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

Lab Record

Computer Networks – 23CS5PCCON

Submitted in partial fulfillment for the 5th Semester Laboratory

Bachelor of Engineering
in
Computer Science and Engineering

Submitted by:

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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 Bramha Anilkumar Bajannavar (1BM23CS071) during the 5th Semester August 2025-December 2025

Signature of the Faculty Incharge:

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Assistant Professor
Department of Computer Science and Engineering
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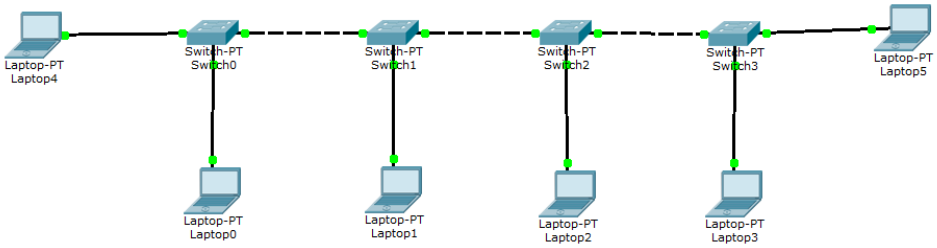
PART - A

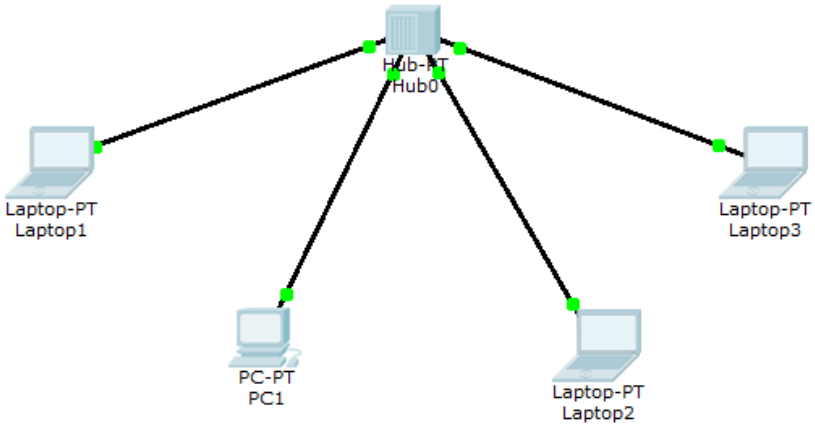
Program 1: Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping message.

Network diagram:

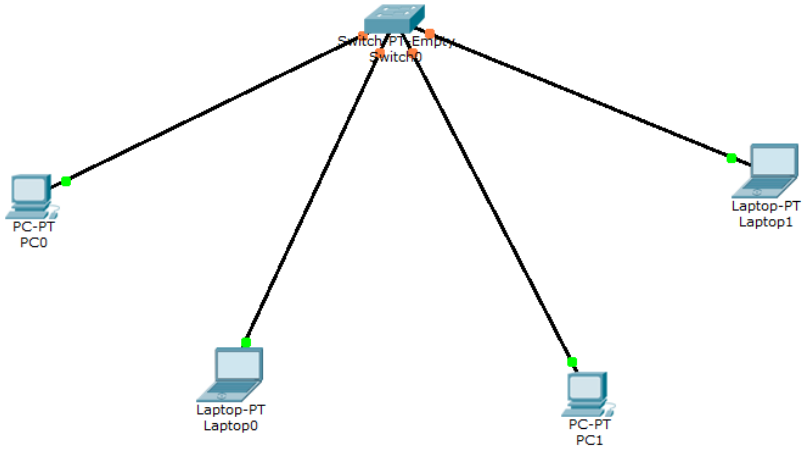
Bus



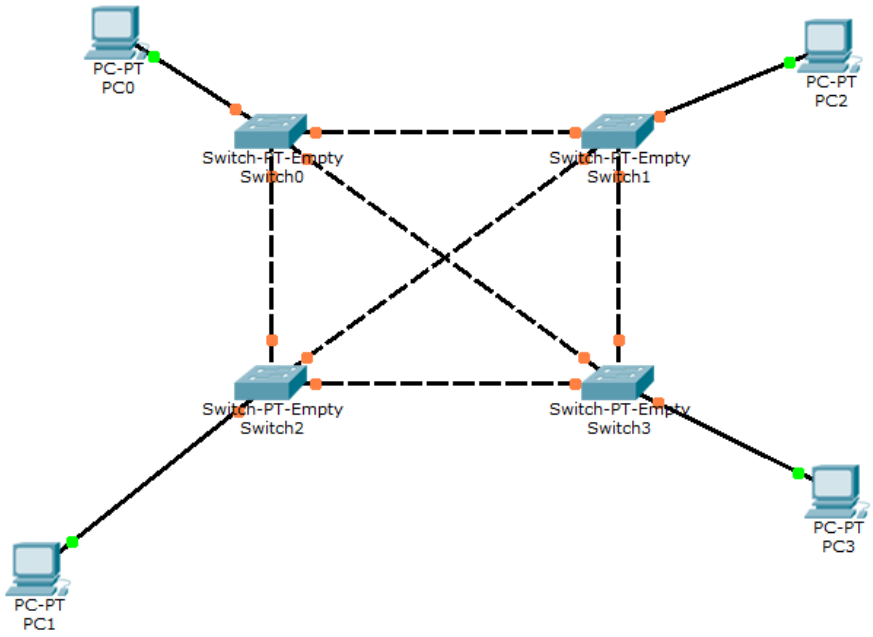
Hub



Switch

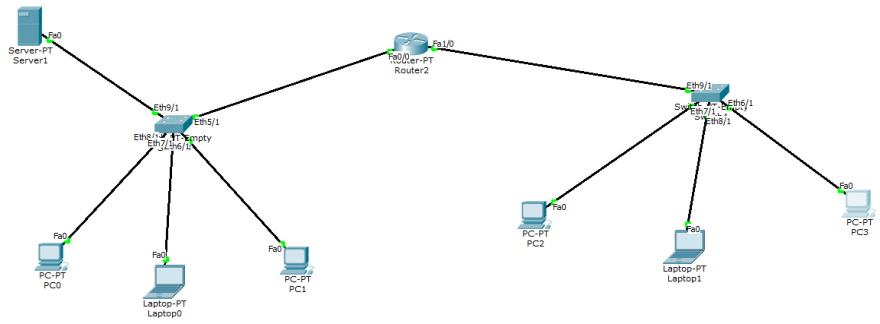

Switch-PT-Empty
Switch0
PC-PT
PC0
Laptop-PT
Laptop1
Laptop-PT
Laptop0
PC-PT
PC1

Mesh

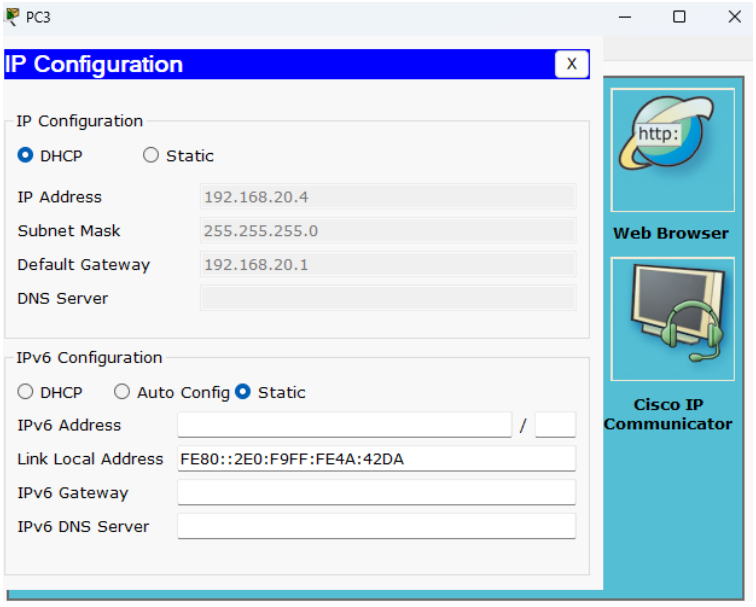

PC-PT
PC0
PC-PT
PC2
Switch-PT-Empty
Switch0
Switch-PT-Empty
Switch1
Switch-PT-Empty
Switch2
Switch-PT-Empty
Switch3
PC-PT
PC3
PC-PT
PC1

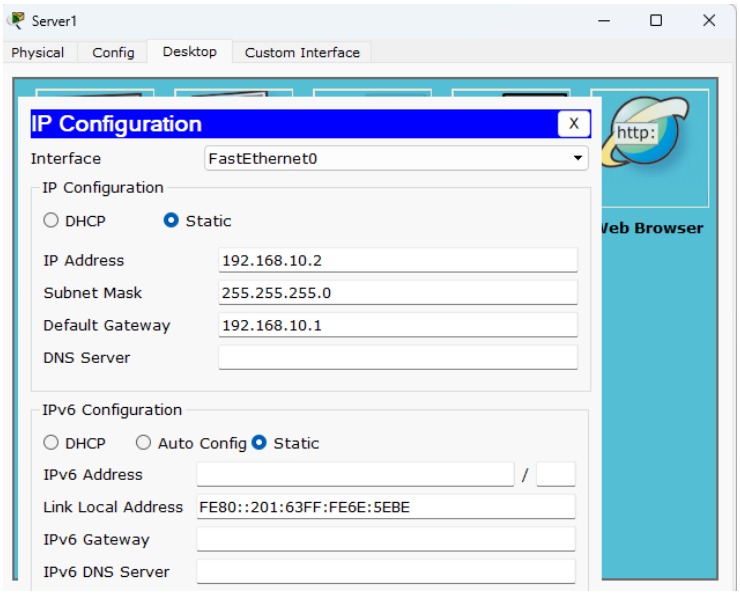
Program 2: Configure DHCP within a LAN and outside LAN.

Network diagram:



Configuration:

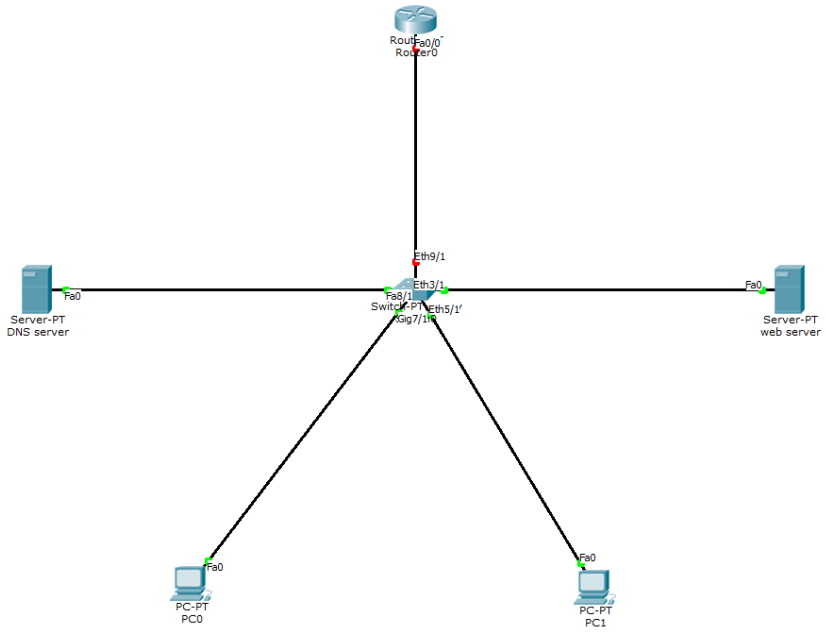




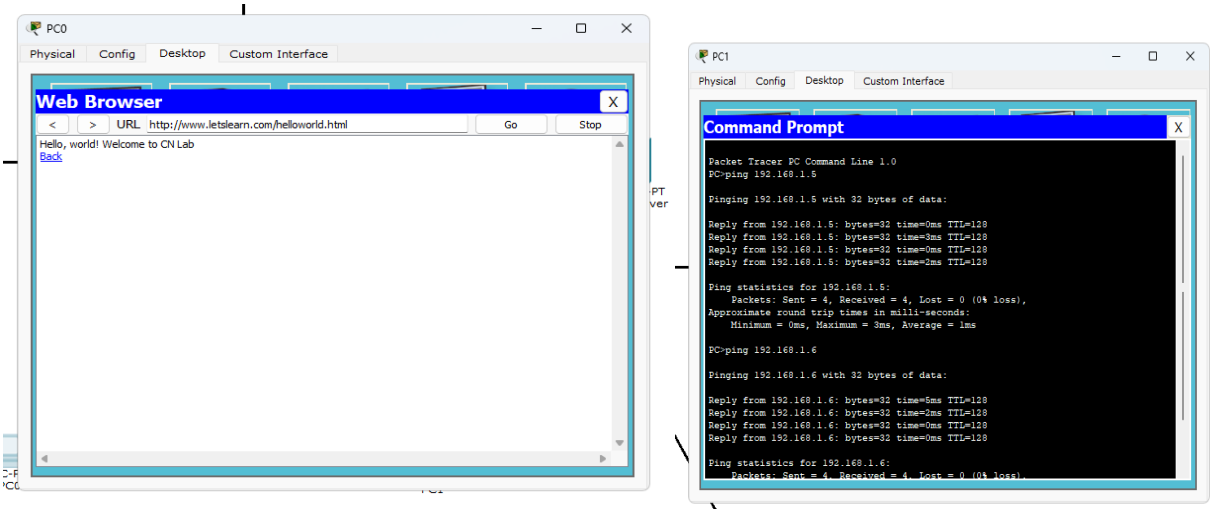
```
PT 1001 (PTSC2005) processor (revision 0x200) with 60416K/5120K bytes of memory
.
Processor board ID PT0123 (0123)
PT2005 processor: part number 0, mask 01
Bridging software.
X.25 software, Version 3.0.0.
4 FastEthernet/IEEE 802.3 interface(s)
2 Low-speed serial(sync/async) network interface(s)
32K 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 t
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 t
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:

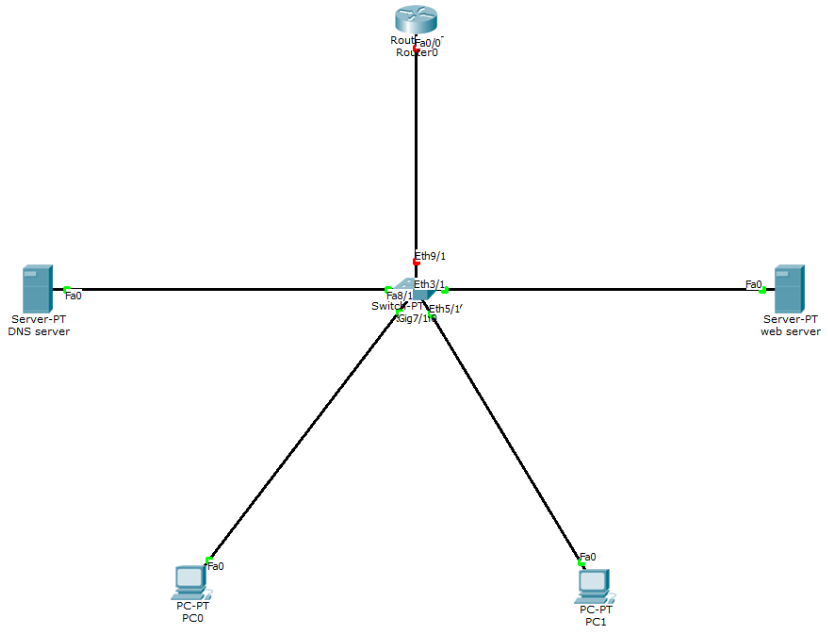


Configuration:



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

Network diagram:



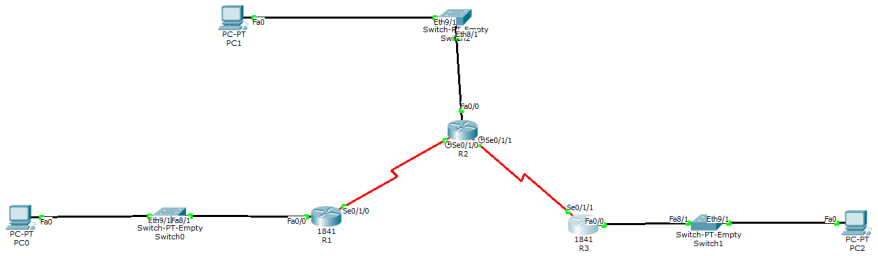
Configuration:

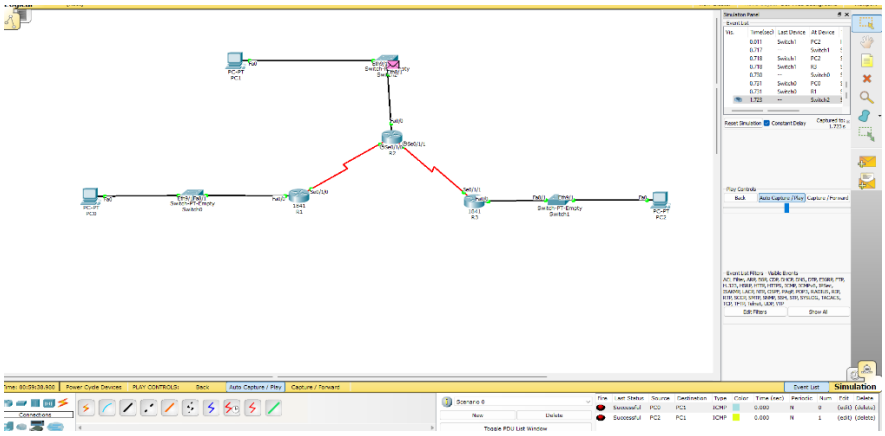
```
PC>ping 192.168.1.101

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),

PC>
```

```
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

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
```

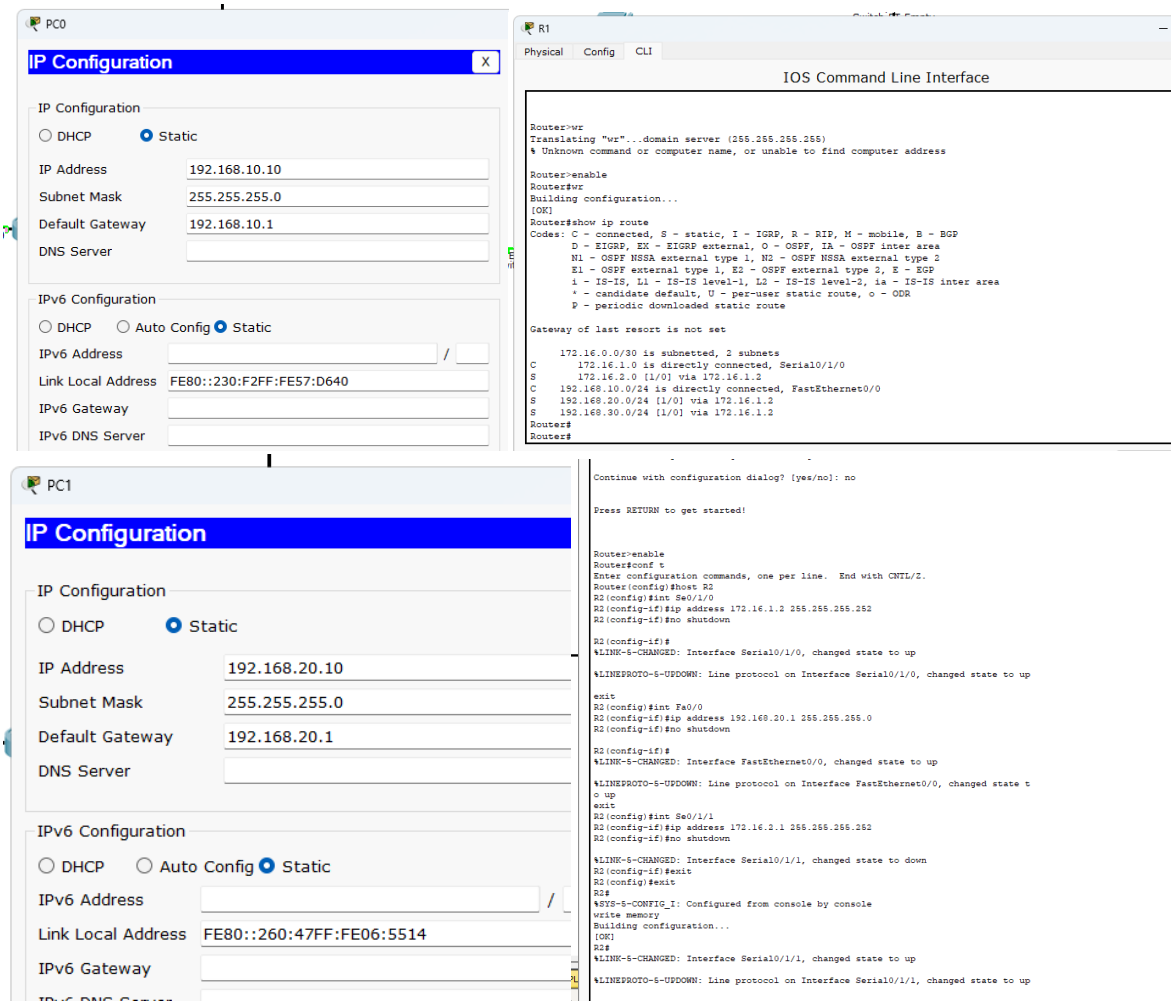
Program 5: Configure default route, static route to the Router.

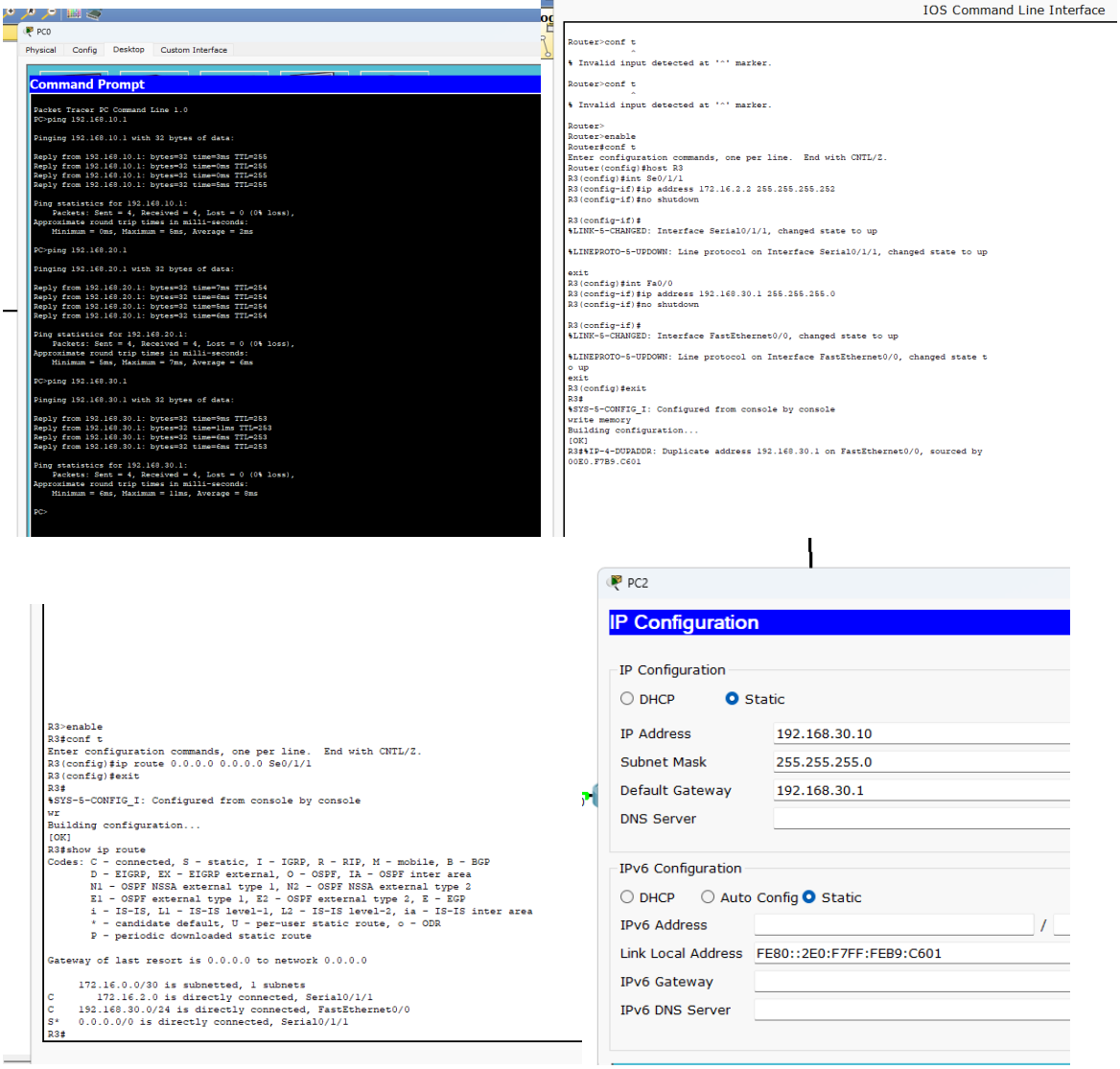
Network diagram:





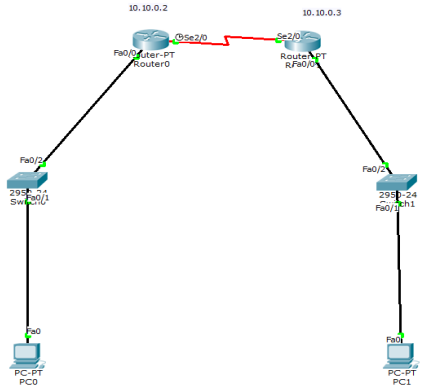
Configuration:



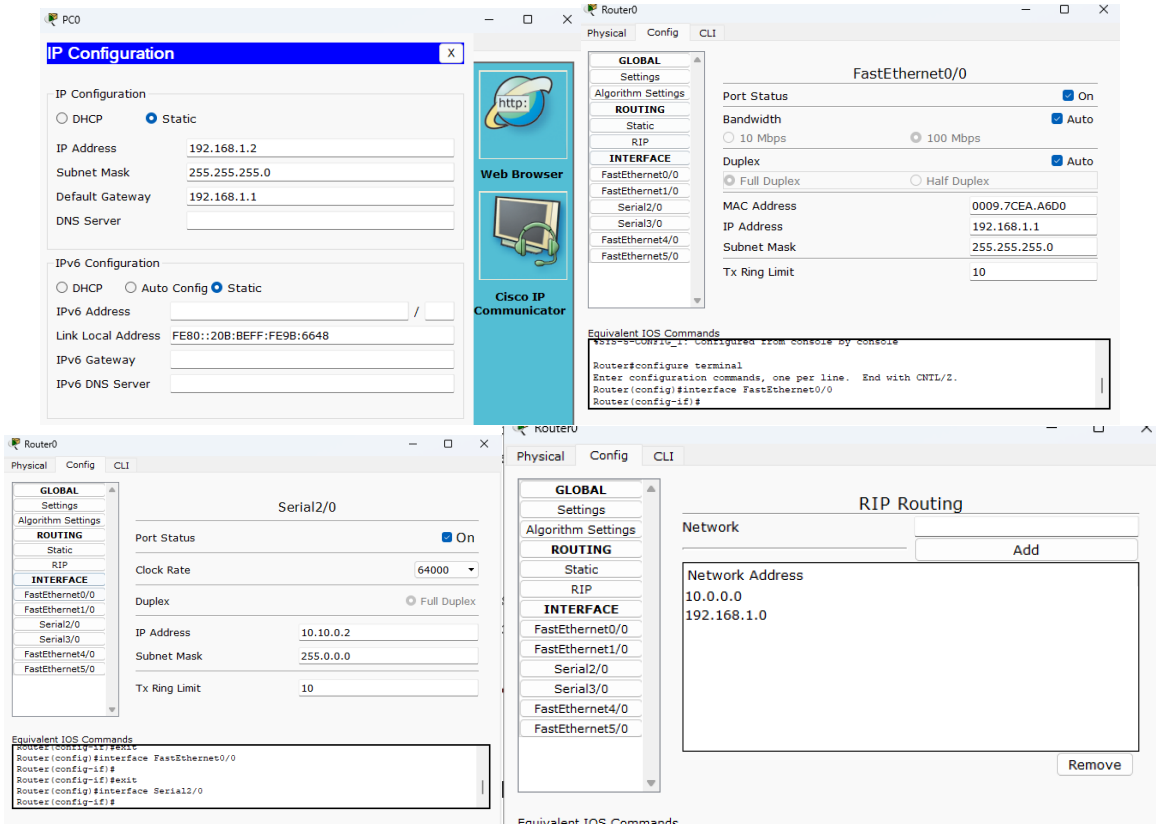

PC0
Physical
Config
Desktop
Custom Interface
Command Prompt
Packet Tracer PC Command Line 1.0
PC>ping 192.168.10.1
Pinging 192.168.10.1 with 32 bytes of data:
Reply from 192.168.10.1: bytes=32 time=3ms TTL=255
Reply from 192.168.10.1: bytes=32 time=0ms TTL=255
Reply from 192.168.10.1: bytes=32 time=0ms TTL=255
Reply from 192.168.10.1: bytes=32 time=5ms TTL=255
Ping statistics for 192.168.10.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 5ms, Average = 2ms
PC>ping 192.168.20.1
Pinging 192.168.20.1 with 32 bytes of data:
Reply from 192.168.20.1: bytes=32 time=7ms TTL=254
Reply from 192.168.20.1: bytes=32 time=6ms TTL=254
Reply from 192.168.20.1: bytes=32 time=5ms TTL=254
Reply from 192.168.20.1: bytes=32 time=6ms TTL=254
Ping statistics for 192.168.20.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 5ms, Maximum = 7ms, Average = 6ms
PC>ping 192.168.30.1
Pinging 192.168.30.1 with 32 bytes of data:
Reply from 192.168.30.1: bytes=32 time=9ms TTL=253
Reply from 192.168.30.1: bytes=32 time=11ms TTL=253
Reply from 192.168.30.1: bytes=32 time=6ms TTL=253
Reply from 192.168.30.1: bytes=32 time=6ms TTL=253
Ping statistics for 192.168.30.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 6ms, Maximum = 11ms, Average = 8ms
PC>
R3
Physical
Config
CLI
IOS Command Line Interface
Router>conf t
% Invalid input detected at '^' marker.
Router>conf t
% Invalid input detected at '^' marker.
Router>
Router>enable
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#host R3
R3(config)#int Se0/1/1
R3(config-if)#ip address 172.16.2.2 255.255.255.252
R3(config-if)#no shutdown
R3(config-if)#
%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
exit
R3(config)#int Fa0/0
R3(config-if)#ip address 192.168.30.1 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state t
o up
exit
R3(config)#exit
R3#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
R3#%IP-4-DUPADDR: Duplicate address 192.168.30.1 on FastEthernet0/0, sourced by
00E0.F7B9.C601
R3>enable
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#ip 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
wr
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#
PC2
IP Configuration
IP Configuration
DHCP
Static
IP Address
192.168.30.10
Subnet Mask
255.255.255.0
Default Gateway
192.168.30.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::2E0:F7FF:FEB9:C601
IPv6 Gateway
IPv6 DNS Server

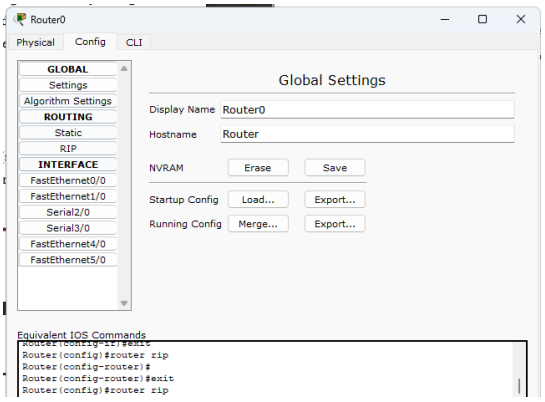
Program 6: Configure RIP routing Protocol in Routers.

Network diagram:



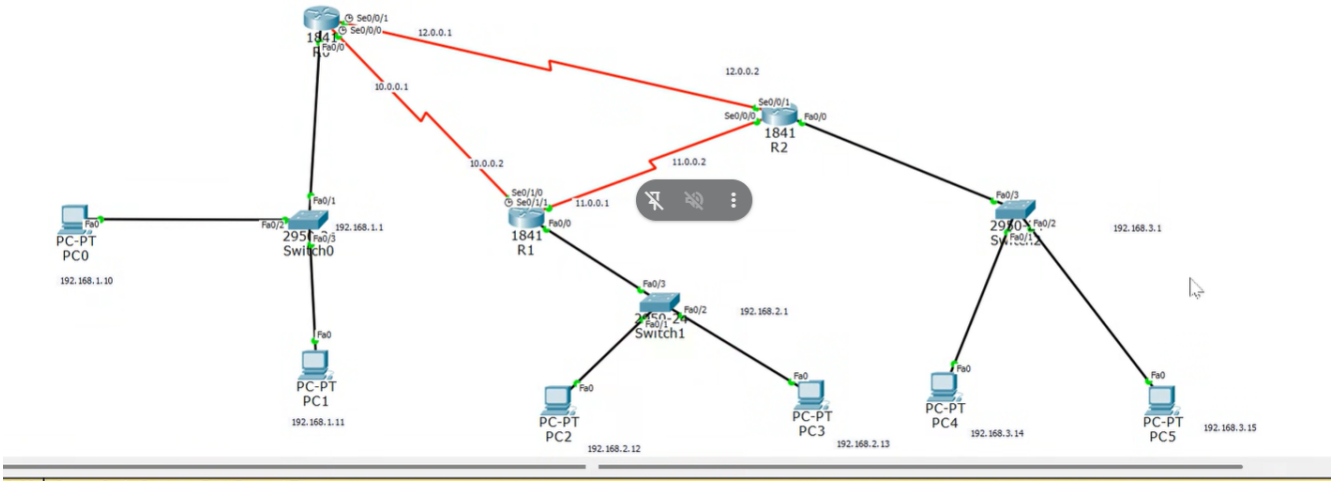
Configuration:





Program 7: Configure OSPF routing protocol.

Network diagram:



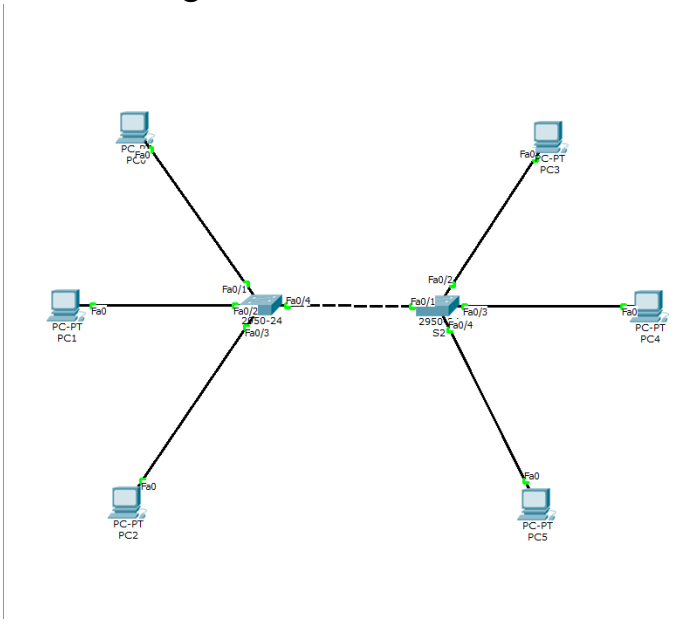
Configuration:

```
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 ospfl
                      ^
% Invalid input detected at '^' marker.

Router(config)#router ospf 1
Router(config-router)#
```

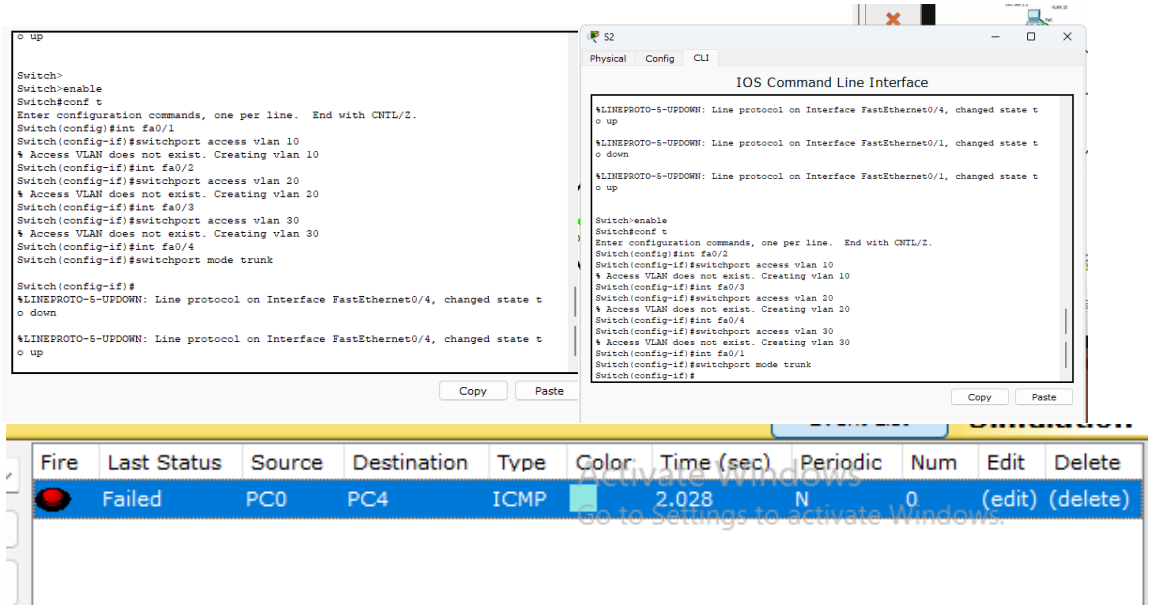
```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial3/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial3/0
Router(config-if)#ip address 11.0.0.1 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface Serial3/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to up
exit
Router(config)#enable
% 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 192.168.2.0 0.0.0.255 area 0
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 11.0.0.0 0.255.255.255 area 0
                                                      ^
% Invalid input detected at '^' marker.

Router(config-router)#network 11.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
wr
Building configuration...
[OK]
Router#
00:10:31: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on Serial3/0 from LOADING t
o FULL, Loading Done
```

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

Network diagram:

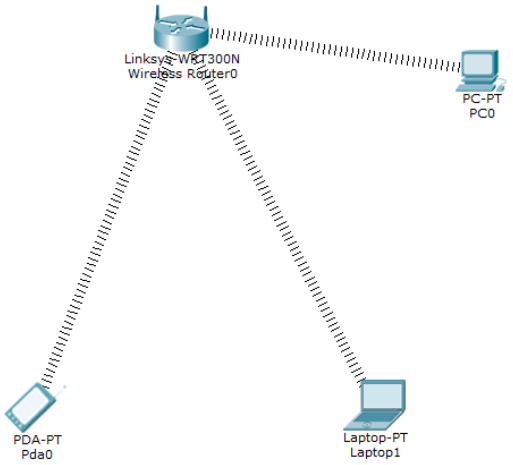


Configuration:

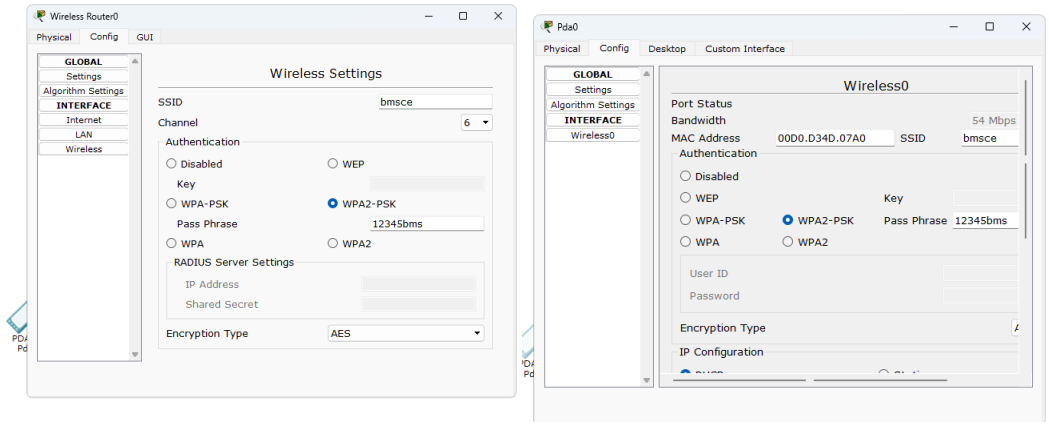


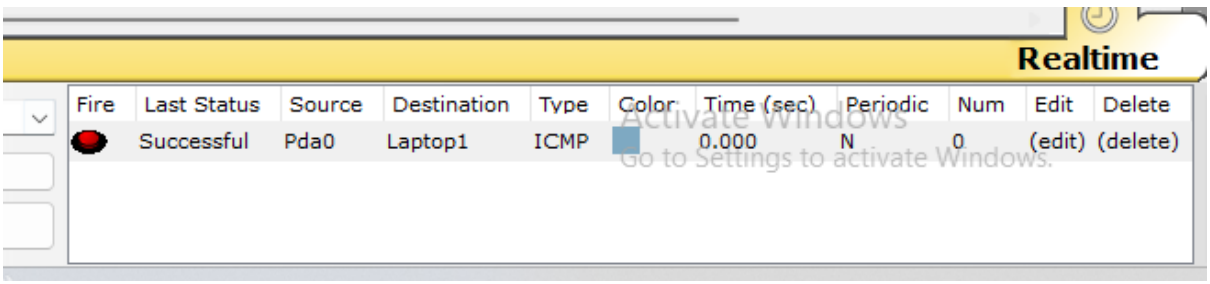
Program 9: To construct a WLAN and make the nodes communicate wirelessly.

Network diagram:



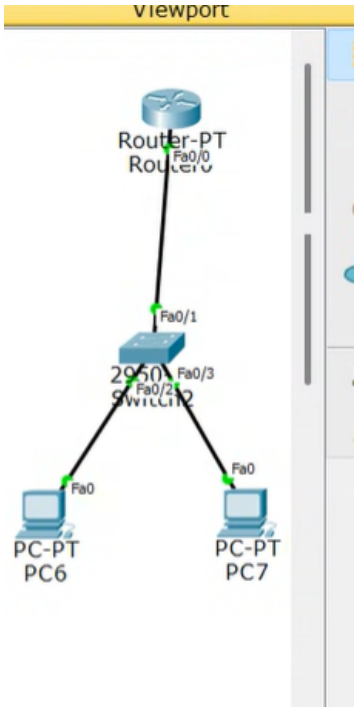
Configuration:



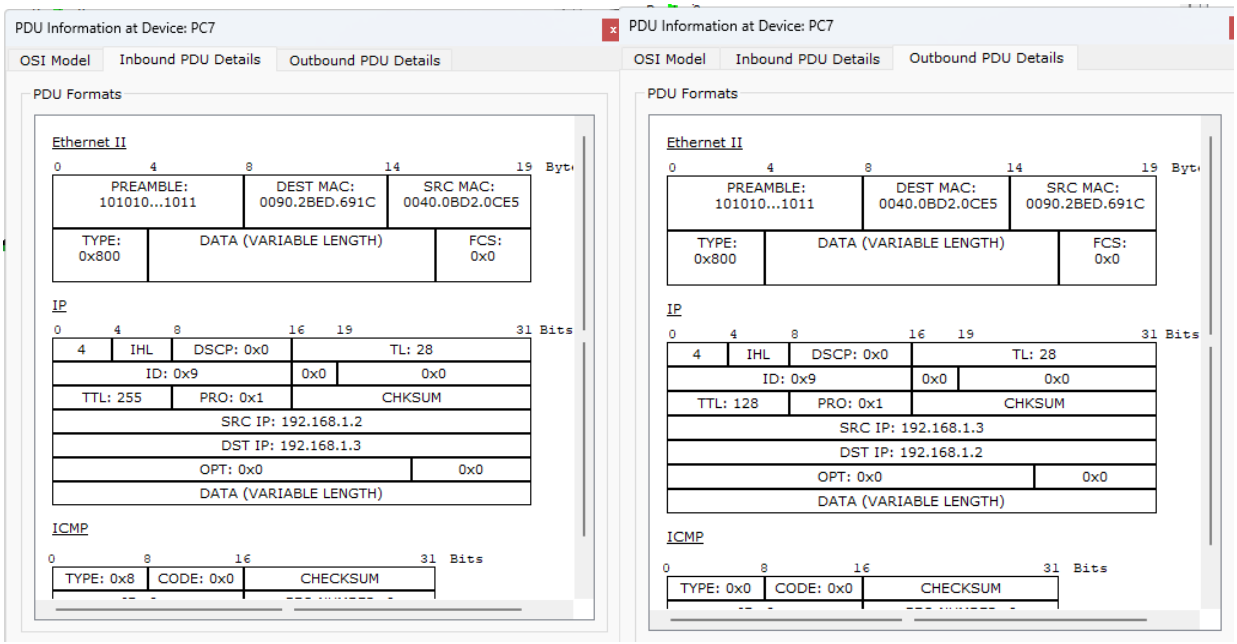


Program 10: Demonstrate the TTL/ Life of a Packet.

Network diagram:

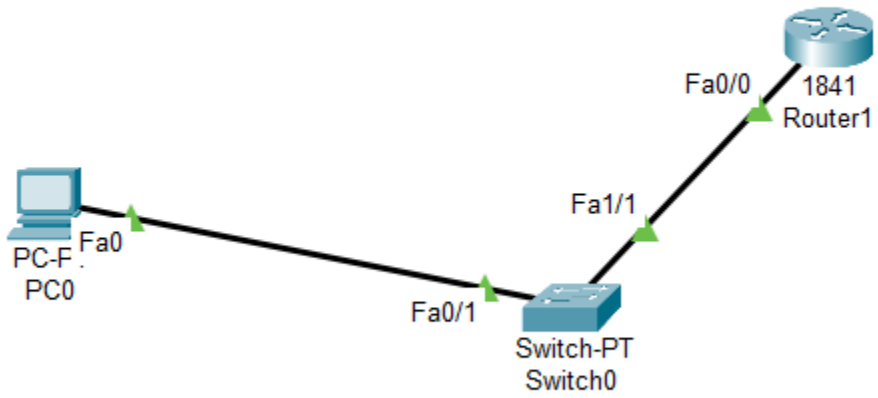


Configuration:



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

Network diagram:

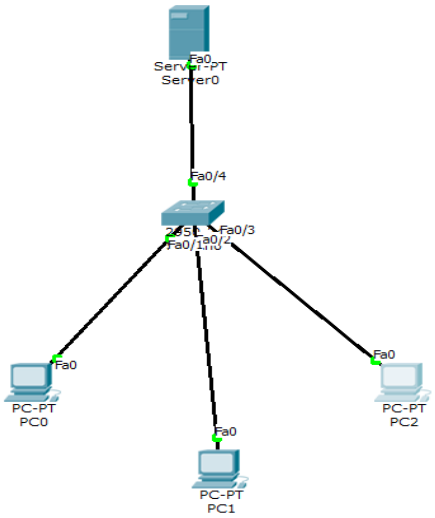


Configuration:

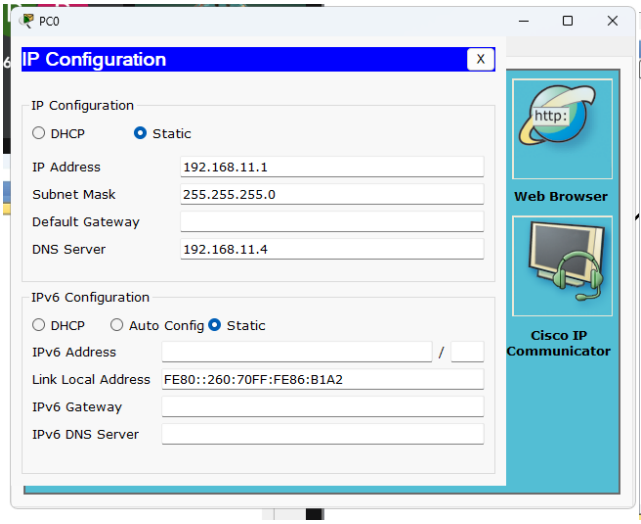
```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#enable secret rp
Router(config)#int Fa 0/0
Router(config-if)#int address 192.168.1.1 255.255.255.0
                   ^
% Invalid input detected at '^' marker.

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)#ine 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
```

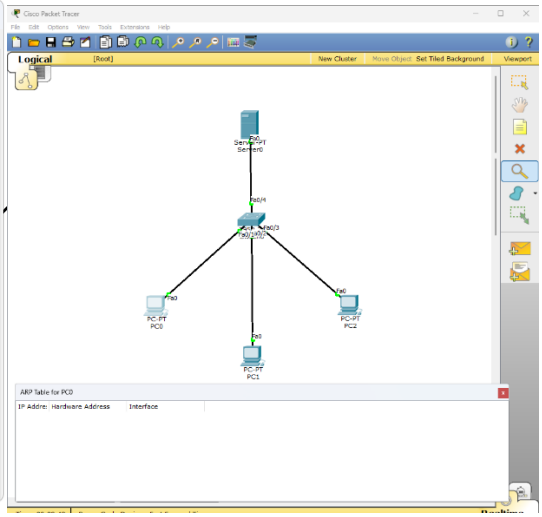
Program 12: To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP).

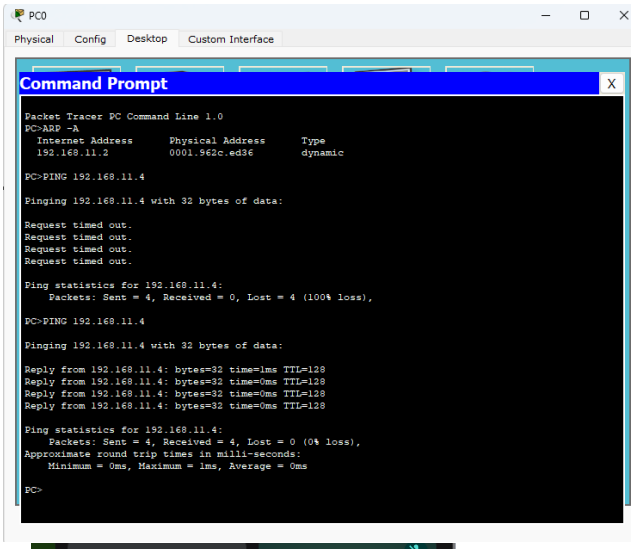
Network diagram:

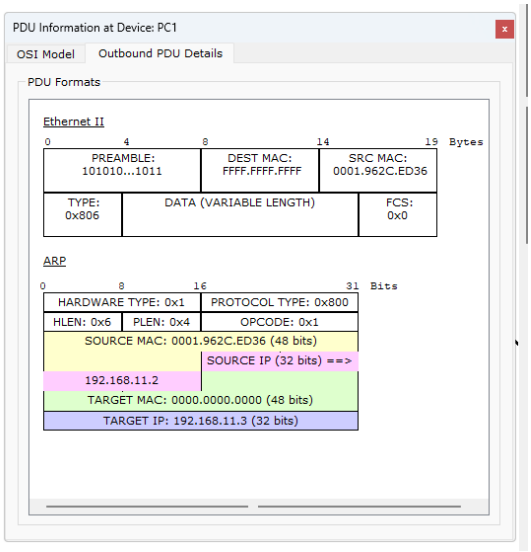


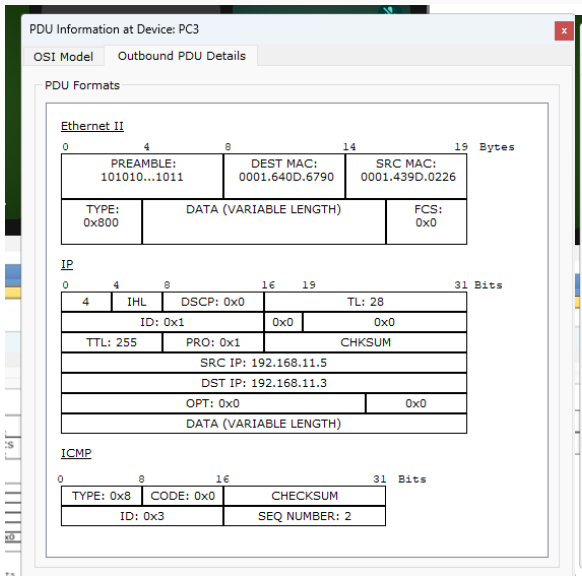
Configuration:

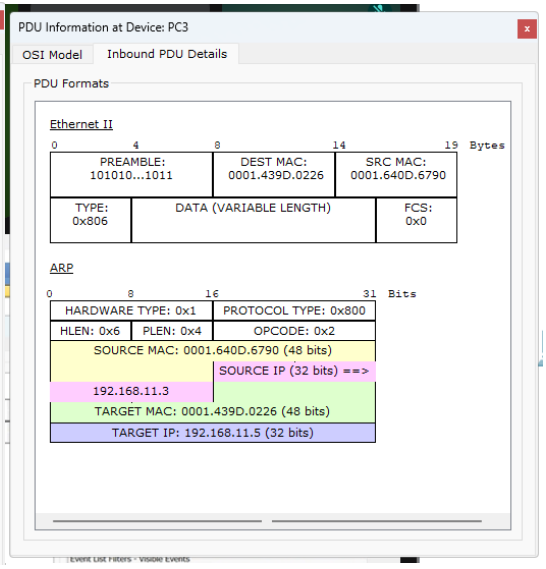





PC0
Physical
Config
Desktop
Custom Interface
Command Prompt
Packet Tracer PC Command Line 1.0
PC>ARP -A
Internet Address Physical Address Type
192.168.11.2 0001.962c.ed36 dynamic
PC>PING 192.168.11.4
Pinging 192.168.11.4 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Ping statistics for 192.168.11.4:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
PC>PING 192.168.11.4
Pinging 192.168.11.4 with 32 bytes of data:
Reply from 192.168.11.4: bytes=32 time=1ms TTL=128
Reply from 192.168.11.4: bytes=32 time=0ms TTL=128
Reply from 192.168.11.4: bytes=32 time=0ms TTL=128
Reply from 192.168.11.4: bytes=32 time=0ms TTL=128
Ping statistics for 192.168.11.4:
Packets: Sent = 4, Received = 4, Lost = 0 (0% 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)
SOURCE IP (32 bits) ==>
192.168.11.2
TARGET MAC: 0000.0000.0000 (48 bits)
TARGET IP: 192.168.11.3 (32 bits)


PDU Information at Device: PC3
OSI Model
Outbound PDU Details
PDU Formats
Ethernet II
0 4 8 14 19 Bytes
PREAMBLE: 101010...1011
DEST MAC: 0001.640D.6790
SRC MAC: 0001.439D.0226
TYPE: 0x800
DATA (VARIABLE LENGTH)
FCS: 0x0
IP
0 4 8 16 19 31 Bits
4
IHL
DSCP: 0x0
TL: 28
ID: 0x1
0x0
0x0
TTL: 255
PRO: 0x1
CHKSUM
SRC IP: 192.168.11.5
DST IP: 192.168.11.3
OPT: 0x0
0x0
DATA (VARIABLE LENGTH)
ICMP
0 8 16 31 Bits
TYPE: 0x8
CODE: 0x0
CHECKSUM
ID: 0x3
SEQ NUMBER: 2


PDU Information at Device: PC3
OSI Model
Inbound PDU Details
PDU Formats
Ethernet II
0 4 8 14 19 Bytes
PREAMBLE: 101010...1011
DEST MAC: 0001.439D.0226
SRC MAC: 0001.640D.6790
TYPE: 0x806
DATA (VARIABLE LENGTH)
FCS: 0x0
ARP
0 8 16 31 Bits
HARDWARE TYPE: 0x1
PROTOCOL TYPE: 0x800
HLEN: 0x6
PLEN: 0x4
OPCODE: 0x2
SOURCE MAC: 0001.640D.6790 (48 bits)
SOURCE IP (32 bits) ==>
192.168.11.3
TARGET MAC: 0001.439D.0226 (48 bits)
TARGET IP: 192.168.11.5 (32 bits)

PART - B

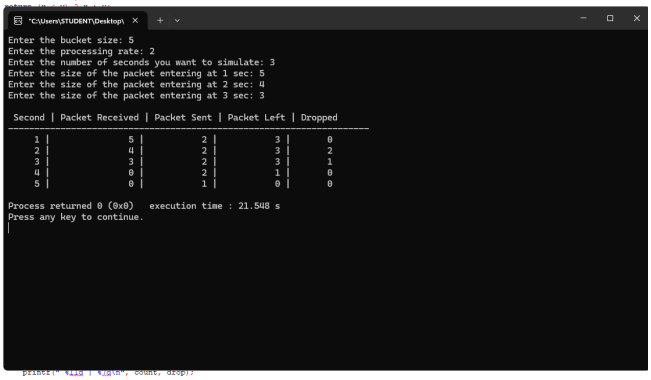
Program 1: Write a program for congestion control using Leaky bucket algorithm.

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:



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], filedata[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] = msj[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.
```