

Bachelor of Engineering  
in  
Computer Science and Engineering

*Submitted by:*

**D A Chethan**

(1BM23CS083)

Department of Computer Science and Engineering  
B.M.S. College of Engineering  
Bull Temple Road, Basavanagudi, Bangalore 560 019  
August 2025-December 2025

**B.M.S. COLLEGE OF ENGINEERING**

**DEPARTMENT OF COMPUTER SCIENCE AND**

**ENGINEERING**



***CERTIFICATE***

This is to certify that the Computer Networks (23CS5PCCON) laboratory has been carried out by D A CHETHAN (1BM23CS083) during the 5<sup>th</sup> Semester August 2025-December 2025

Signature of the Faculty Incharge:

Sarala D V  
Assistant Professor  
Department of Computer Science and Engineering  
B.M.S. College of Engineering, Bangalore

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3.	Configure Web Server, DNS within a LAN.
4.	Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.
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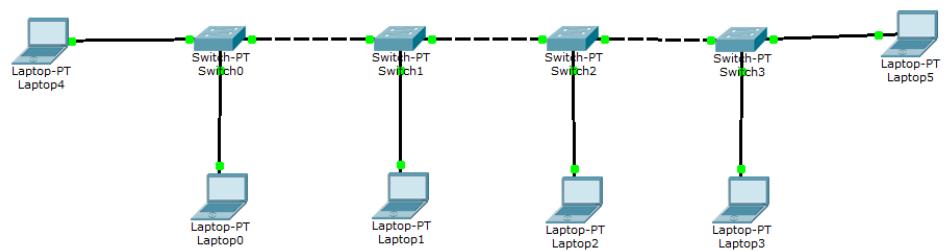
<b>PART – B</b>	
<b>Serial No.</b>	<b>Name of Experiment</b>
1.	Write a program for congestion control using Leaky bucket algorithm.
2.	Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.
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4.	Write a program for error detecting code using CRC-CCITT (16-bits).

## PART - A

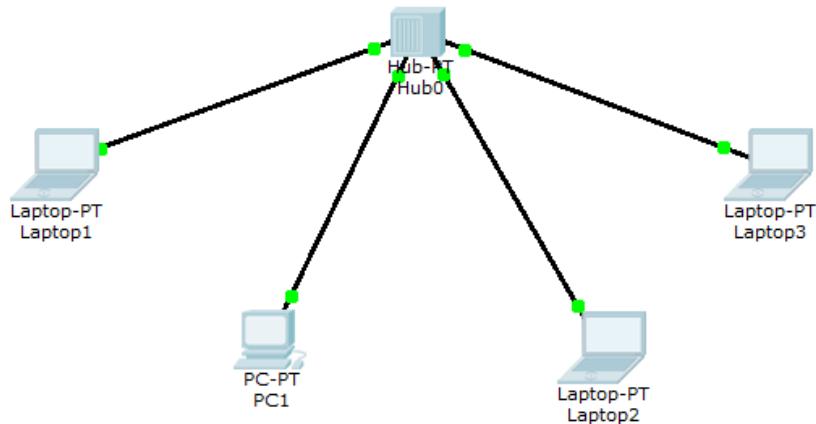
Program 1: Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping message.

Network diagram:

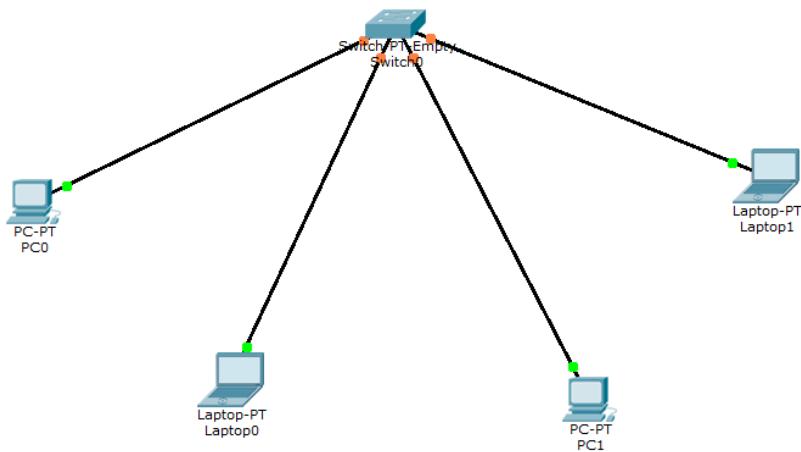
Bus



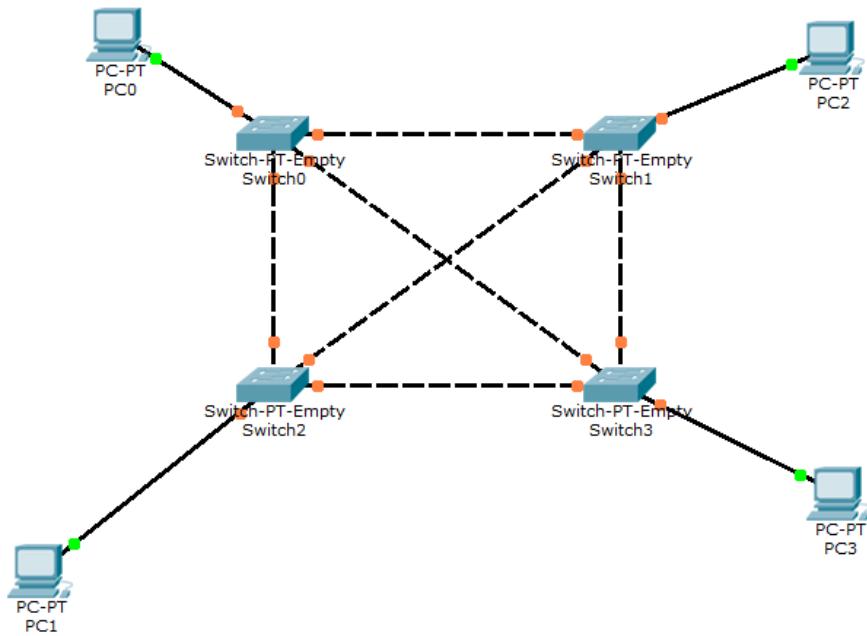
Hub



Switch

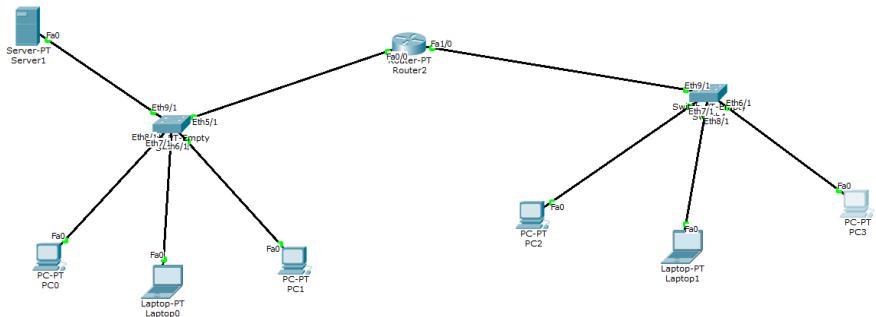


Mesh

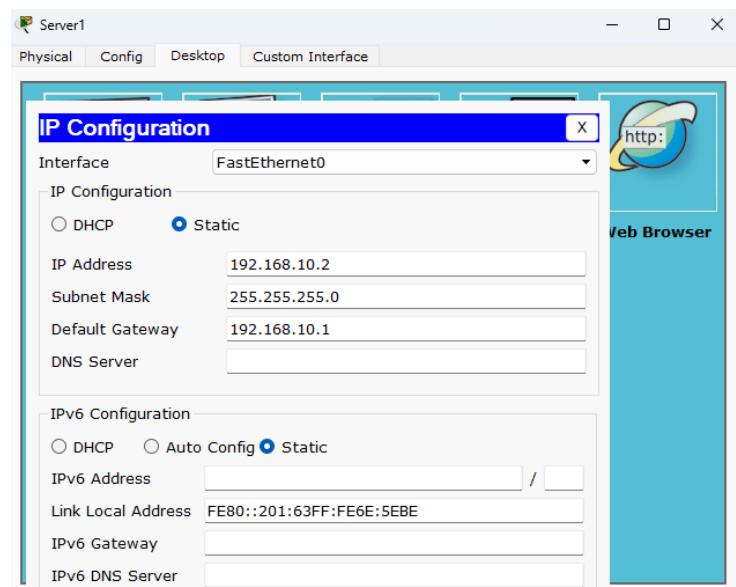
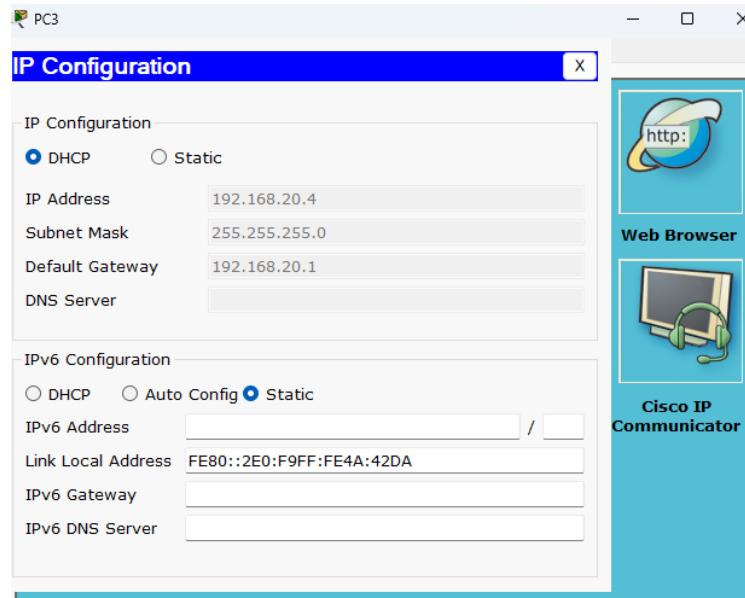


## Program 2: Configure DHCP within a LAN and outside LAN.

Network diagram:



Configuration:



```
PT 1001 (PTSC2005) processor (revision 0x200) with 60416K/8120K bytes of memory
.
Processor board ID PT0123 (0123)
PT2005 processor: part number 0, mask 01
Bridging software.
X.25 software, Version 3.0.0.
4 FastEthernet/IEEE 802.3 interface(s)
2 Low-speed serial(sync/async) network interface(s)
32K bytes of non-volatile configuration memory.
63488K bytes of ATA CompactFlash (Read/Write)

    --- System Configuration Dialog ---

Continue with configuration dialog? [yes/no]: no

Press RETURN to get started!

Router>enable
Router>conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int Fa0/0
Router(config-if)#ip address 192.168.10.1 255.255.255.0
Router(config-if)#ip helper-address 192.168.10.2
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

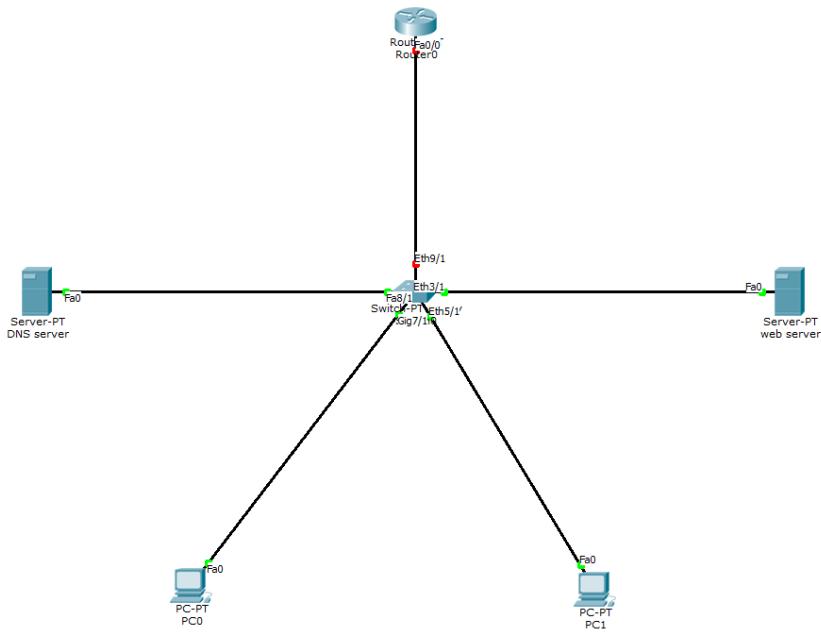
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to
o up
do write memory
Building configuration...
[OK]
Router(config-if)#exit
Router(config)#int Fa1/0
Router(config-if)#ip address 192.168.20.1 255.255.255.0
Router(config-if)#ip helper-address 192.168.10.2
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up

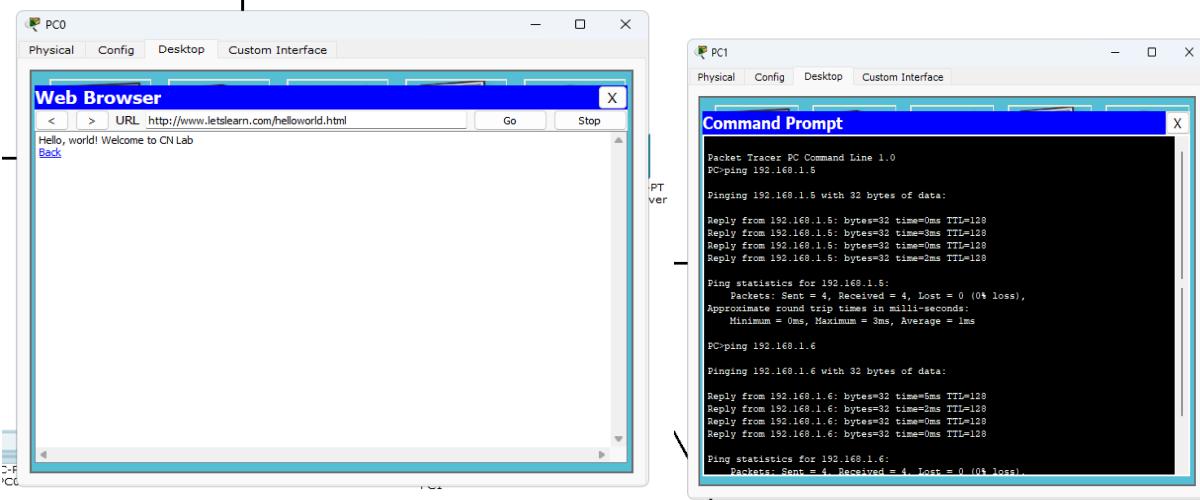
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to
o up
do write memory
Building configuration...
[OK]
Router(config-if)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router##IP-4-DUPADDR: Duplicate address 192.168.10.1 on FastEthernet0/0, sourced
by 000A.4166.1664
```

## Program 3: Configure Web Server, DNS within a LAN.

Network diagram:

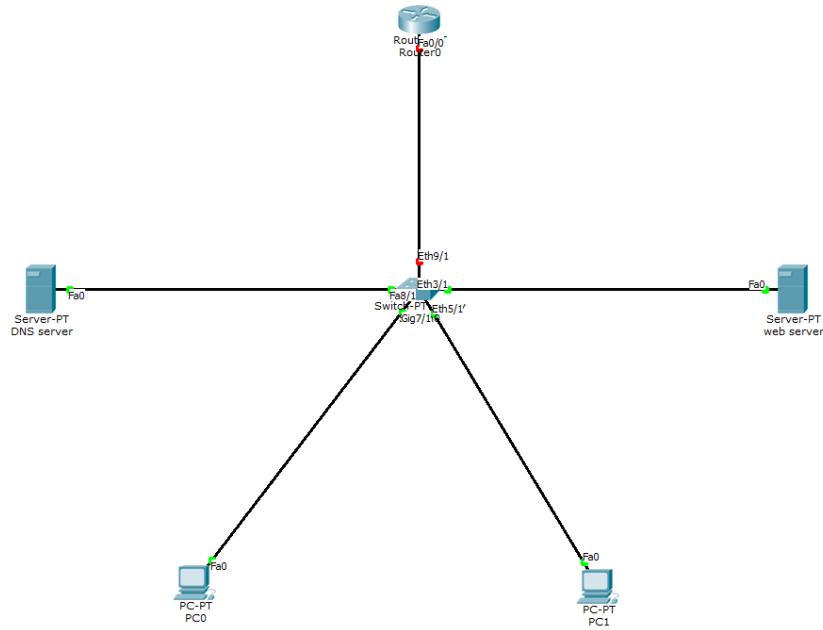


Configuration:



Program 4: Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.

Network diagram:



Configuration:

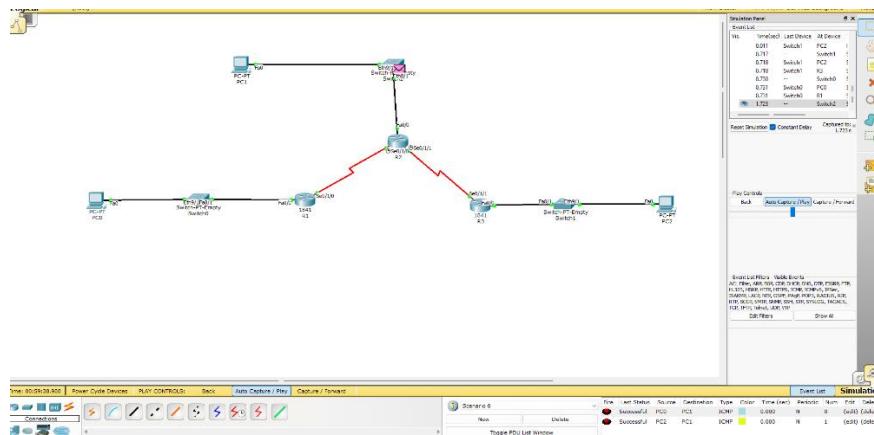
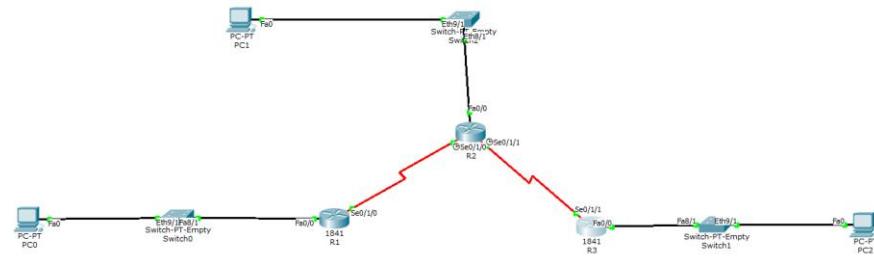
```
PC>ping 192.168.1.101
Pinging 192.168.1.101 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.101:
  Packets: Sent = 4, Received = 0, Lost = 4 (100% loss), Ping statistics for 192.168.1.6:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss)
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 5ms, Average = 1ms

PC>ping 192.168.1.6
Pinging 192.168.1.6 with 32 bytes of data:
Reply from 192.168.1.6: bytes=32 time=5ms TTL=128
Reply from 192.168.1.6: bytes=32 time=0ms TTL=128
Reply from 192.168.1.6: bytes=32 time=0ms TTL=128
Reply from 192.168.1.6: bytes=32 time=0ms TTL=128
```

## Program 5: Configure default route, static route to the Router.

Network diagram:



## Configuration:

**PC0**

**IP Configuration**

**IP Configuration**

- DHCP  Static

IP Address: 192.168.10.10  
Subnet Mask: 255.255.255.0  
Default Gateway: 192.168.10.1  
DNS Server: [ ]

**IPv6 Configuration**

- DHCP  Auto Config  Static

IPv6 Address: [ ] / [ ]  
Link Local Address: FE80::230:F2FF:FE57:D640  
IPv6 Gateway: [ ]  
IPv6 DNS Server: [ ]

**R1**

**Physical Config CLI**

**IOS Command Line Interface**

```

Router>enable
Router#enable
Building configuration...
[OK]
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - Candidate default, o - per-user static route, o - ODR
      P - Periodic downloaded static route

Gateway of last resort is not set

 172.16.1.0/24 is directly connected, Serial0/1/0
 C 172.16.1.0/24 is directly connected, Serial0/1/0
 S 172.16.2.0/24 is directly connected, FastEthernet0/0
 S 192.168.10.0/24 [1/0] via 172.16.1.2
 S 192.168.20.0/24 [1/0] via 172.16.1.2
 S 192.168.30.0/24 [1/0] via 172.16.1.2
Router#
Router#

```

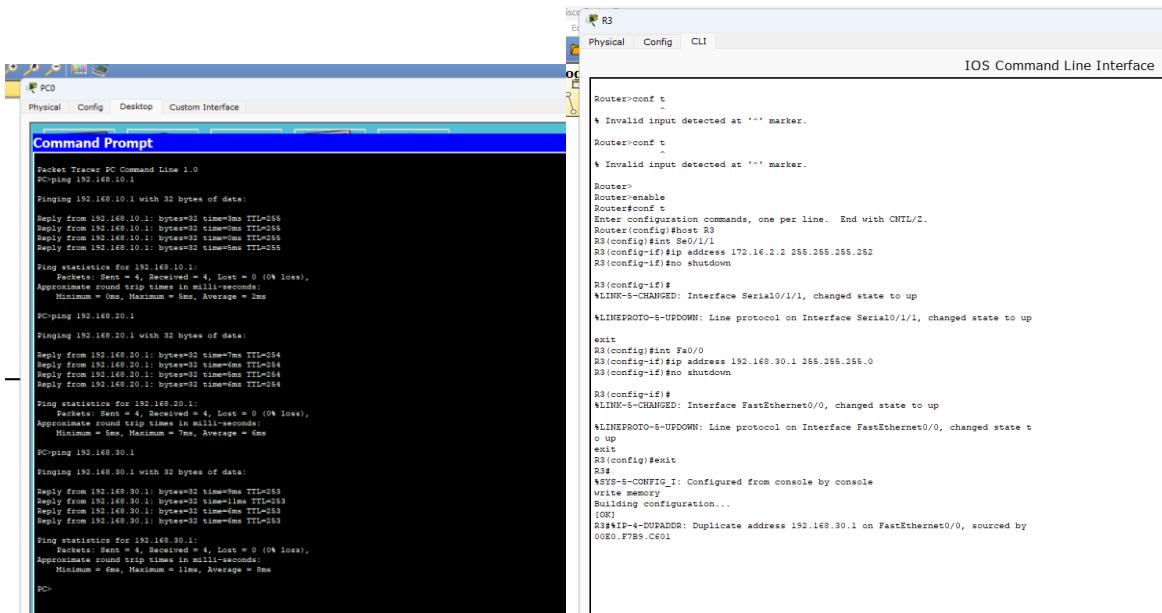
Continue with configuration dialog? {yes/no}: no

Press RETURN to get started!

```

Router>enable
Router>conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router>(config)#int R2/0
R2(config)#ip address 192.168.20.1 255.255.255.252
R2(config)#no shutdown
R2(config-if)#
R2(config-if)#LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
*LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
exit
R2(config)#int Fa0/0
R2(config-if)#ip address 192.168.20.1 255.255.255.0
R2(config-if)#no shutdown
R2(config-if)#
*LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
*LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
exit
R2(config)#int Se0/1/1
R2(config-if)#ip address 172.16.2.1 255.255.255.252
R2(config-if)#no shutdown
*LINK-5-CHANGED: Interface Serial0/1/1, changed state to down
R2(config-if)#exit
R2(config)#exit
R2#
*SYS-5-CONFIG_I: Configured from console by console
Build configuration...
[OK]
R2#
*LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
*LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up

```



```

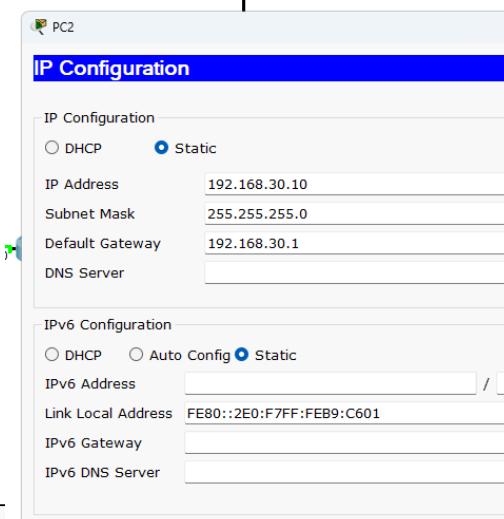
R3>enable
R3>conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#route 0.0.0.0 0.0.0.0 Se0/1/1
R3(config)#exit
R3#
%SYS-5-CONFIG_I: Configured from console by console
ur
Building configuration...
(OK)

R3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

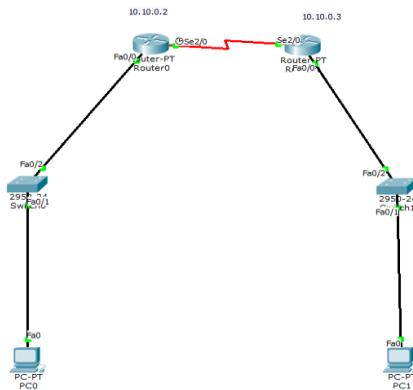
      172.16.0.0/30 is subnetted, 1 subnets
C       172.16.2.0 is directly connected, Serial0/1/1
C       192.168.30.0/24 is directly connected, FastEthernet0/0
S*     0.0.0.0/0 is directly connected, Serial0/1/1
R3#

```

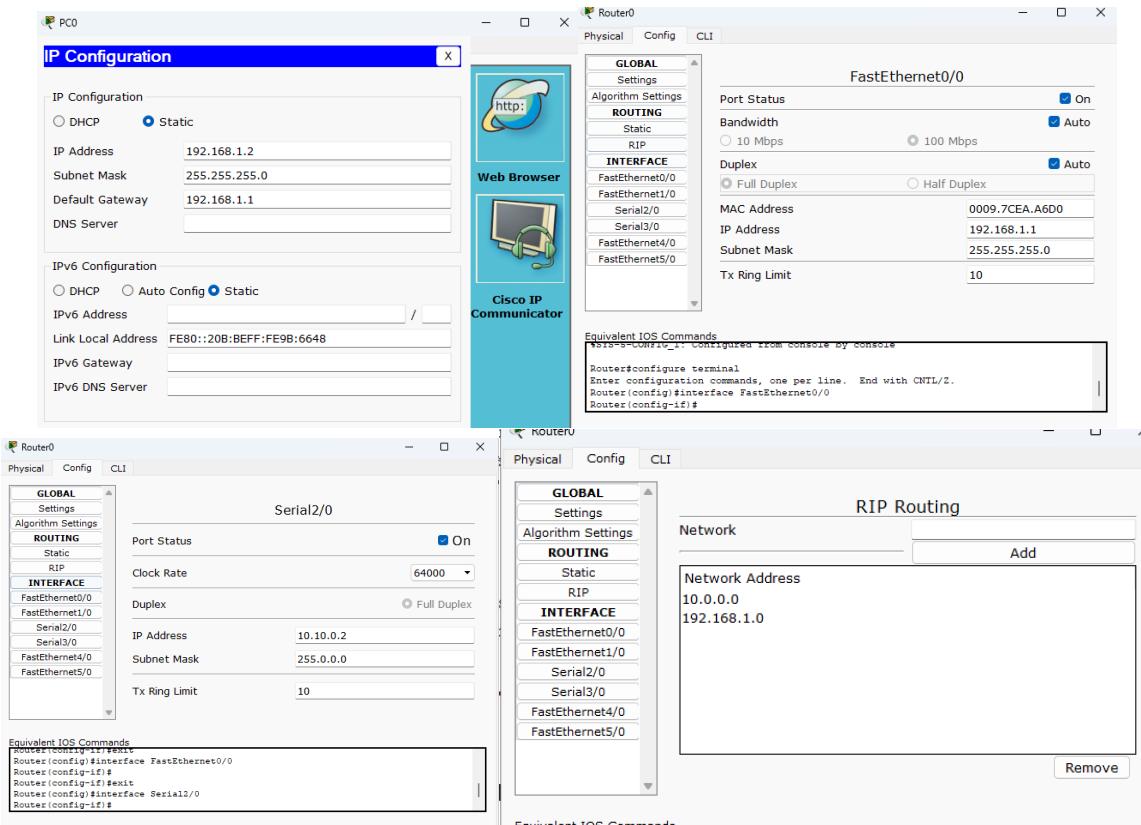


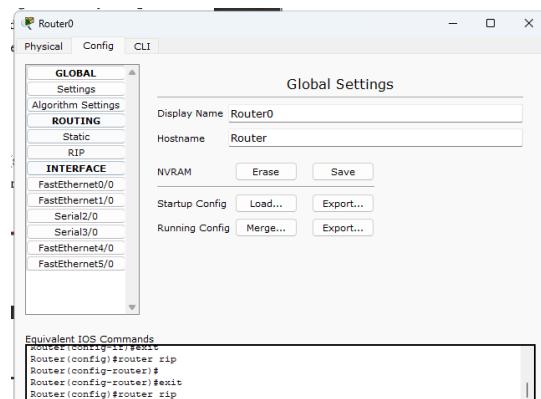
## Program 6: Configure RIP routing Protocol in Routers.

Network diagram:



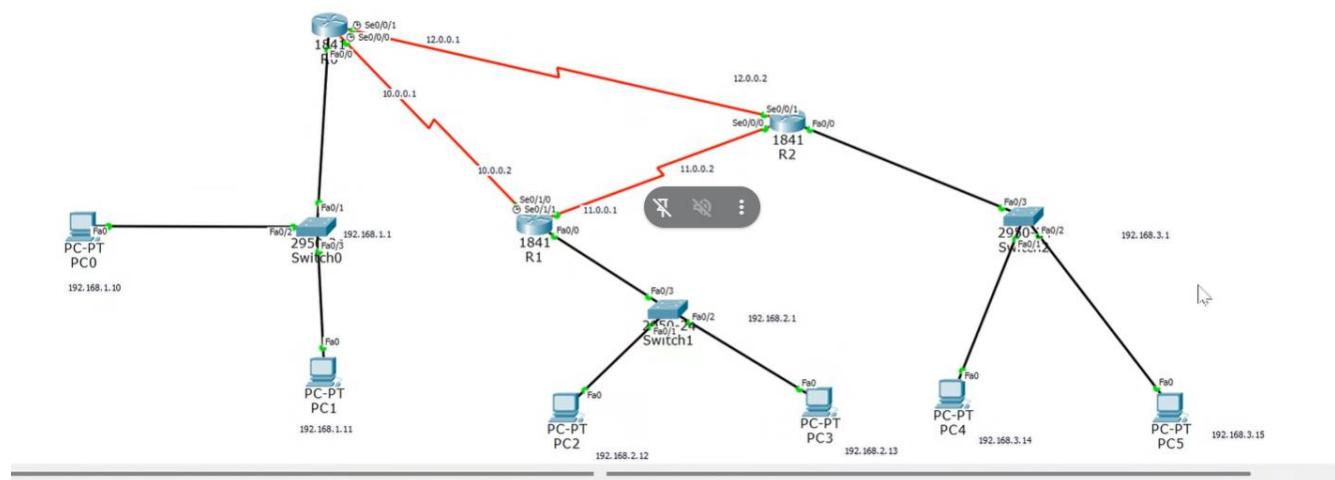
Configuration:





## Program 7: Configure OSPF routing protocol.

Network diagram:



Configuration:

```

# incomplete command.
Router(config)#exit
Router#
SYS-5-CONFIG_I: Configured from console by console
enable
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 192.168.1.0 0.0.0.255 area0
^
% Invalid input detected at '^' marker.

Router(config-router)#network 192.168.1.1 0.0.0.255 area0
^
% Invalid input detected at '^' marker.

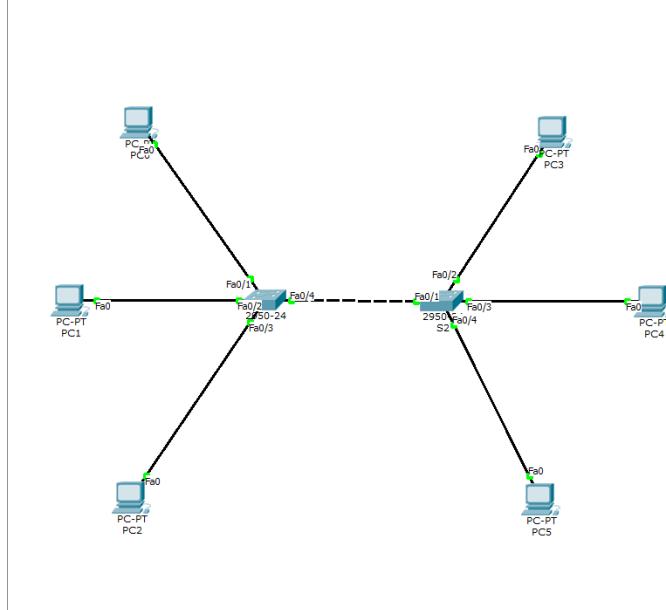
Router(config-router)#exit
Router(config)#exit
Router#
SYS-5-CONFIG_I: Configured from console by console
enable
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf1
Router(config-router)#network 192.168.2.0 0.0.0.255 area 0
Router(config-router)#network 10.0.0.0 0.0.0.255 area 0
Router(config-router)#network 11.0.0.0 0.0.0.255 area 0
^
% Invalid input detected at '^' marker.

Router(config-router)#network 11.0.0.0 0.0.0.255 area 0
Router(config-router)#exit
Router(config)#exit
SYS-5-CONFIG_I: Configured from console by console
enable
Router#conf t
Building configuration...
[OK]
Router#show ver
Version 1: 0050PF-F-A03C8U: Process 1, Mbr 192.168.1.1 on Serial3/0 from LOADING to
FULL, Loading Done
|

```

Program 8: To construct a VLAN and make the PC's communicate among a VLAN.

Network diagram:

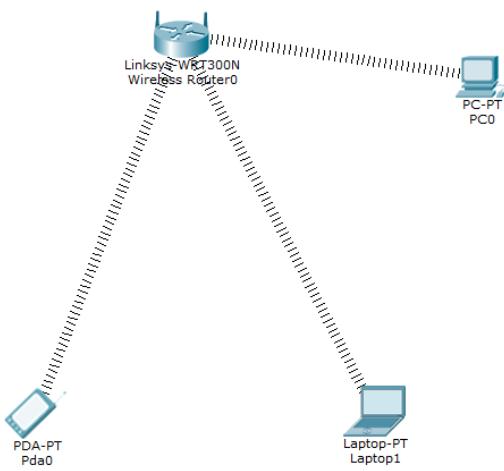


Configuration:

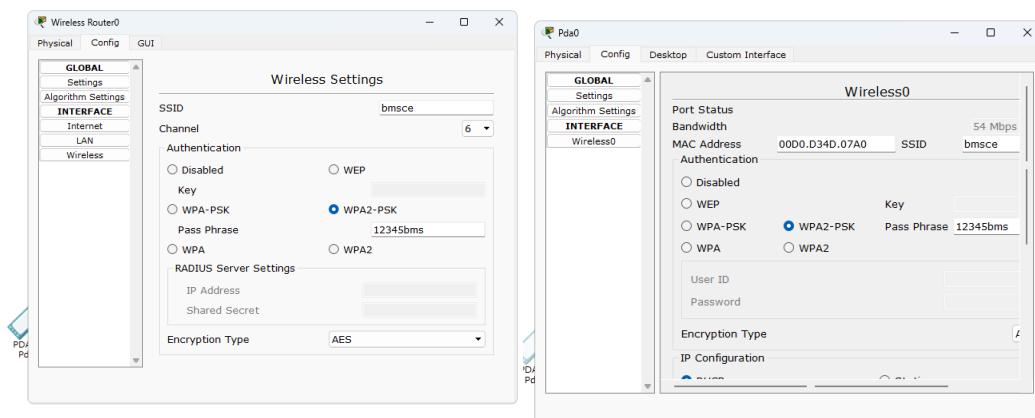
Switch Configuration (CLI)	IOS Command Line Interface (CLI)	Firewall Log Table
<pre> Switch&gt; Switch&gt;enable Switch&gt;conf t Enter configuration commands, one per line. End with CNTL/Z. Switch(config)#int fa0/1 Switch(config-if)#switchport access vlan 10 # Access VLAN does not exist. Creating vlan 10 Switch(config-if)#int fa0/2 Switch(config-if)#switchport access vlan 20 # Access VLAN does not exist. Creating vlan 20 Switch(config-if)#int fa0/3 Switch(config-if)#switchport access vlan 30 # Access VLAN does not exist. Creating vlan 30 Switch(config-if)#int fa0/4 Switch(config-if)#switchport mode trunk  Switch(config-if)# \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state t o down  \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state t o up </pre>	<pre> Physical Config CLI IOS Command Line Interface  \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state t o up  \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state t o down  \$LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state t o up  Switch&gt;enable Switch&gt;conf t Enter configuration commands, one per line. End with CNTL/Z. Switch(config)#int fa0/0 Switch(config-if)#switchport access vlan 10 # Access VLAN does not exist. Creating vlan 10 Switch(config-if)#int fa0/3 Switch(config-if)#switchport access vlan 20 # Access VLAN does not exist. Creating vlan 20 Switch(config-if)#int fa0/4 Switch(config-if)#switchport access vlan 30 # Access VLAN does not exist. Creating vlan 30 Switch(config-if)#int fa0/1 Switch(config-if)#switchport mode trunk Switch(config-if)# </pre>	<pre> Fire Last Status Source Destination Type Color Time (sec) Periodic Num Edit Delete Failed PC0 PC4 ICMP 2.028 N 0 (edit) (delete) </pre>

Program 9: To construct a WLAN and make the nodes communicate wirelessly.

Network diagram:



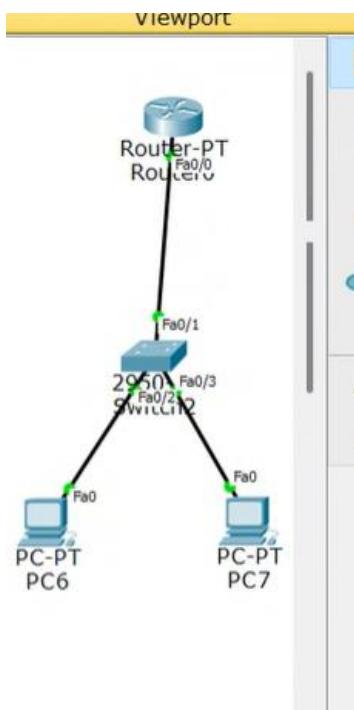
Configuration:



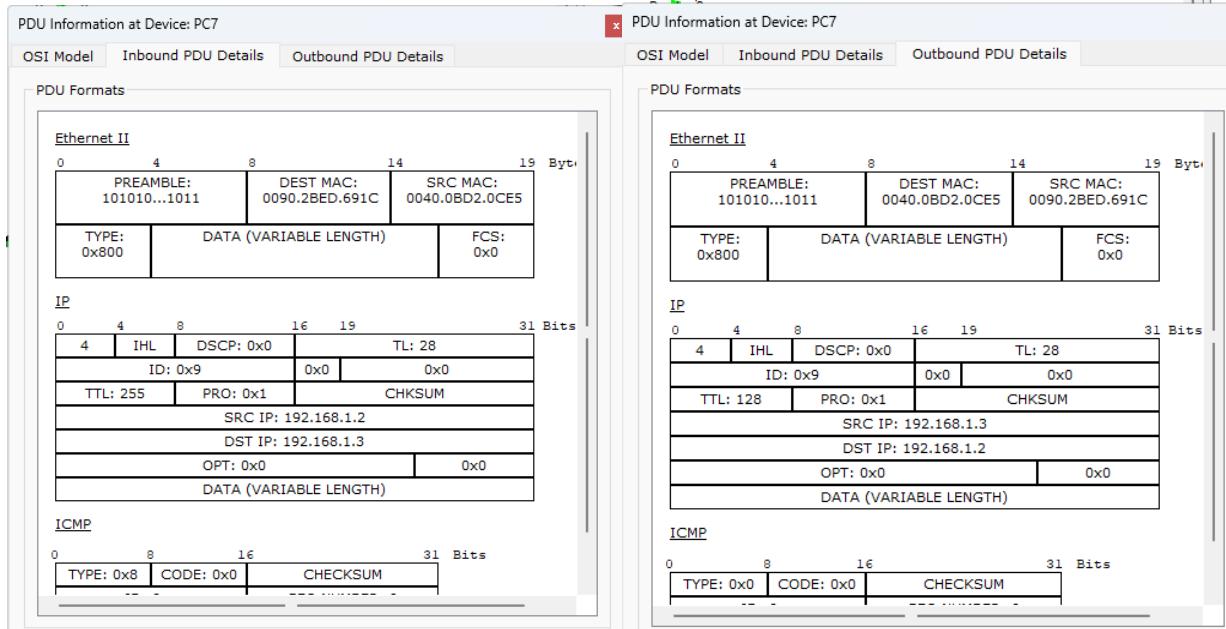
Fire	Last Status	Source	Destination	Type	Color	Time (sec)	Periodic	Num	Edit	Delete
	Successful	Pda0	Laptop1	ICMP		0.000	N	0	(edit)	(delete)

## Program 10: Demonstrate the TTL/ Life of a Packet.

Network diagram:

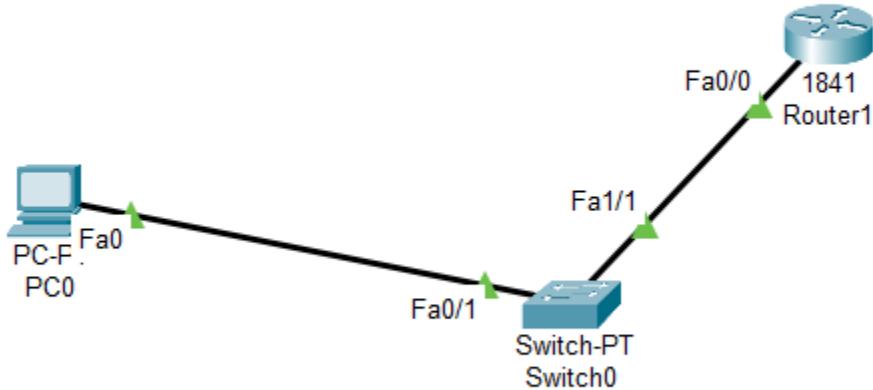


Configuration:



Program 11: To understand the operation of TELNET by accessing the router in server room from a PC in IT office.

Network diagram:



Configuration:

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#enable secret rp
Router(config)#int Fa 0/0
Router(config-if)#int address 192.168.1.1 255.255.255.0
^
% Invalid input detected at '^' marker.

Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#
Router(config-if)#line vty
^
% Invalid input detected at '^' marker.

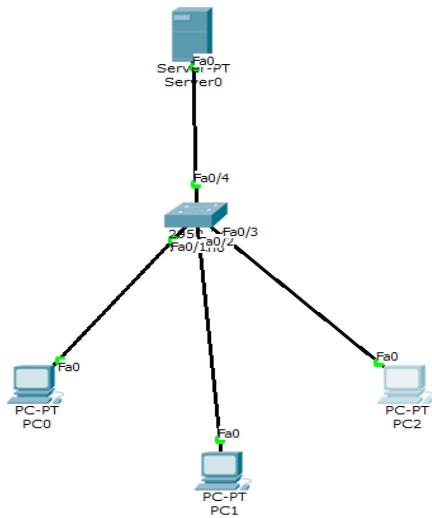
Router(config-if)#line vty
^
% Invalid input detected at '^' marker.

Router(config-if)#line vty
^
% Invalid input detected at '^' marker.

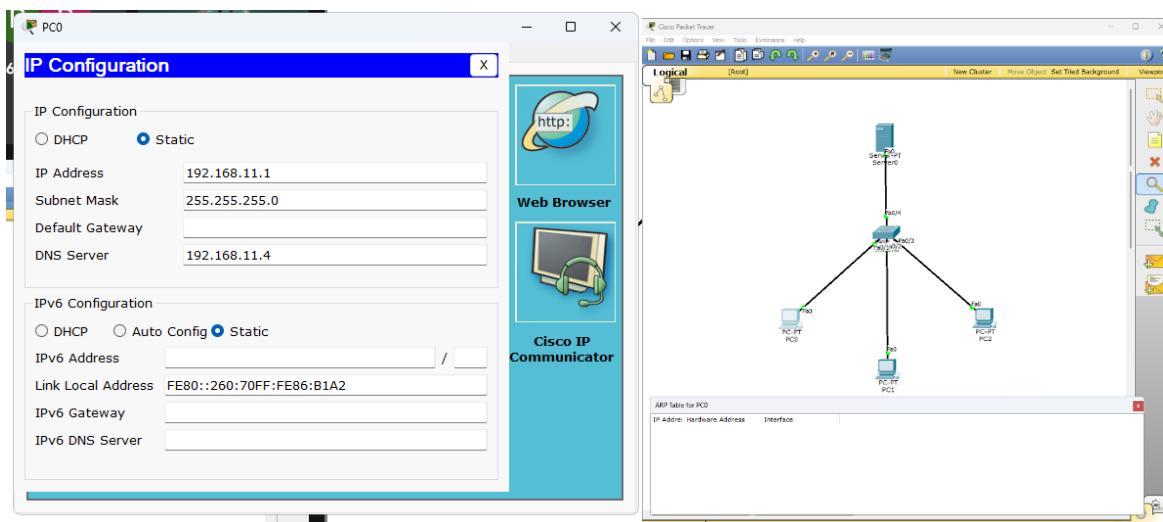
Router(config-if)#exit
Router(config)#line vty
% Incomplete command.
Router(config)#login
% Incomplete command.
Router(config)#enable secret rp
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#enable secret rp
```

Program 12: To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP).

Network diagram:



Configuration:



PC0

Physical Config Desktop Custom Interface

**Command Prompt**

```

Packet Tracer PC Command Line 1.0
PC>ARP -A
  Internet Address      Physical Address      Type
  192.168.11.4          0001.962C.ED36      dynamic

PC>PING 192.168.11.4
Pinging 192.168.11.4 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.11.4:
  Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>

```

PDU Information at Device: PC1

OSI Model Outbound PDU Details

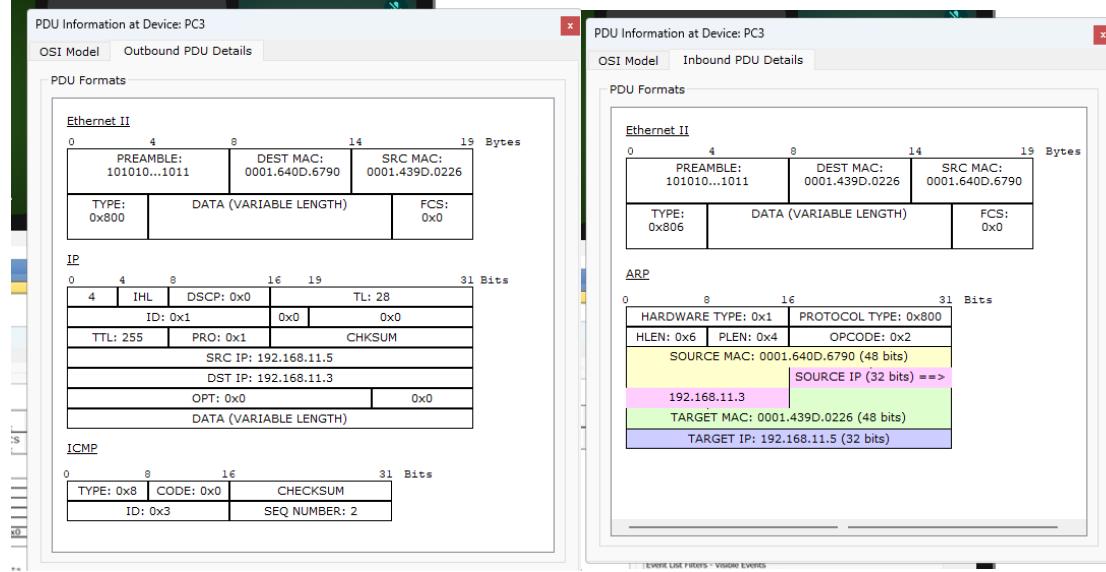
PDU Formats

**Ethernet II**

0	4	8	14	19	Bytes
PREAMBLE: 101010...1011				DEST MAC: FFFF.FFFF.FFFF	SRC MAC: 0001.962C.ED36
TYPE: 0x806				DATA (VARIABLE LENGTH)	
				FCS: 0x0	

**ARP**

0	8	16	31	Bits
HARDWARE TYPE: 0x1   PROTOCOL TYPE: 0x800				
HLEN: 0x6	PLEN: 0x4	OPCODE: 0x1		
SOURCE MAC: 0001.962C.ED36 (48 bits)				
192.168.11.2   SOURCE IP (32 bits) ==>				
TARGET MAC: 0000.0000.0000 (48 bits)				
TARGET IP: 192.168.11.3 (32 bits)				



## PART - B

Program 1: Write a program for congestion control using Leaky bucket algorithm.

Code: #include<stdio.h>

```
int min(int x, int y) {
    return (x < y) ? x : y;
}
int main() {
    int drop = 0, mini, nsec, cap, count = 0, i, inp[25], process;
    printf("Enter the bucket size: ");
    scanf("%d", &cap);
    printf("Enter the processing rate: ");
    scanf("%d", &process);
    printf("Enter the number of seconds you want to simulate: ");
    scanf("%d", &nsec);
    for (i = 0; i < nsec; i++) {
        printf("Enter the size of the packet entering at %d sec: ", i + 1);
        scanf("%d", &inp[i]);
    }
    printf("\n Second | Packet Received | Packet Sent | Packet Left | Dropped \n");
    printf("-----\n");
    for (i = 0; i < nsec; i++) {
        count += inp[i];
        if (count > cap) {
            drop = count - cap;
            count = cap;
        }
        printf("%6d | %15d | ", i + 1, inp[i]);
        mini = min(count, process);
        printf(" %11d | ", mini);

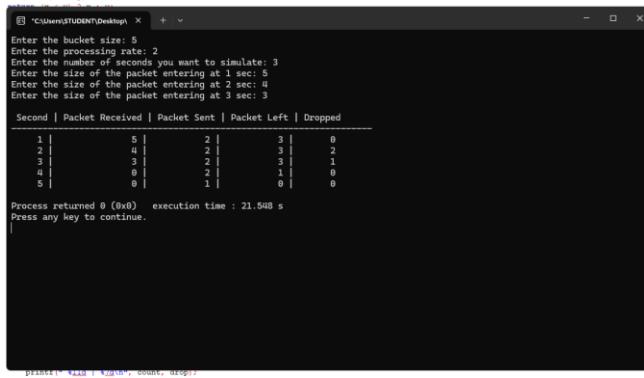
        count -= mini;
        printf(" %11d | %7d\n", count, drop);

        drop = 0;
    }
    while (count != 0) {
        i++;
        if (count > cap) {
            drop = count - cap;
            count = cap;
        }
        printf("%6d | %15d | ", i, 0);
        mini = min(count, process);
        printf(" %11d | ", mini);

        count -= mini;
        printf(" %11d | %7d\n", count, drop);
    }
}
```

```
    }
    return 0;
}
```

**OUTPUT:**



Second	Packet Received	Packet Sent	Packet Left	Dropped
1	5	2	3	0
2	4	2	3	2
3	3	2	3	1
4	0	2	1	0
5	0	1	0	0

```
Process returned 0 (0x0) execution time : 21.548 s
Press any key to continue.
```

Program 2: Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.

Code:

Server:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

int main(int argc, char *argv[])
{
    int sockfd, newsockfd, portno, n;
    char buffer[256], line[2000], filedatal[20000];
    struct sockaddr_in serv, cli;
    socklen_t len;
```

```
FILE *fp;
if (argc < 2) {
    printf("Error: No port number provided.\nUsage: ./server <port>\n");
    exit(1);
}
sockfd = socket(AF_INET, SOCK_STREAM, 0);
if (sockfd < 0) {
    perror("Socket creation failed");
    exit(1);
}
memset(&serv, 0, sizeof(serv));
portno = atoi(argv[1]);
serv.sin_family = AF_INET;
serv.sin_addr.s_addr = INADDR_ANY;
serv.sin_port = htons(portno);
if (bind(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Bind failed");
    exit(1);
}
listen(sockfd, 5);
printf("Server: Waiting for connection...\n");
len = sizeof(cli);
newsockfd = accept(sockfd, (struct sockaddr *)&cli, &len);
if (newsockfd < 0) {
    perror("Accept failed");
    exit(1);
}
```

```
memset(buffer, 0, sizeof(buffer));
n = read(newsockfd, buffer, sizeof(buffer) - 1);
if (n < 0) {
    perror("Error reading file name");
    exit(1);
}
printf("Server received file request: %s\n", buffer);
fp = fopen(buffer, "r");
if (fp == NULL) {
    printf("Server: File not found.\n");
    write(newsockfd, "File not found", 15);
    close(newsockfd);
    close(sockfd);
    return 0;
}
printf("Server: File found. Reading...\n");
memset(filedata, 0, sizeof(filedata));
while (fgets(line, sizeof(line), fp) != NULL) {
    strcat(filedata, line);
}
fclose(fp);
n = write(newsockfd, filedata, strlen(filedata));
if (n < 0)
    perror("Error writing to socket");
printf("Transfer complete.\n");
```

```
    close(newsockfd);
    close(sockfd);
    return 0;
}
```

Client:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

int main(int argc, char *argv[])
{
    int sockfd, portno, n;
    char filename[256], filedata[20000];
    struct sockaddr_in serv;
    if (argc < 2) {
        printf("Error: No port number provided.\nUsage: ./client <port>\n");
        exit(1);
    }
    sockfd = socket(AF_INET, SOCK_STREAM, 0);
    if (sockfd < 0) {
        perror("Socket creation failed");
        exit(1);
    }
    memset(&serv, 0, sizeof(serv));
```

```
portno = atoi(argv[1]);
serv.sin_family = AF_INET;
serv.sin_port = htons(portno);
serv.sin_addr.s_addr = INADDR_ANY; // connecting to same machine
if (connect(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Server not responding");
    exit(1);
}
printf("Enter file path: ");
scanf("%s", filename);
n = write(sockfd, filename, strlen(filename));
if (n < 0)
    perror("Error writing filename");
memset(filedata, 0, sizeof(filedata));
n = read(sockfd, filedata, sizeof(filedata) - 1);
if (n < 0)
    perror("Error reading data from server");
printf("\n--- File Content ---\n%s\n", filedata);
close(sockfd);
return 0;
}
```

Output:

```
$ cc socketserver.c
$ ./a.out 1025
server:
waiting for connection
server received:/home/aps/cse.txt
```

server:/home/aps/cse.txt found

opening and reading..

reading..

..reading complete

transfer complete

\$ cc socketclient.c

\$ ./a.out 1025

Enter the file with complete path

/home/aps/cse.txt

Reading..

..

client: display content of /home/aps/cse.txt

..

Welcome to the CSE department.....

2)

\$ cc fserver.c

\$ ./a.out

error: no port no

usage:

/server port no

\$ cc fclient.c

\$./a.out

Err: no port no.

usage:

./client portno

ex:./client 7777

Program 3: Using UDP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.

Code:

Server:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

int main(int argc, char *argv[])
{
    int sockfd, portno, n;
    char buffer[1024];
    struct sockaddr_in servaddr, cliaddr;
    socklen_t len;

    if (argc < 2) {
        printf("Usage: ./server <port>\n");
        exit(1);
    }

    portno = atoi(argv[1]);
```

```
sockfd = socket(AF_INET, SOCK_DGRAM, 0);
if (sockfd < 0) {
    perror("Socket creation failed");
    exit(1);
}

memset(&servaddr, 0, sizeof(servaddr));
memset(&cliaddr, 0, sizeof(cliaddr));

servaddr.sin_family = AF_INET;
servaddr.sin_addr.s_addr = INADDR_ANY;
servaddr.sin_port = htons(portno);

if (bind(sockfd, (struct sockaddr *)&servaddr, sizeof(servaddr)) < 0) {
    perror("Bind failed");
    exit(1);
}

printf("UDP Server: Waiting for data...\n");

len = sizeof(cliaddr);
memset(buffer, 0, sizeof(buffer));

n = recvfrom(sockfd, buffer, sizeof(buffer)-1, 0,
             (struct sockaddr *)&cliaddr, &len);
if (n < 0) {
    perror("Receive failed");
```

```
    exit(1);

}

printf("Received from client: %s\n", buffer);

// Echo back the same data
n = sendto(sockfd, buffer, strlen(buffer), 0,
           (struct sockaddr *)&cliaddr, len);
if (n < 0)
    perror("Send failed");

close(sockfd);
return 0;
}
```

Client:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

int main(int argc, char *argv[])
{
    int sockfd, portno, n;
    char buffer[1024];
```

```
struct sockaddr_in servaddr;
socklen_t len;

if (argc < 2) {
    printf("Usage: ./client <port>\n");
    exit(1);
}

portno = atoi(argv[1]);

sockfd = socket(AF_INET, SOCK_DGRAM, 0);
if (sockfd < 0) {
    perror("Socket creation failed");
    exit(1);
}

memset(&servaddr, 0, sizeof(servaddr));

servaddr.sin_family = AF_INET;
servaddr.sin_port = htons(portno);
servaddr.sin_addr.s_addr = INADDR_ANY; // local machine

printf("Enter message to send: ");
scanf("%[^\\n]", buffer);

len = sizeof(servaddr);
```

```
n = sendto(sockfd, buffer, strlen(buffer), 0,
           (struct sockaddr *)&servaddr, len);
if (n < 0) {
    perror("Send failed");
    exit(1);
}

memset(buffer, 0, sizeof(buffer));

n = recvfrom(sockfd, buffer, sizeof(buffer)-1, 0,
             (struct sockaddr *)&servaddr, &len);
if (n < 0) {
    perror("Receive failed");
    exit(1);
}

printf("Server replied: %s\n", buffer);
close(sockfd);
return 0;
}
```

Output:

1)

UDP Server: Waiting for data...

Received from client: Hello UDP Server!

2)

Enter message to send: Hello UDP Server!

Server replied: Hello UDP Server!

Program 4: Write a program for error detecting code using CRC-CCITT (16-bits).

```
Code: #include <stdio.h>
#include <string.h>
#include <stdlib.h>

int main() {
    char rem[50], a[50], s[50], c, msj[50], gen[30];
    int i, genlen, t, j, flag = 0, k, n;

    printf("Enter the generator polynomial: ");
    fgets(gen, sizeof(gen), stdin);
    gen[strcspn(gen, "\n")] = '\0';
    printf("Generator polynomial is CRC: %s\n", gen);

    genlen = strlen(gen);
    k = genlen - 1;

    printf("Enter the message: ");
    n = 0;
    while ((c = getchar()) != '\n') {
        msj[n] = c;
        n++;
    }
    msj[n] = '\0';

    for (i = 0; i < n; i++) {
        a[i] = msj[i];
    }
    for (i = 0; i < k; i++) {
        a[n + i] = '0';
    }
    a[n + k] = '\0';

    printf("\nMessage polynomial appended with zeros:\n");
    puts(a);

    for (i = 0; i < n; i++) {
        if (a[i] == '1') {
            t = i;
            for (j = 0; j <= k; j++) {
                a[t] = (a[t] == gen[j]) ? '0' : '1';
                t++;
            }
        }
    }

    for (i = 0; i < k; i++) {
        rem[i] = a[n + i];
    }
```

```

rem[k] = '\0';

printf("The checksum appended:\n");
puts(rem);
printf("\nThe message with checksum appended:\n");
for (i = 0; i < n; i++) {
    a[i] = msg[i];
}
for (i = 0; i < k; i++) {
    a[n + i] = rem[i];
}
a[n + k] = '\0';
puts(a);

n = 0;
printf("Enter the received message: ");
while ((c = getchar()) != '\n') {
    s[n] = c;
    n++;
}
s[n] = '\0';
for (i = 0; i < n; i++) {
    if (s[i] == '1') {
        t = i;
        for (j = 0; j <= k; j++, t++) {
            s[t] = (s[t] == gen[j]) ? '0' : '1';
        }
    }
}

for (i = 0; i < k; i++) {
    rem[i] = s[n + i];
}
rem[k] = '\0';
for (i = 0; i < k; i++) {
    if (rem[i] == '1') {
        flag = 1;
    }
}

if (flag == 0) {
    printf("Received polynomial is error-free.\n");
} else {
    printf("Received polynomial has an error.\n");
}

return 0;
}

```

OUTPUT:

```
Enter the generator polynomial: 10011
Generator polynomial is CRC: 10011
Enter the message: 1101011011

Message polynomial appended with zeros:
11010110110000
The checksum appended:
1110

The message with checksum appended:
11010110111110
Enter the received message: 11010110111110
Received polynomial is error-free.

Process returned 0 (0x0)  execution time : 20.417 s
Press any key to continue.
|
```