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:

DHARUNYA BALAVELAVAN

(1BM23CS090)

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 Dharunya Balavelavan (1BM23CS090) during the 5th Semester August 2025-December 2025.

Signature of the Faculty Incharge:

Sarala D V
Assistant Professor

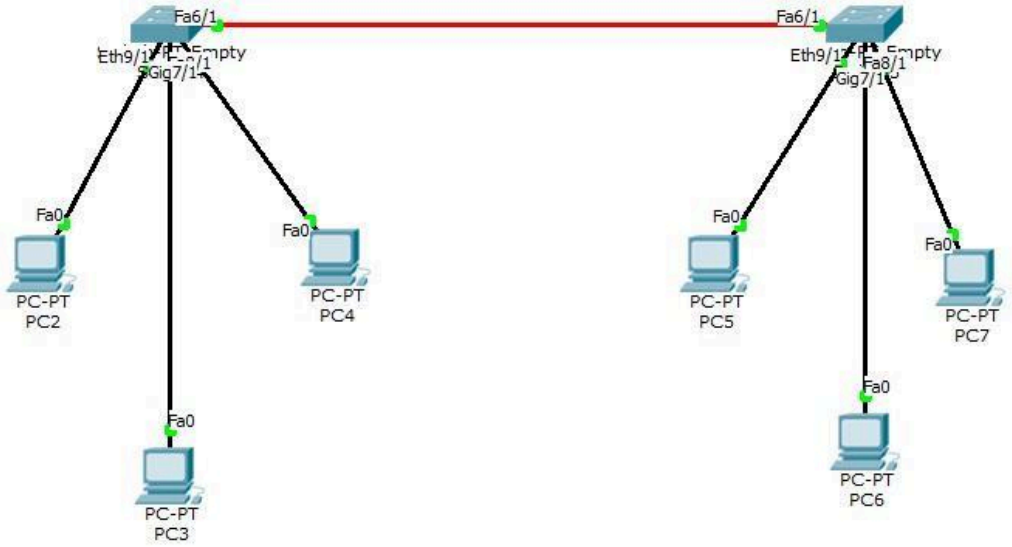
Department of Computer Science and Engineering

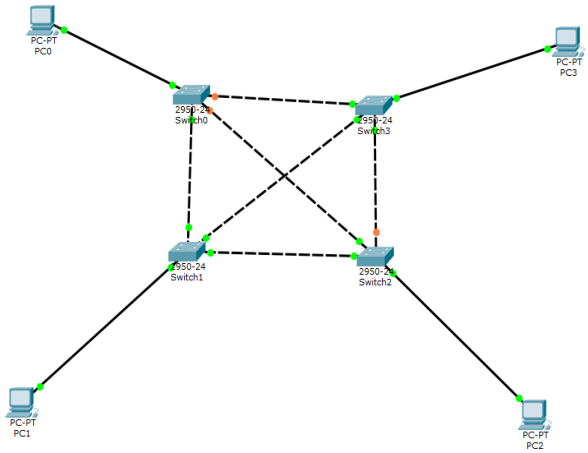
Table of Contents

PART - A

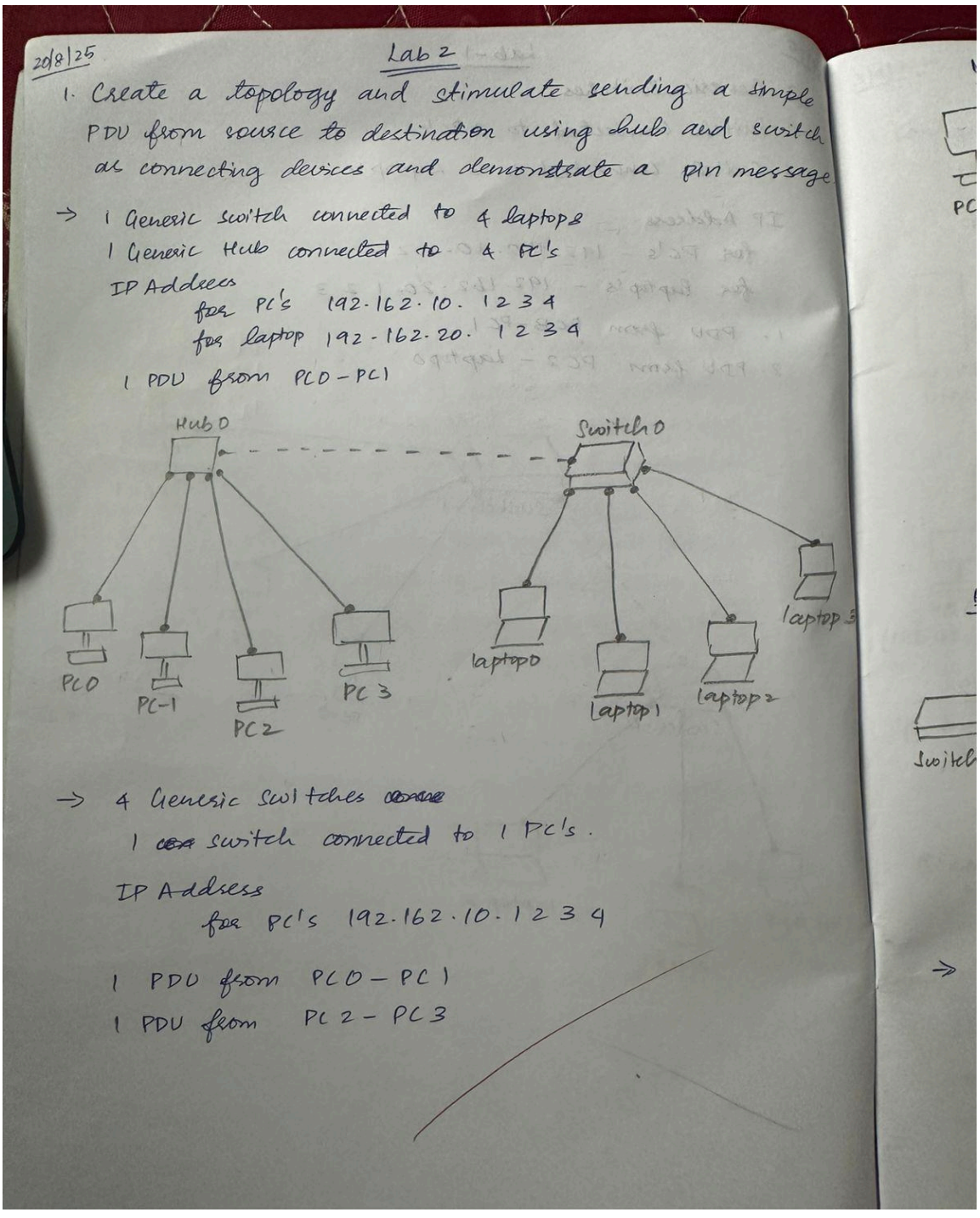
Program 1: Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping messages.

Network diagram:



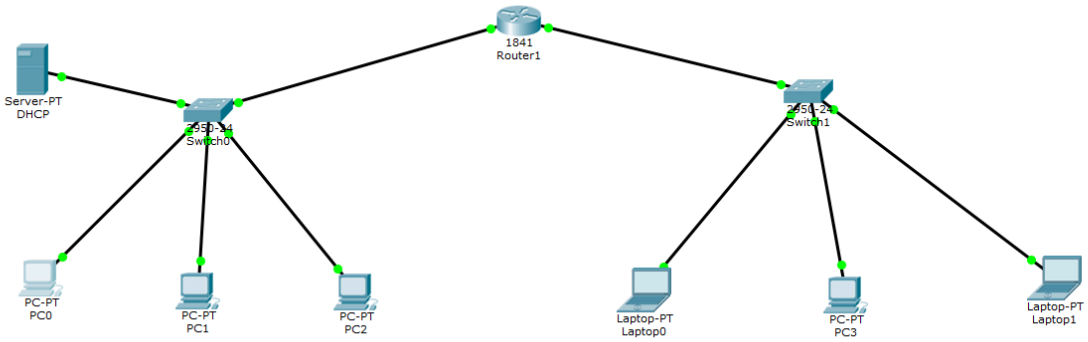


Configuration:

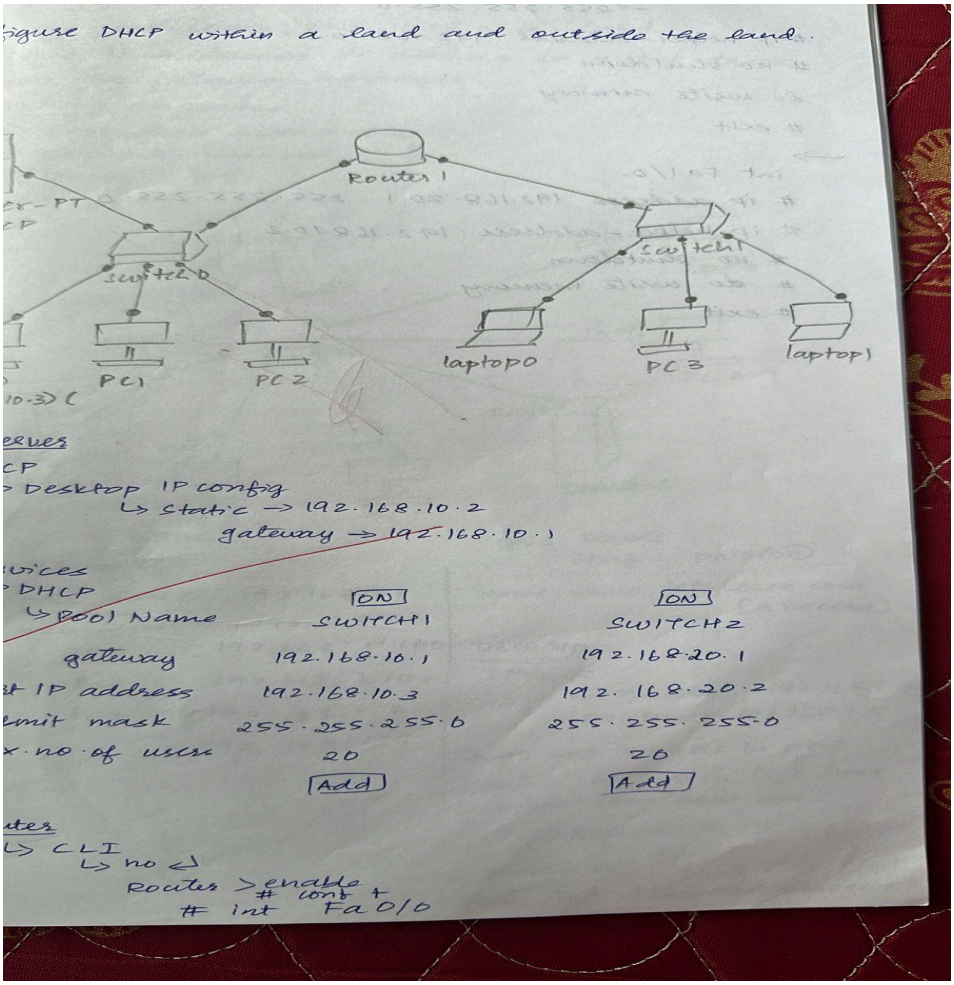


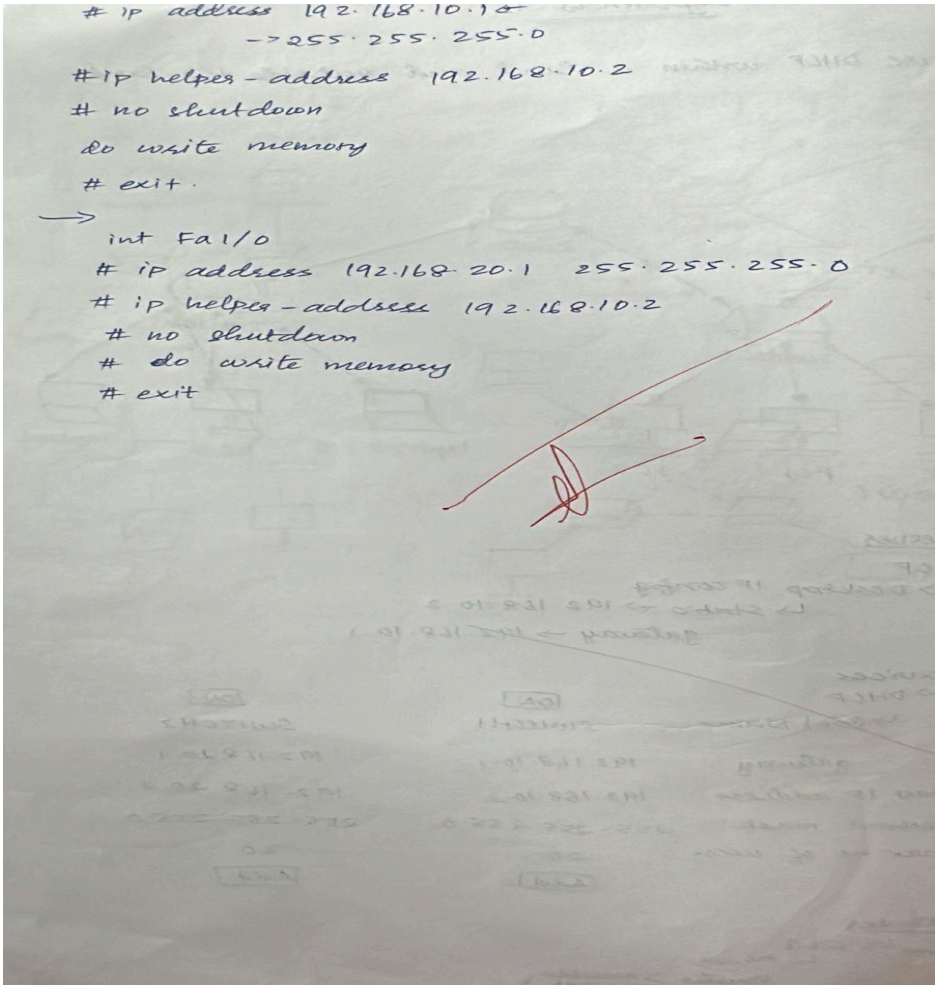
Program 2: Configure DHCP within a LAN and outside LAN.

Network diagram:



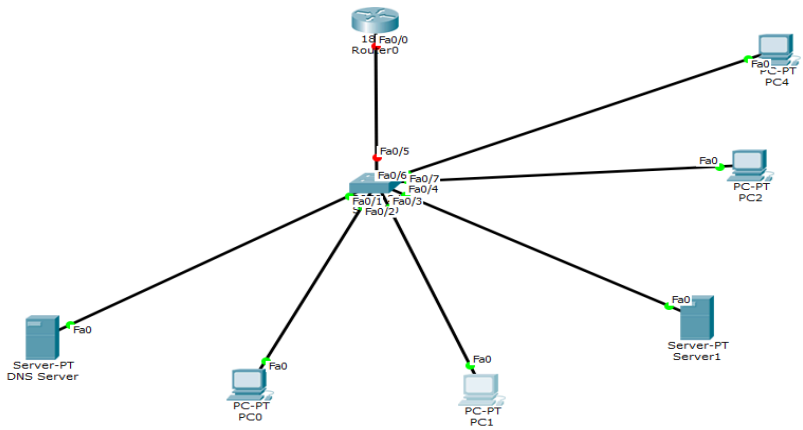
Configuration:



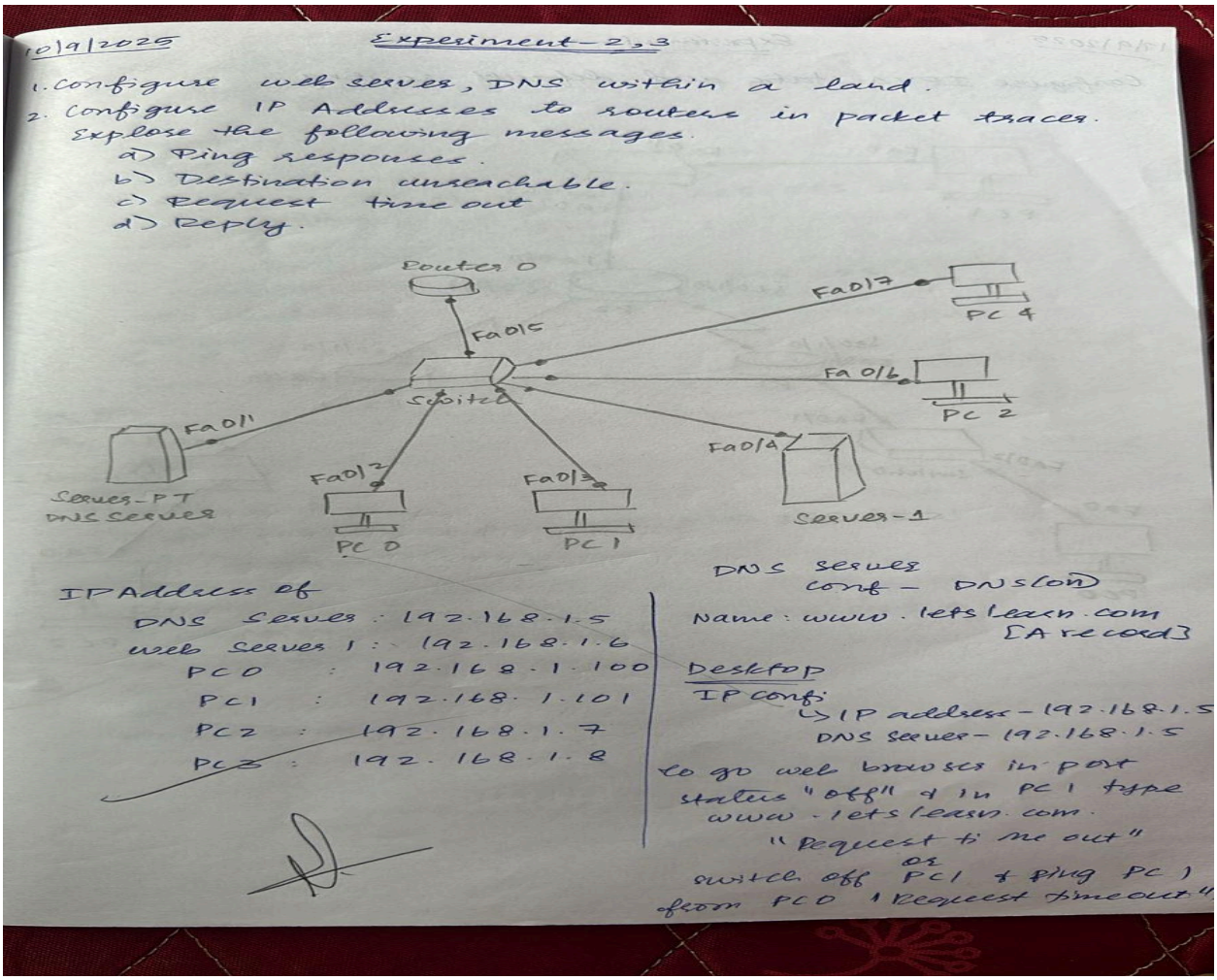


Program 3: Configure Web Server, DNS within a LAN.

Network diagram:

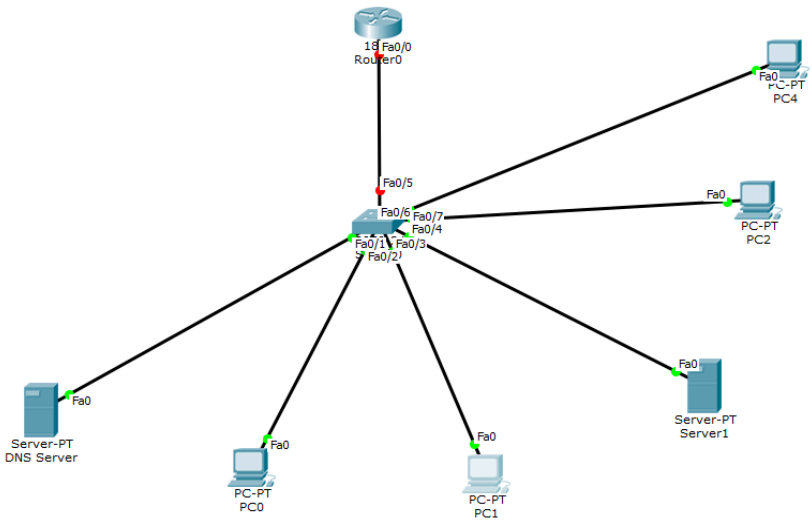


Configuration:

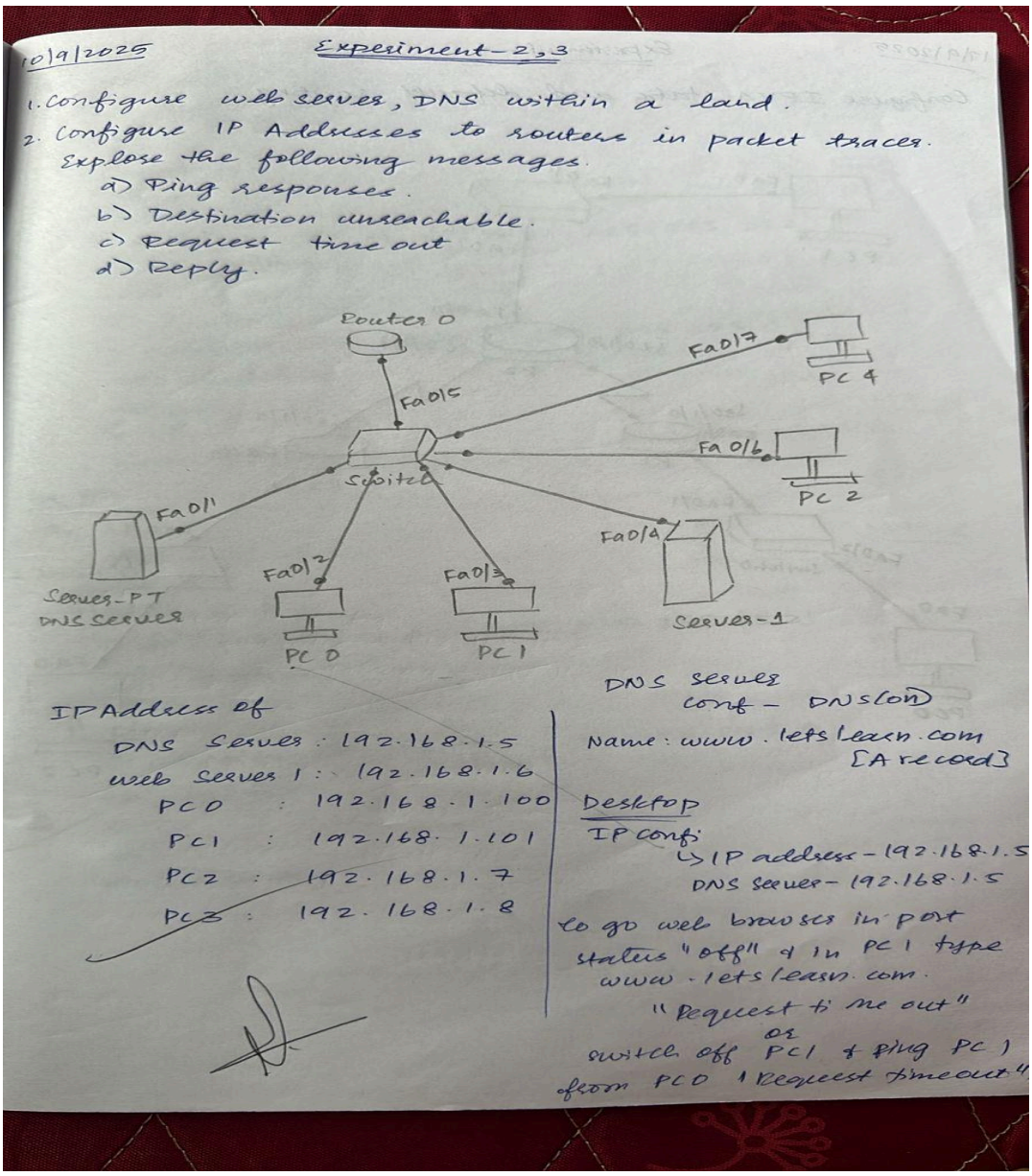


Program 4: Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply.

Network diagram:

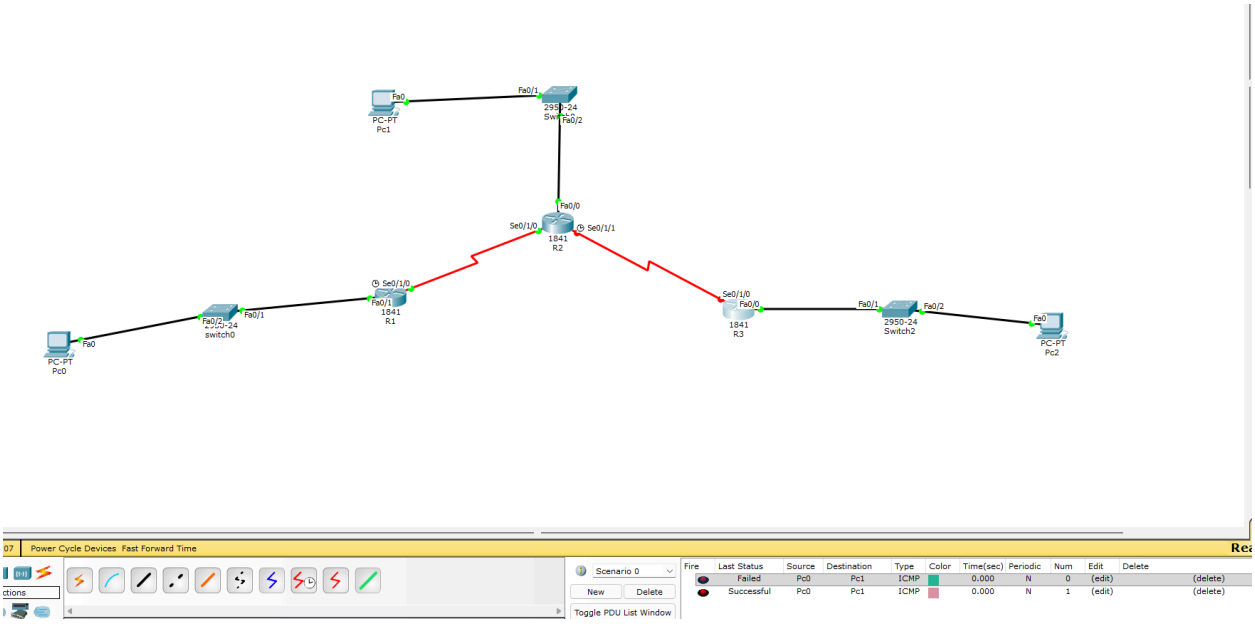


Configuration:



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

Network diagram:

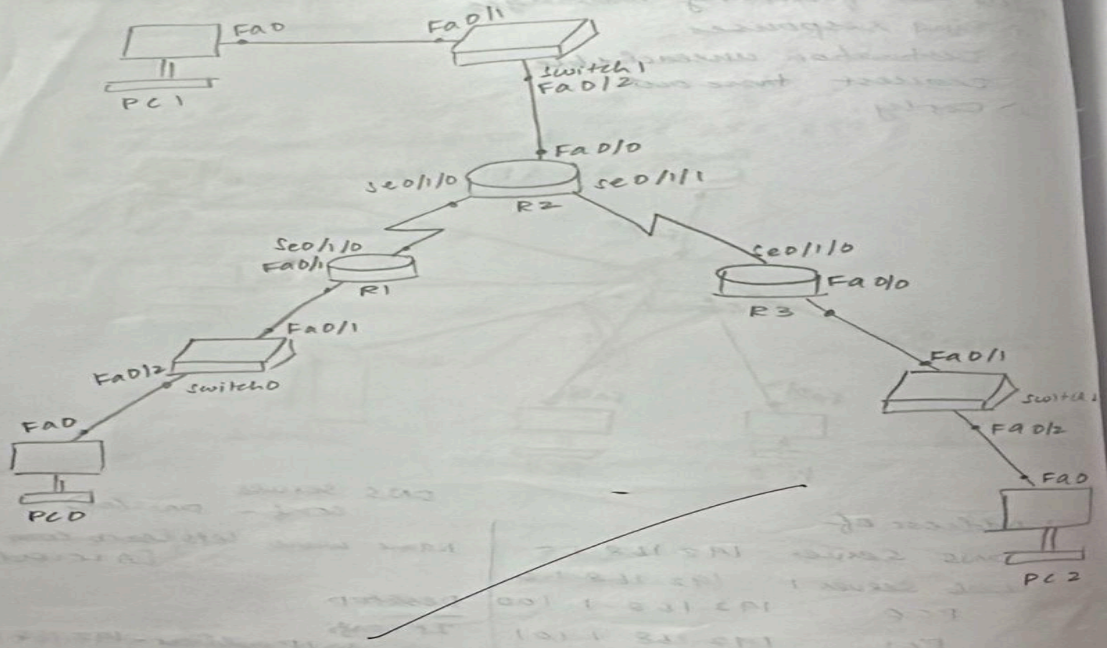


Configuration:

17/9/2025

Experiment – 4

Configuse IPV4 static and default routing



For R1

In physical → off switch
drag & drop HWIC-2T

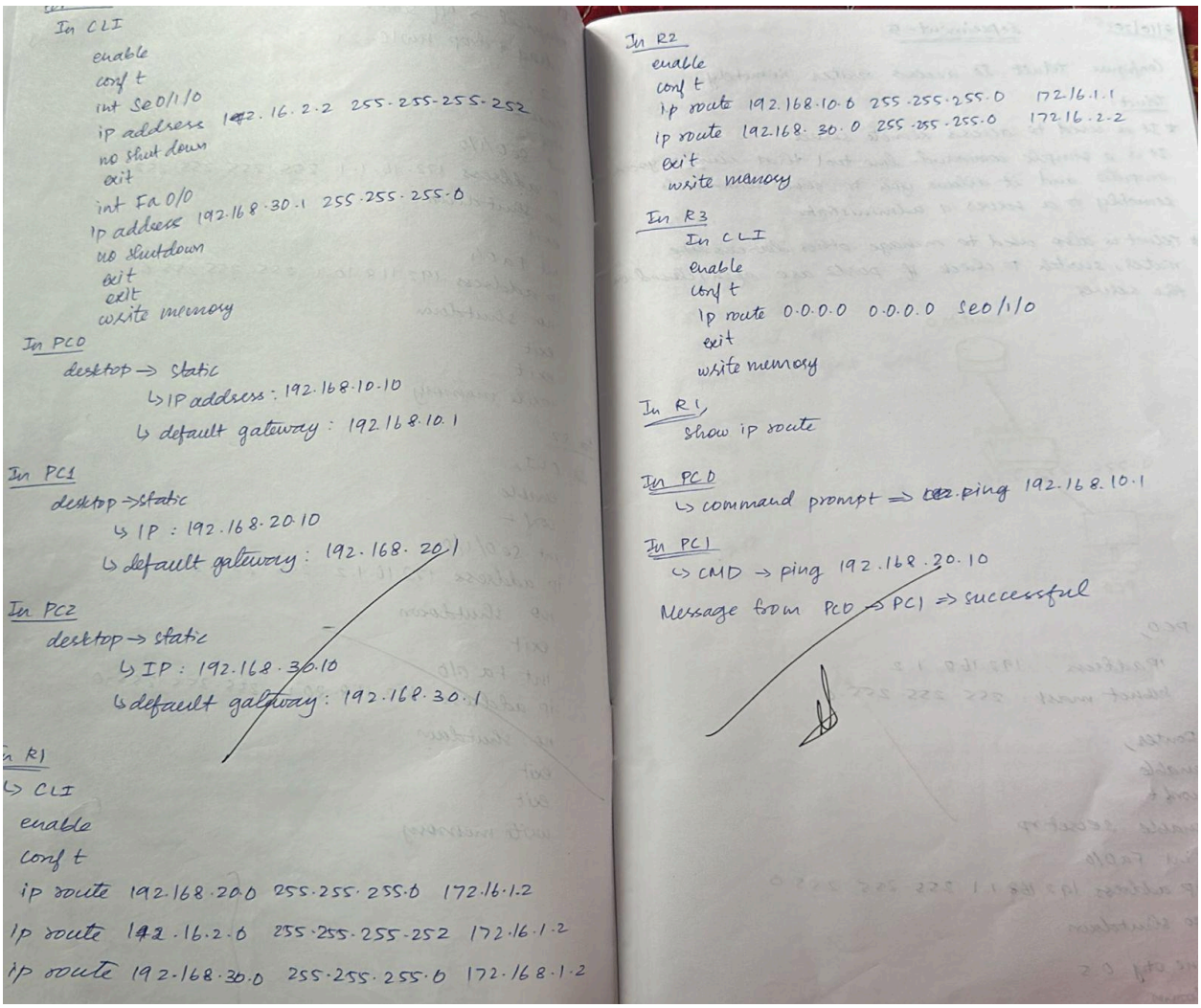
In CLI,

```
enable
conf t
int se0/1/0
ip address 172.16.1.1 255.255.255.252
no shut down
exit
int Fa0/1
ip address 192.168.10.1 255.255.255.0
no shutdown
exit
exit
write memory
```

For R2

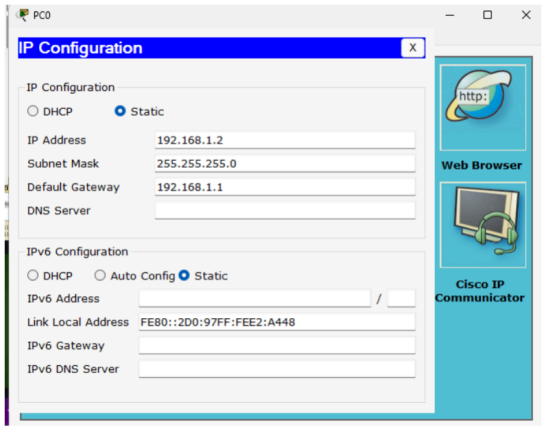
In CLI,

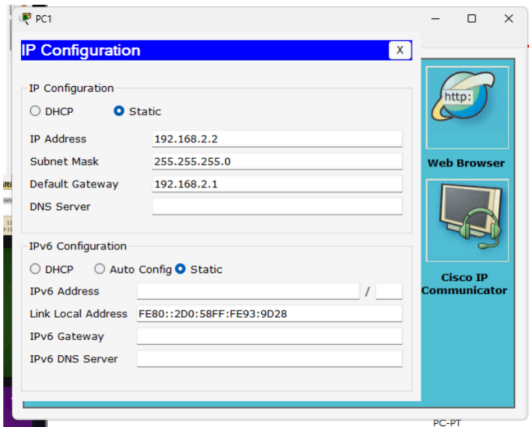
```
enable
conf t
int se0/1/0
ip address 172.16.1.2 255.255.255.252
no shutdown
exit
int Fa 0/0
ip address 192.168.20.1 255.255.255.0
no shutdown
exit
exit
write memory
```

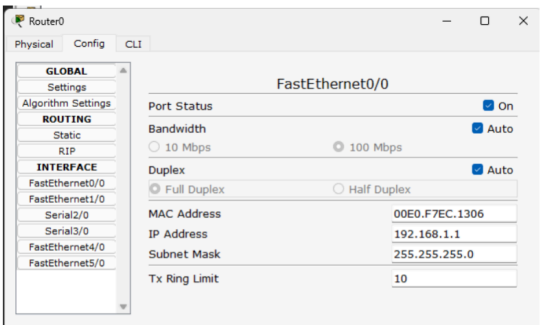


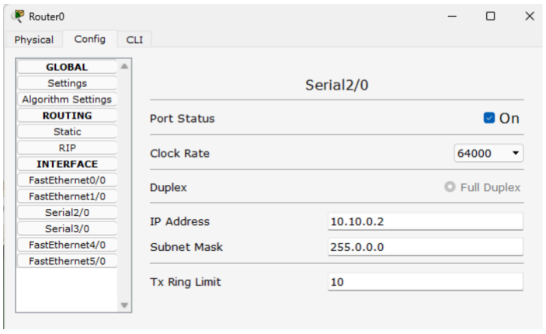
Program 6: Configure RIP routing Protocol in Routers.

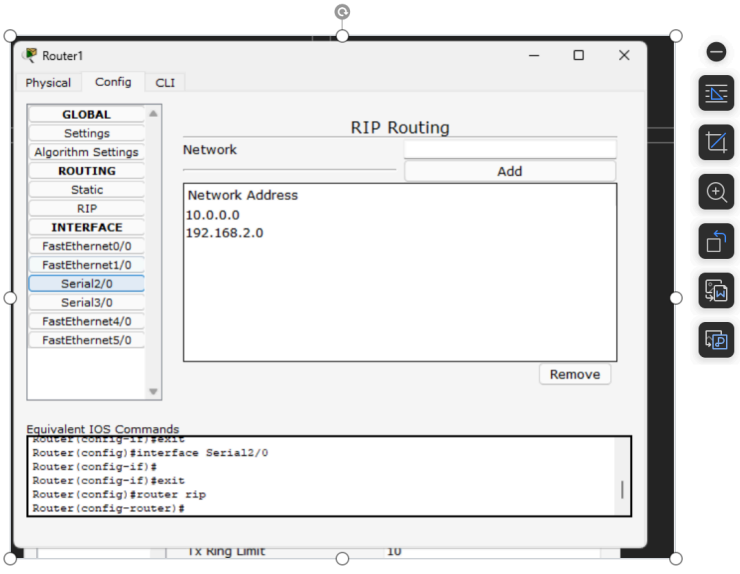
Network diagram:

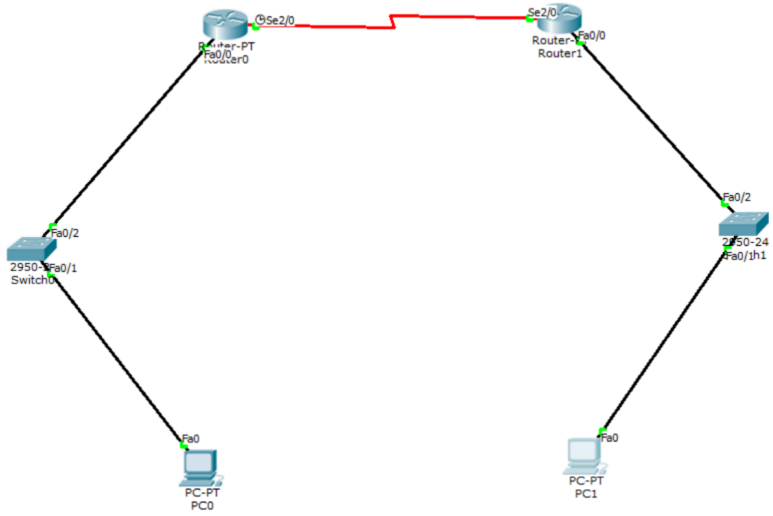

PC0
IP Configuration
IP Configuration
DHCP
Static
IP Address
192.168.1.2
Subnet Mask
255.255.255.0
Default Gateway
192.168.1.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::2D0:97FF:FEE2:A448
IPv6 Gateway
IPv6 DNS Server
Web Browser
Cisco IP Communicator


PC1
IP Configuration
IP Configuration
DHCP
Static
IP Address
192.168.2.2
Subnet Mask
255.255.255.0
Default Gateway
192.168.2.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::2D0:58FF:FE93:9D28
IPv6 Gateway
IPv6 DNS Server
Web Browser
Cisco IP Communicator
PC-PT

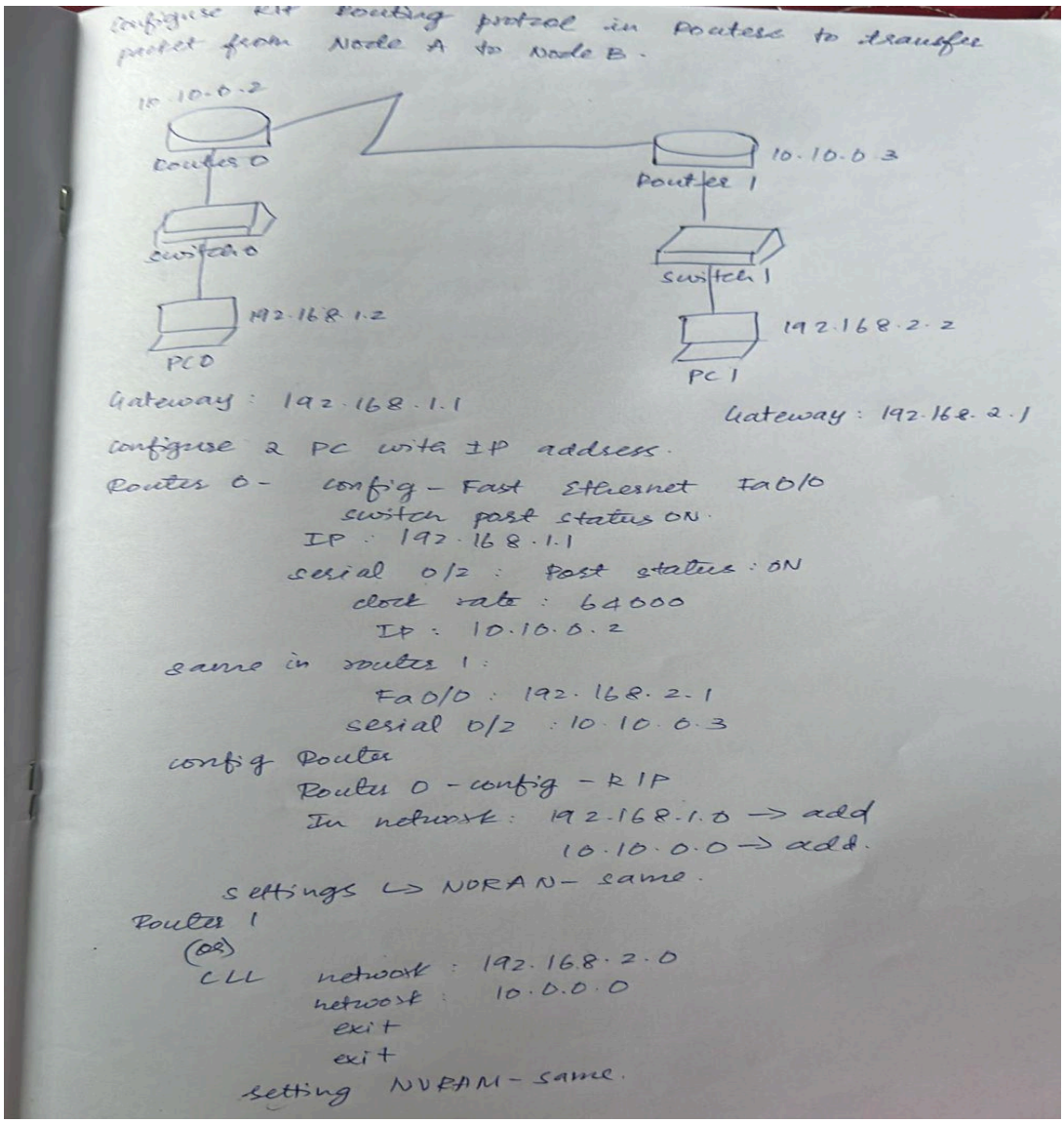

Router0
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
FastEthernet0/0
Port Status
On
Bandwidth
Auto
10 Mbps
100 Mbps
Duplex
Auto
Full Duplex
Half Duplex
MAC Address
00E0.F7EC.1306
IP Address
192.168.1.1
Subnet Mask
255.255.255.0
Tx Ring Limit
10


Router0
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
Serial2/0
Port Status
On
Clock Rate
64000
Duplex
Full Duplex
IP Address
10.10.0.2
Subnet Mask
255.0.0.0
Tx Ring Limit
10


Router1
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
RIP Routing
Network
Add
Network Address
10.0.0.0
192.168.2.0
Remove
Equivalent IOS Commands
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#
Tx Ring Limit
10

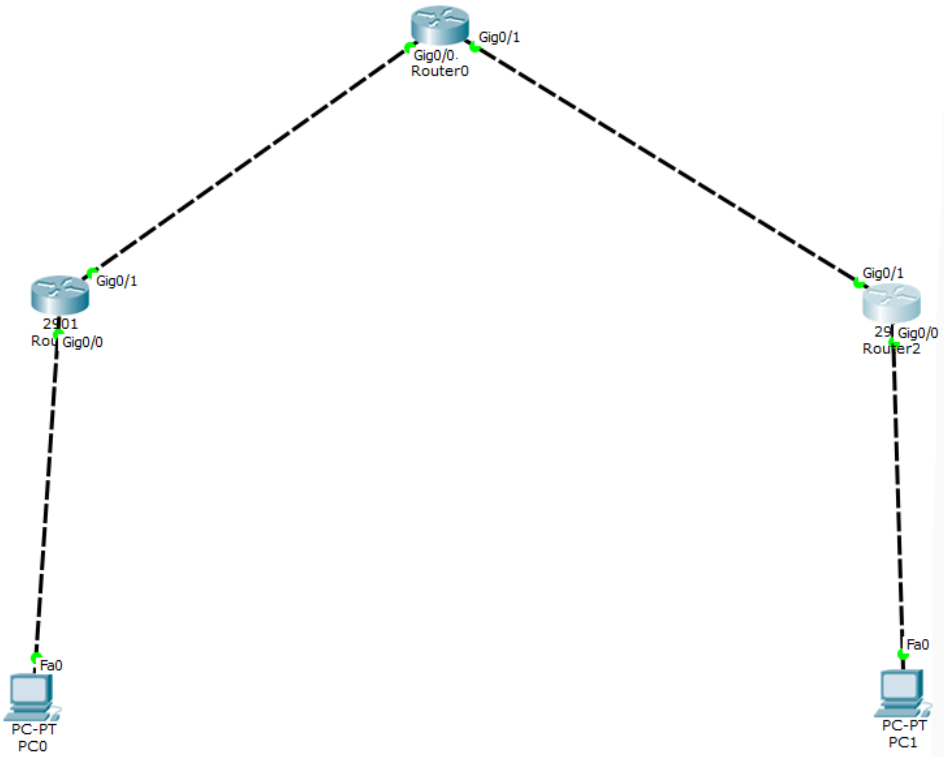


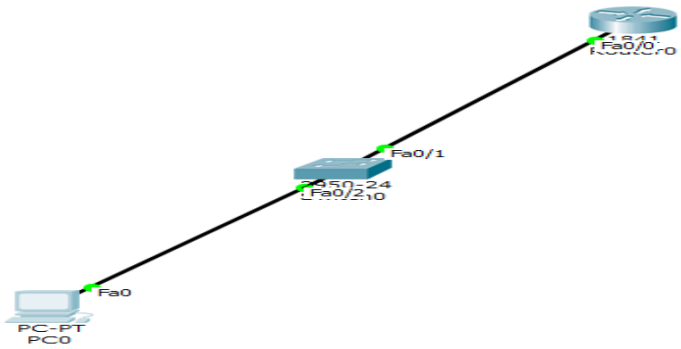
Configuration:

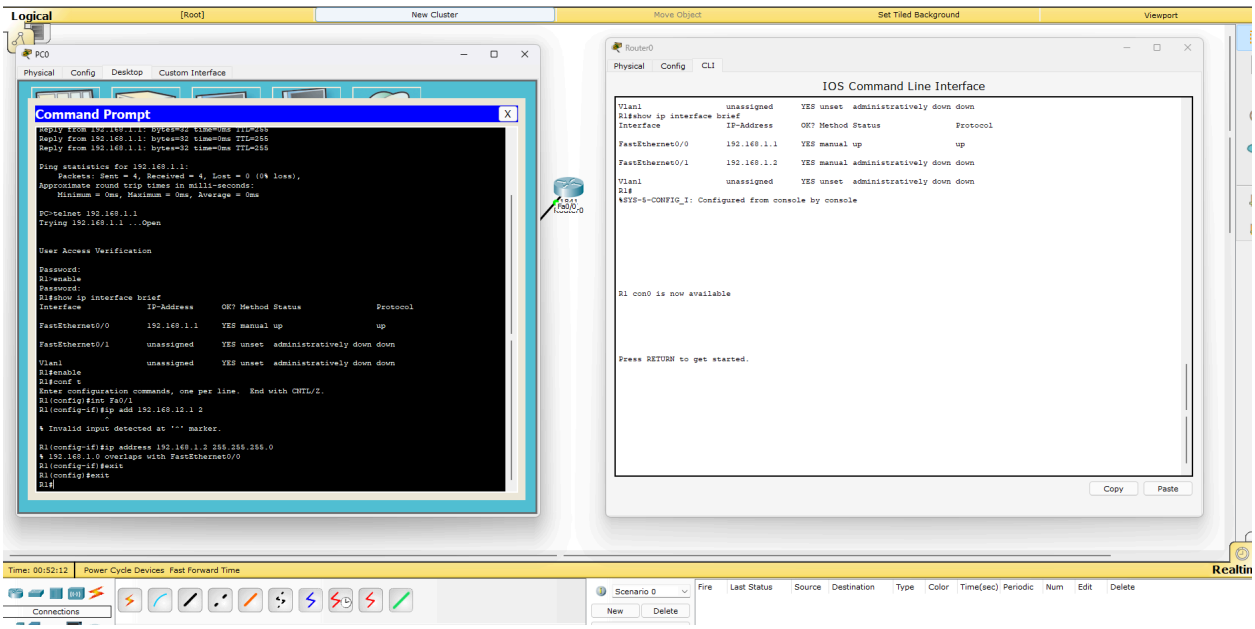


Program 7: Configure OSPF routing protocol.

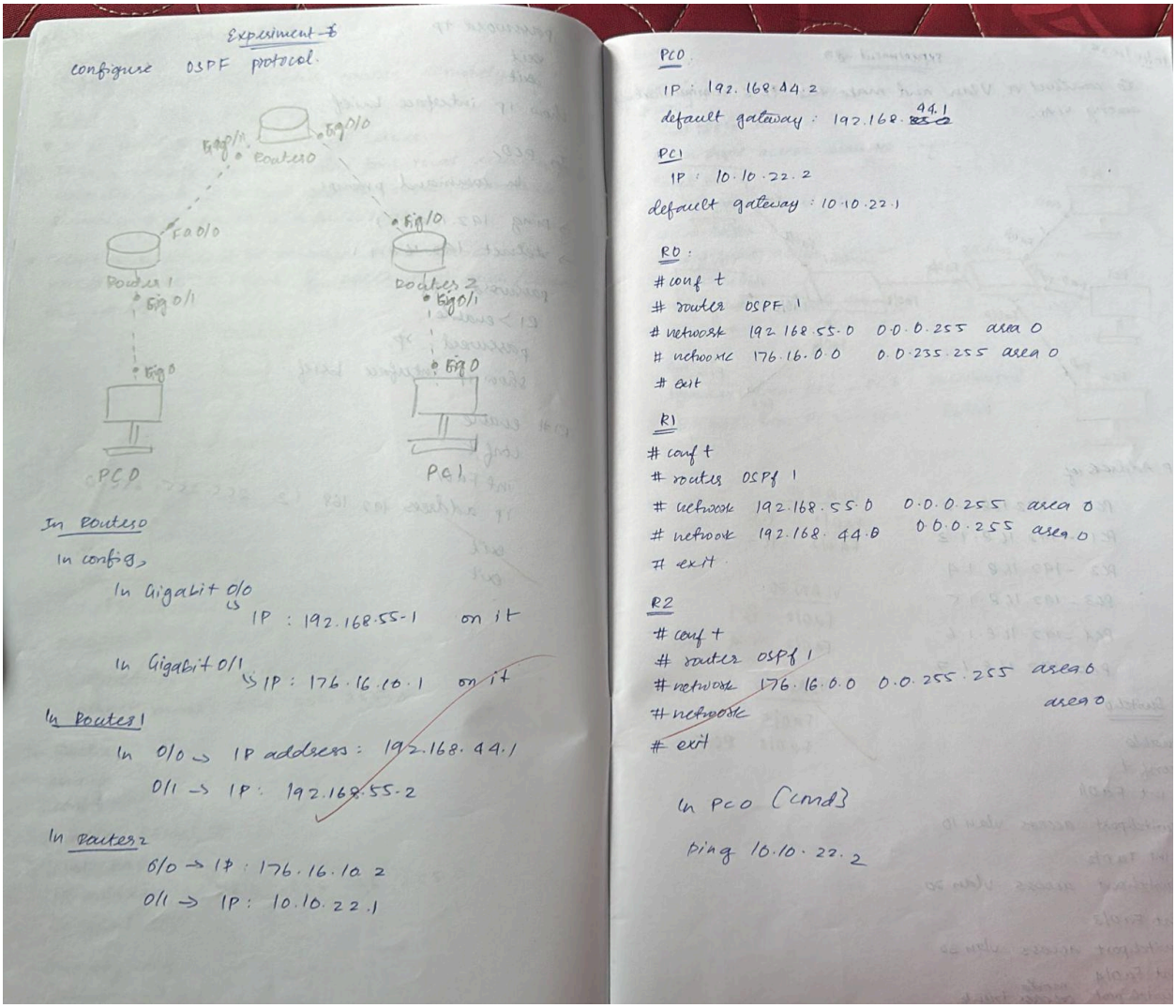
Network diagram:


Gig0/1
Gig0/0
Router0
Gig0/1
2901
Gig0/0
Gig0/1
Gig0/0
Router2
Fa0
PC-PT
PC0
Fa0
PC-PT
PC1


Fa0/0
Fa0/1
Fa0
PC-PT
PC0

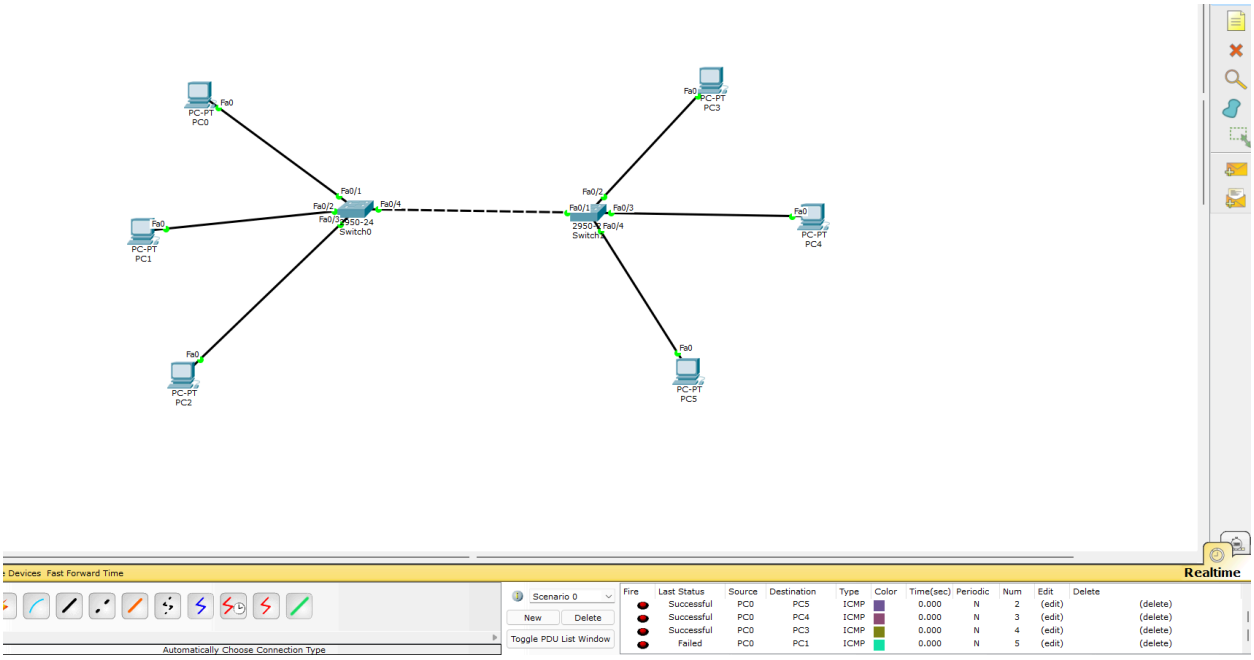


Configuration:

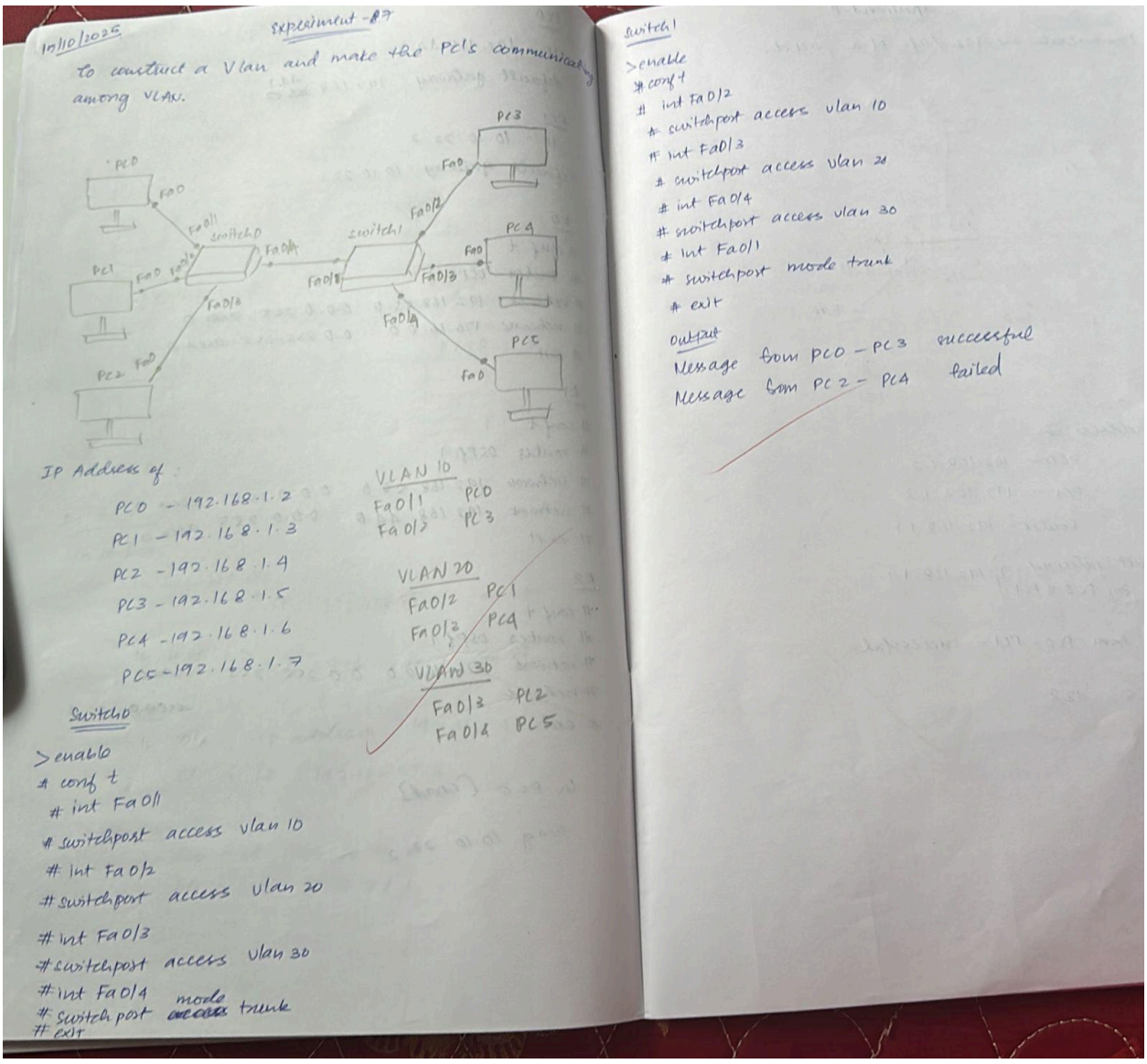


Program 8: To construct a VLAN and make the PC's communicate among a VLAN.

Network diagram:

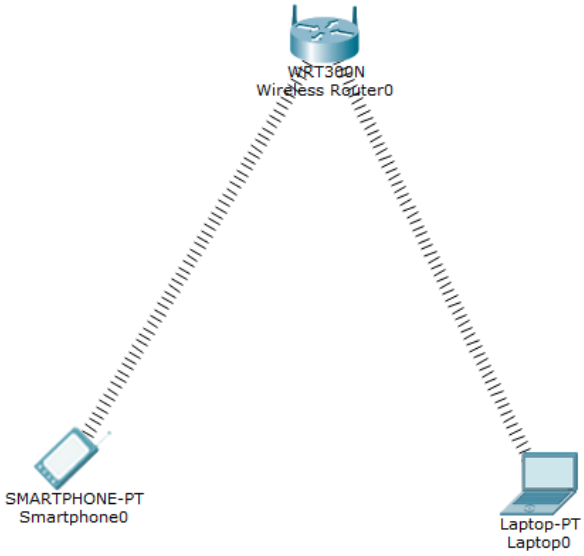


Configuration:

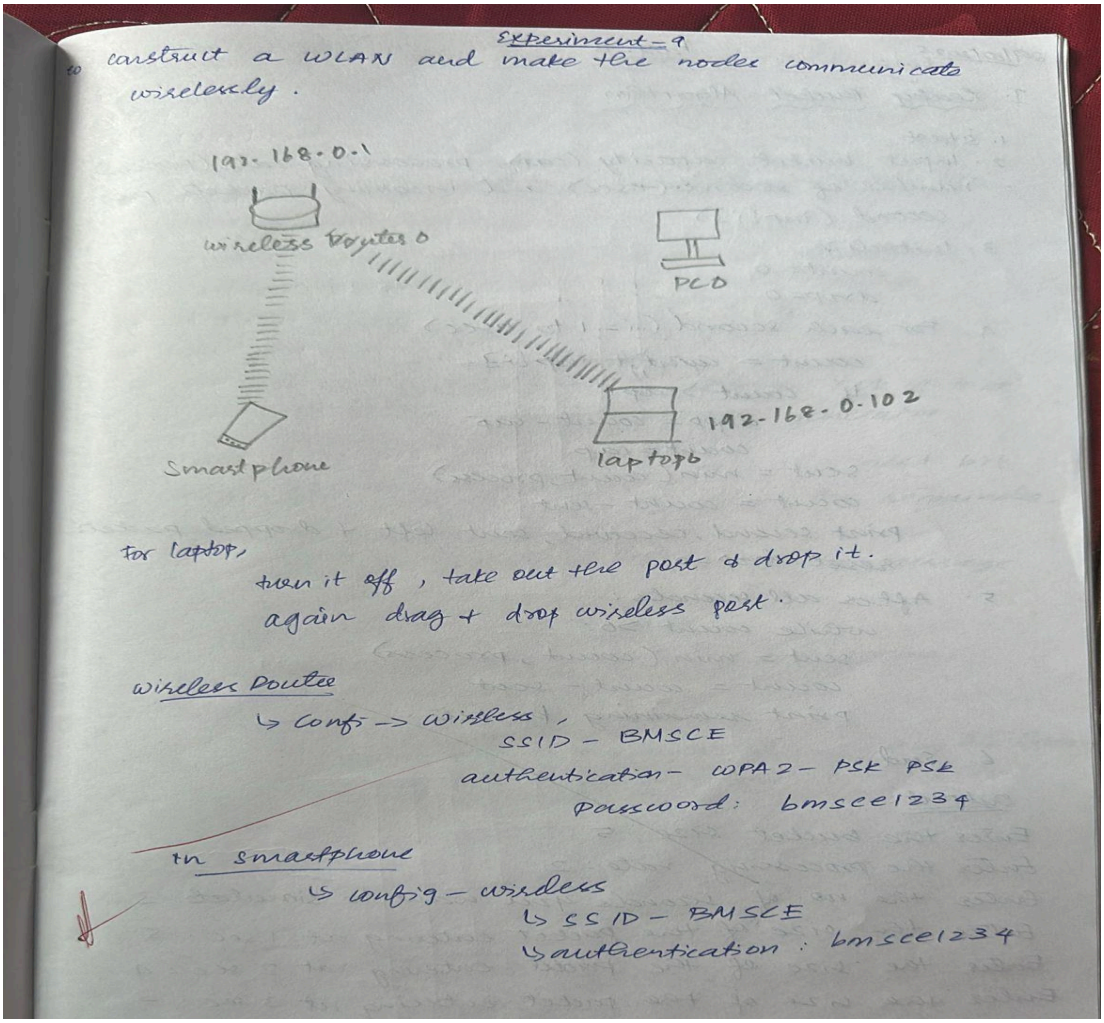


Program 9: To construct a WLAN and make the nodes communicate wirelessly.

Network diagram:

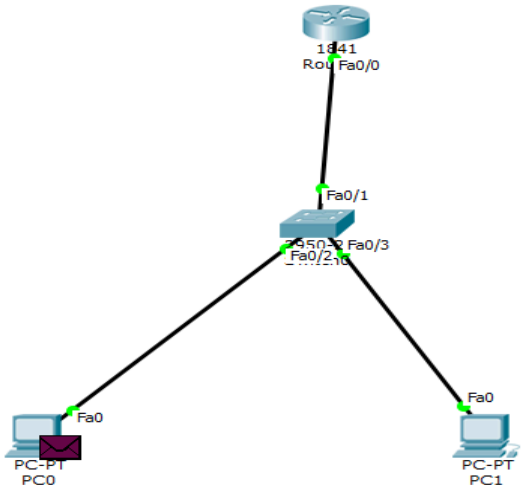


Configuration:

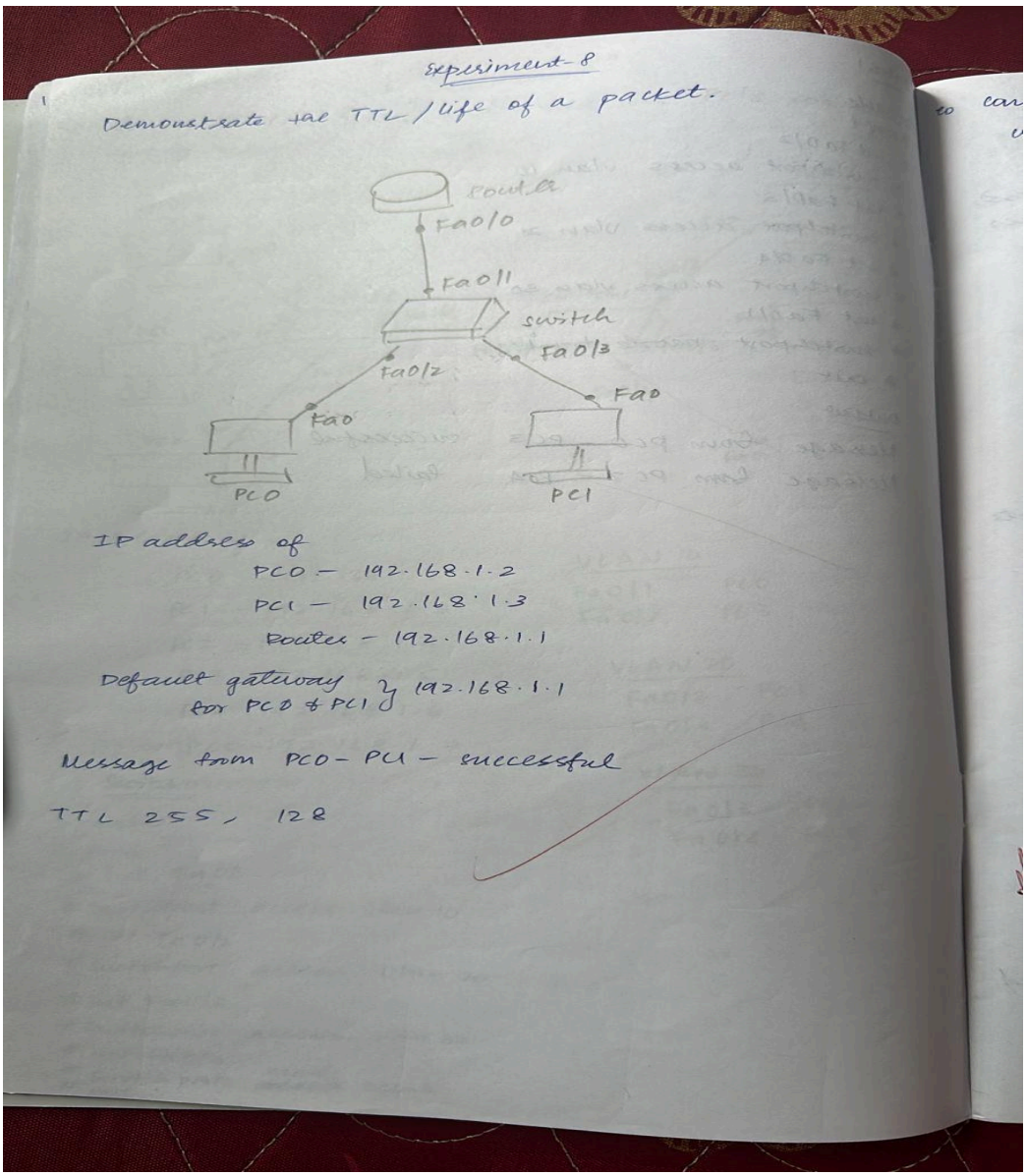


Program 10: Demonstrate the TTL/ Life of a Packet.

Network diagram:

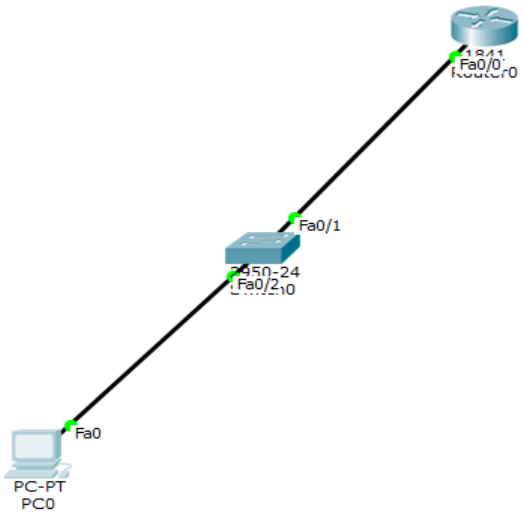


Configuration:

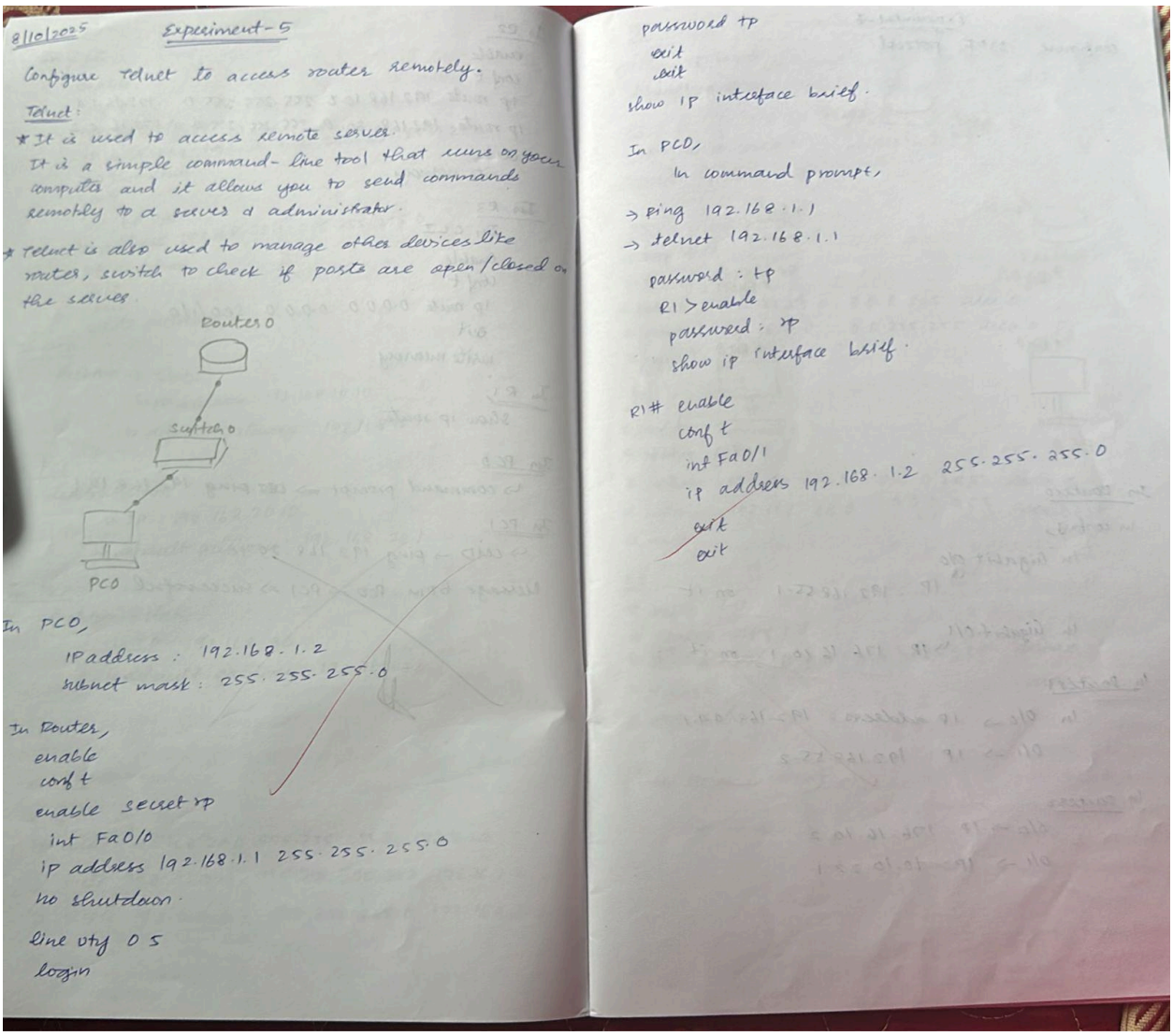


Program 11: To understand the operation of TELNET by accessing the router in the server room from a PC in the IT office.

Network diagram:



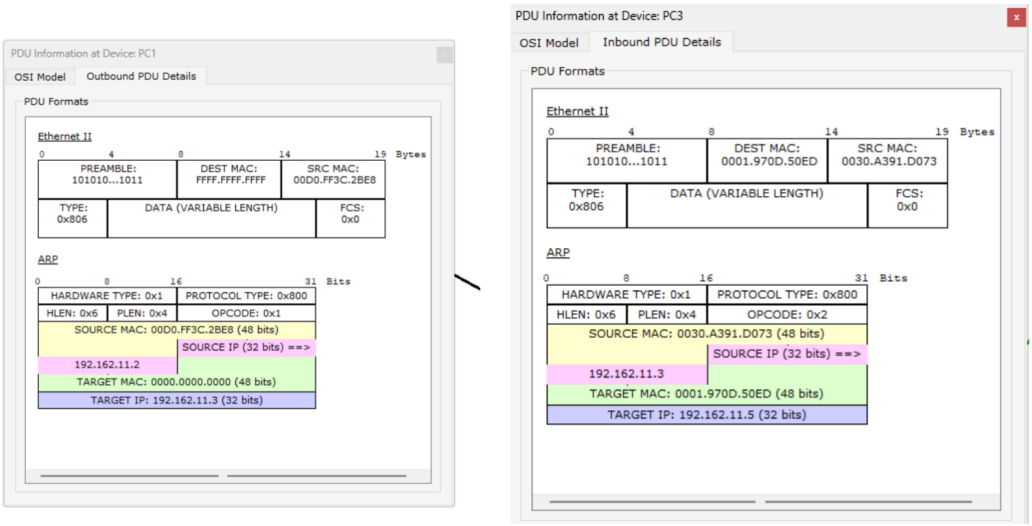
Configuration:



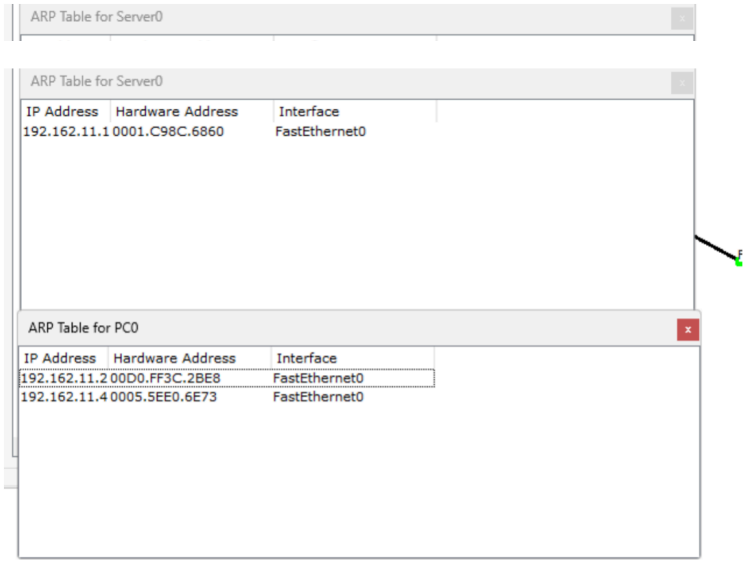
Program 12: To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP).

Network diagram:

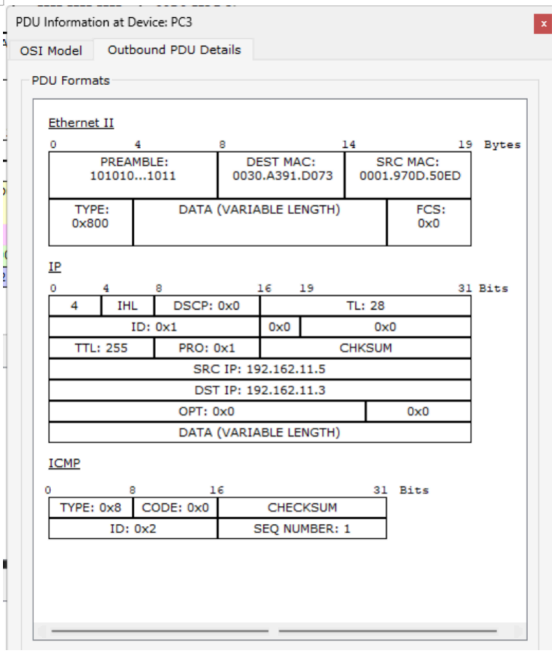
ARP



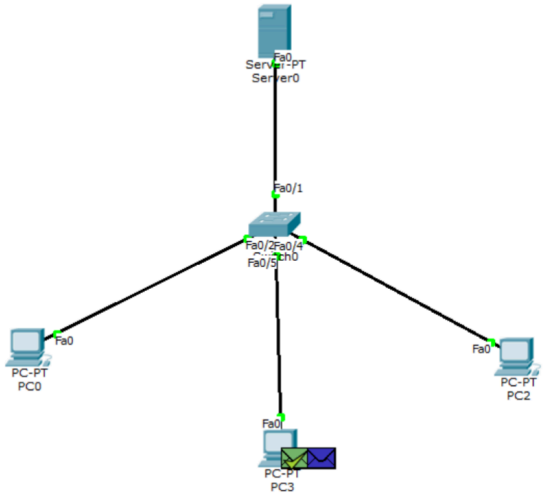
THE MAC ADDRESS before and after encrypting and sending



ARP table of pc0 and server after sending a simple PDU

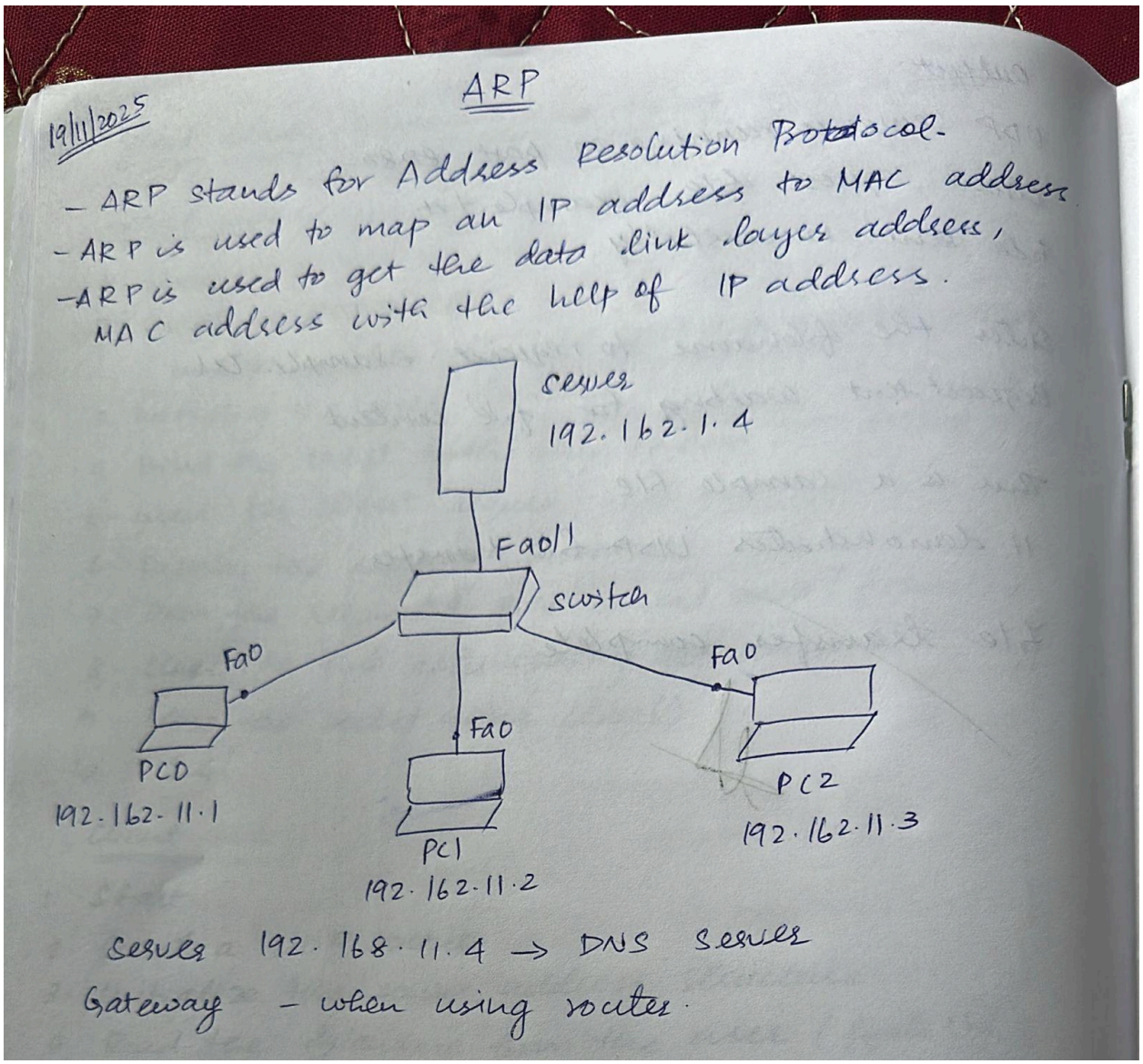


The address of sent one



topology

Configuration:



PART - B

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

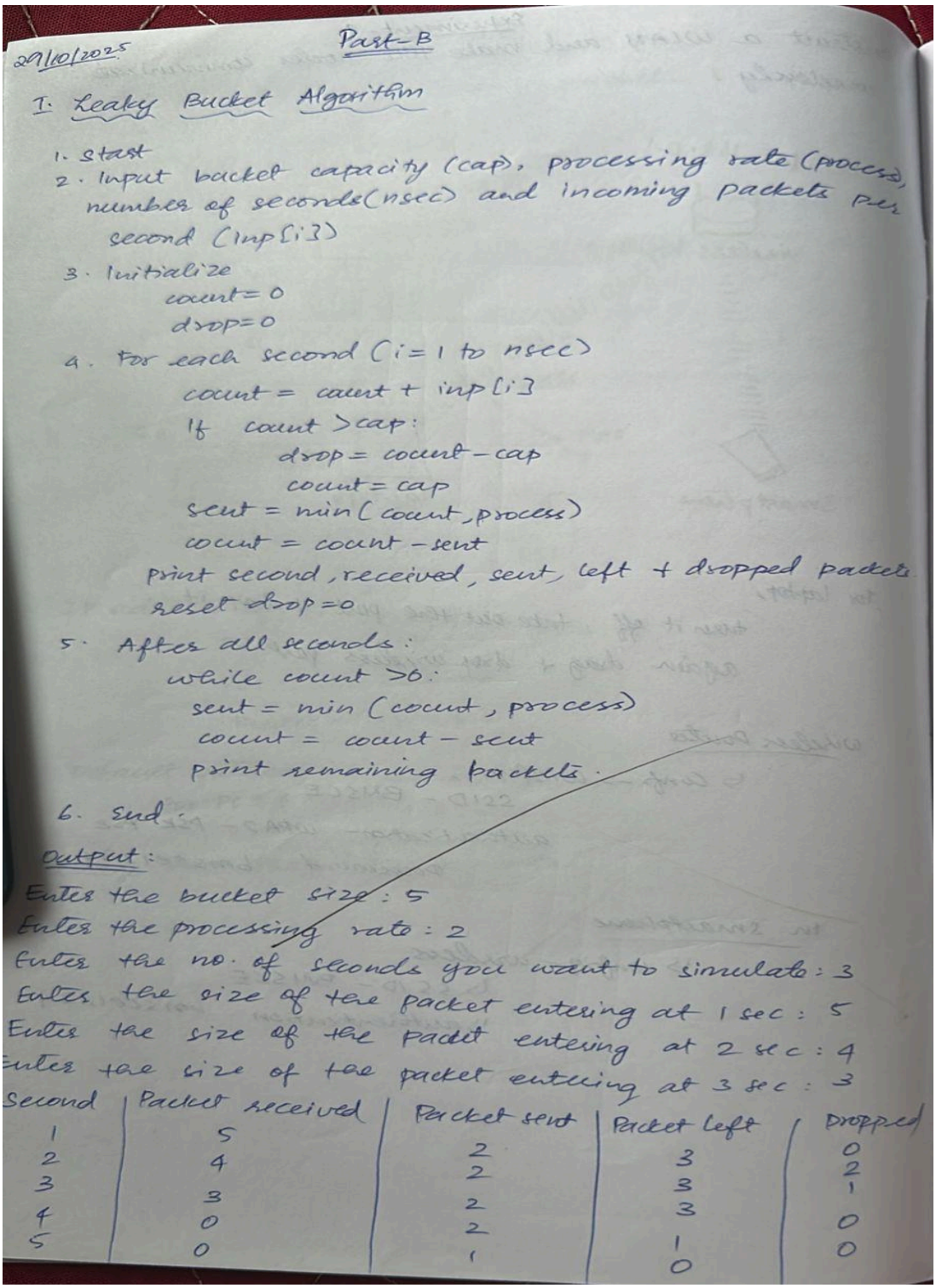
Code:

```
#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:\n");
    scanf("%d", &cap);
    printf("Enter the processing rate:\n");
    scanf("%d", &process);
    printf("Enter the number of seconds you want to simulate:\n");
    scanf("%d", &nsec);
    for (i = 0; i < nsec; i++)
    {
        printf("Enter the size of the packet entering at %d sec:\n", 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++)
{
        printf("Enter the size of the packet entering at %d sec:\n", 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(" %12d | %7d\n", count, drop);

        drop = 0;
    }
    // Process remaining packets after all seconds
    for (; count != 0; i++)
    {
  if (count > cap)
        {
```

```
            drop = count - cap;
            count = cap;
        }

        printf("%6d | %15d |", i + 1, 0);

        mini = min(count, process);
        printf(" %11d |", mini);

        count -= mini;
        printf(" %12d | %7d\n", count, drop);
    }

    return 0;
}
```

Output:



29/10/2025

Part-B

1. Leaky Bucket Algorithm

1. start
2. Input bucket capacity (cap), processing rate (process), number of seconds(nsec) and incoming packets per second (inp[i])
3. Initialize
   count = 0
   drop = 0
4. For each second (i = 1 to nsec)
   count = count + inp[i]
   If count > cap:
      drop = count - cap
      count = cap
   sent = min(count, process)
   count = count - sent
   print second, received, sent, left + dropped packets
   reset drop = 0
5. After all seconds:
   while count > 0:
   sent = min(count, process)
   count = count - sent
   print remaining packets.
6. End.

Output:

Enter the bucket size: 5
Enter the processing rate: 2
Enter the no. of seconds you want to simulate: 3
Enter the size of the packet entering at 1 sec: 5
Enter the size of the packet entering at 2 sec: 4
Enter the size of the packet entering at 3 sec: 3

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

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

Code:

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

int main(int argc, char *argv[])
{
   int sockfd, portno, n;
   struct sockaddr_in serv;
   struct hostent *server;
   char buffer[256];
   char c[20000];

   if (argc < 3) {
      printf("Error: insufficient arguments.\n");
      printf("Usage: %s <hostname> <port>\nExample: %s 127.0.0.1 7777\n",
argv[0], argv[0]);
      exit(1);
   }

   portno = atoi(argv[2]);

   // Create socket
```

```
sockfd = socket(AF_INET, SOCK_STREAM, 0);
if (sockfd < 0) {
    perror("Error opening socket");
    exit(1);
}

// Get server by name/IP
server = gethostbyname(argv[1]);
if (server == NULL) {
    fprintf(stderr, "Error: no such host.\n");
    exit(1);
}

// Zero out the structure
bzero((char *)&serv, sizeof(serv));
serv.sin_family = AF_INET;
bcopy((char *)server->h_addr, (char *)&serv.sin_addr.s_addr, server->h_length);
serv.sin_port = htons(portno);

// Connect to server
if (connect(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Error connecting");
    exit(1);
}

printf("Enter the file path (complete path): ");
scanf("%s", buffer);
```

```
    // Send filename to server
    n = write(sockfd, buffer, strlen(buffer));
    if (n < 0) {
        perror("Error writing to socket");
        exit(1);
    }

    bzero(c, sizeof(c));
    printf("Reading file contents from server...\n");

    // Read file contents
    n = read(sockfd, c, sizeof(c) - 1);
    if (n < 0) {
        perror("Error reading from socket");
        exit(1);
    }

    printf("\nClient: Display content of %s\n----------------------------------\n",
buffer);
    fputs(c, stdout);
    printf("\n----------------------------------\n");

    close(sockfd);
    return 0;
}
#include <stdio.h>
```

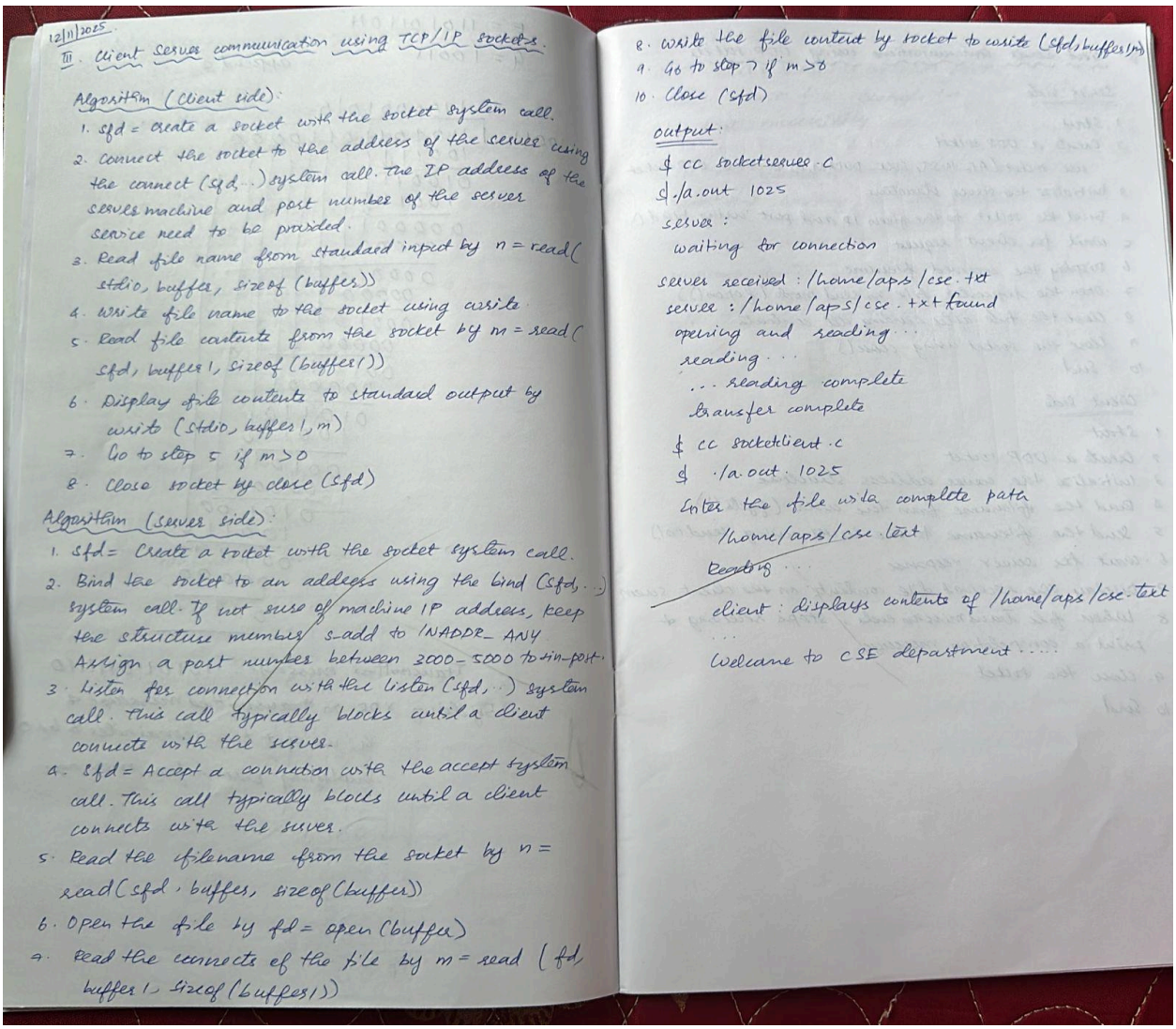
```
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

int main(int argc, char *argv[])
{
   int sockfd, newsockfd, portno, len, n;
   char buffer[256], c[2000], cc[20000];
   struct sockaddr_in serv, cli;
   FILE *fd;

   if (argc < 2) {
      printf("Error: no port number provided.\n");
      printf("Usage: %s <port>\nExample: %s 7777\n", argv[0], argv[0]);
      exit(1);
   }

   // Create socket
   sockfd = socket(AF_INET, SOCK_STREAM, 0);
   if (sockfd < 0) {
      perror("Error opening socket");
      exit(1);
   }
```

```
// Initialize server address structure
bzero((char *)&serv, sizeof(serv));
portno = atoi(argv[1]);
serv.sin_family = AF_INET;
serv.sin_addr.s_addr = INADDR_ANY;
serv.sin_port = htons(portno);

// Bind socket
if (bind(sockfd, (struct sockaddr *)&serv, sizeof(serv)) < 0) {
    perror("Error on binding");
    close(sockfd);
    exit(1);
}

// Listen for incoming connections
listen(sockfd, 5);
len = sizeof(cli);
printf("Server: waiting for connection on port %d...\n", portno);

// Accept a client
newsockfd = accept(sockfd, (struct sockaddr *)&cli, (socklen_t *)&len);
if (newsockfd < 0) {
    perror("Error on accept");
    close(sockfd);
    exit(1);
}
```

```
// Read filename from client
bzero(buffer, 255);
n = read(newsockfd, buffer, 255);
if (n < 0) {
    perror("Error reading from socket");
    close(newsockfd);
    close(sockfd);
    exit(1);
}

printf("Server received filename: %s\n", buffer);

// Try to open the file
fd = fopen(buffer, "r");
if (fd != NULL) {
    printf("Server: file '%s' found, reading and sending...\n", buffer);
    bzero(cc, sizeof(cc));
    while (fgets(c, sizeof(c), fd) != NULL) {
        strcat(cc, c);
    }
    fclose(fd);

    // Send file content to client
    n = write(newsockfd, cc, strlen(cc));
    if (n < 0)
        perror("Error writing to socket");
    else
```

```
            printf("File transfer complete.\n");
        } else {
            printf("Server: file not found.\n");
            n = write(newsockfd, "Error: file not found.\n", 24);
            if (n < 0)
                perror("Error writing to socket");
        }

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

Output:



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

Code:

```
#include <stdio.h>

#include <stdlib.h>

#include <string.h>

#include <unistd.h>

#include <arpa/inet.h>
```

```
#define PORT 8080
#define MAXLINE 1024

int main() {
    int sockfd;
    char buffer[MAXLINE];
    struct sockaddr_in servaddr, cliaddr;
    socklen_t len;
    ssize_t n;

    // Create UDP socket
    if ((sockfd = socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
        perror("socket creation failed");
        exit(EXIT_FAILURE);
    }

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

    // Server info
    servaddr.sin_family = AF_INET;
    servaddr.sin_addr.s_addr = INADDR_ANY;
    servaddr.sin_port = htons(PORT);

    // Bind socket to the port
    if (bind(sockfd, (const struct sockaddr *)&servaddr, sizeof(servaddr)) < 0) {
        perror("bind failed");
```

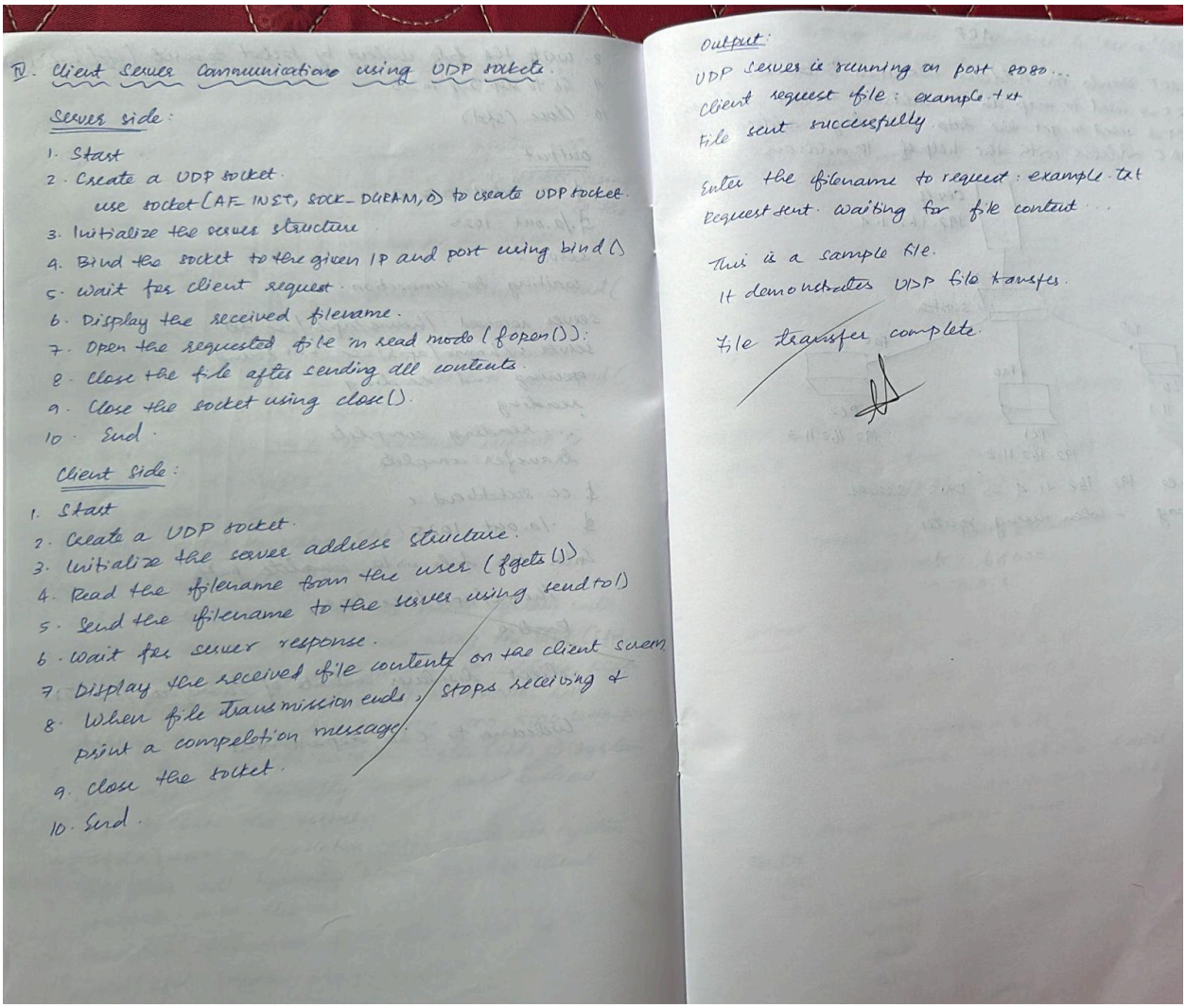
```
        close(sockfd);
        exit(EXIT_FAILURE);
    }

    printf("UDP Server is running on port %d...\n", PORT);

    len = sizeof(cliaddr);

    // Receive filename from client
    n = recvfrom(sockfd, (char *)buffer, MAXLINE, 0, (struct sockaddr *)&cliaddr,
&len);
    buffer[n] = '\0';
    printf("Client requested file: %s\n", buffer);

    FILE *fp = fopen(buffer, "r");
    if (fp == NULL) {
        char *msg = "File not found!";
        sendto(sockfd, msg, strlen(msg), 0, (struct sockaddr *)&cliaddr, len);
        printf("File not found, message sent to client.\n");
    } else {
        // Read and send file content
        while (fgets(buffer, MAXLINE, fp) != NULL) {
            sendto(sockfd, buffer, strlen(buffer), 0, (struct sockaddr *)&cliaddr, len);
        }
        fclose(fp);
        printf("File sent successfully.\n");
    }
```

```
    close(sockfd);
    return 0;
}
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>
#include <arpa/inet.h>

#define PORT 8080
#define MAXLINE 1024

int main() {
    int sockfd;
    char buffer[MAXLINE];
    struct sockaddr_in servaddr;
    socklen_t len;

    // Create UDP socket
    if ((sockfd = socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
        perror("socket creation failed");
        exit(EXIT_FAILURE);
    }

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

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

    printf("Enter the filename to request: ");
    fgets(buffer, MAXLINE, stdin);
    buffer[strcspn(buffer, "\n")] = '\0';  // remove newline

    // Send filename to server
    sendto(sockfd, buffer, strlen(buffer), 0, (const struct sockaddr *)&servaddr,
sizeof(servaddr));

    printf("Request sent. Waiting for file content...\n\n");

    len = sizeof(servaddr);

    // Receive file contents
    ssize_t n;
    while ((n = recvfrom(sockfd, buffer, MAXLINE, 0, (struct sockaddr
*)&servaddr, &len)) > 0) {
        buffer[n] = '\0';
        printf("%s", buffer);
        if (n < MAXLINE - 1) break;  // assume end of file
    }

    printf("\n\nFile transfer complete.\n");
```

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

Output:



IV. Client Server Communications using UDP sockets.

Server side:

1. Start
2. Create a UDP socket.
   use socket(AF_INET, SOCK_DGRAM, 0) to create UDP socket.
3. Initialize the server structure.
4. Bind the socket to the given IP and port using bind()
5. Wait for client request.
6. Display the received filename.
7. Open the requested file in read mode (fopen()).
8. Close the file after sending all contents.
9. Close the socket using close().
10. End.

Client Side:

1. Start
2. Create a UDP socket.
3. Initialize the server address structure.
4. Read the filename from the user (fgets())
5. Send the filename to the server using sendto()
6. Wait for server response.
7. Display the received file contents on the client screen
8. When file transmission ends, stops receiving & print a completion message.
9. Close the socket.
10. End.

Output:

UDP Server is running on port 8080...
Client request file: example.txt
File sent successfully

Enter the filename to request: example.txt
Request sent. waiting for file content...

This is a sample file.
It demonstrates UDP file transfer.

File transfer complete.

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:\n");
    fgets(gen, sizeof(gen), stdin);
    gen[strcspn(gen, "\n")] = '\0';  // remove newline if present
    printf("Generator polynomial (CRC-CCITT): %s\n", gen);

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

    printf("Enter the message:\n");
    fgets(msj, sizeof(msj), stdin);
    msj[strcspn(msj, "\n")] = '\0';  // remove newline

    n = strlen(msj);

    // Append k zeros to the message
    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);

// Division (XOR)
for (i = 0; i < n; i++)
{
   if (a[i] == '1')
   {
      t = i;
      for (j = 0; j <= k; j++)
      {
         if (a[t] == gen[j])
            a[t] = '0';
         else
            a[t] = '1';
         t++;
      }
   }
}
// Get remainder
for (i = 0; i < k; i++)
   rem[i] = a[n + i];
rem[k] = '\0';
printf("\nChecksum (Remainder):\n");
puts(rem);
// Append checksum to message
printf("\nTransmitted message (with checksum):\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);
// Receiver side
printf("\nEnter the received message:\n");
fgets(s, sizeof(s), stdin);
s[strcspn(s, "\n")] = '\0';  // remove newline
n = strlen(s);
// Division on received message
for (i = 0; i < n - k; i++)
{
    if (s[i] == '1')
    {
        t = i;
        for (j = 0; j <= k; j++, t++)
        {
            if (s[t] == gen[j])
                s[t] = '0';
            else
                s[t] = '1';
        }
    }
}
for (i = 0; i < k; i++)
```

```
        rem[i] = s[n - k + i];
    rem[k] = '\0';
    // Check for error
    flag = 0;
    for (i = 0; i < k; i++)
    {
        if (rem[i] == '1')
            flag = 1;
    }
    if (flag == 0)
        printf("\nReceived message is error-free ✅\n");
    else
        printf("\nReceived message contains errors ❌\n");
    return 0;
}
```

Output:

Output

```
Enter the generator polynomial:
101
Generator polynomial (CRC-CCITT): 101
Enter the message:
110101

Message polynomial appended with zeros:
11010100

Checksum (Remainder):
11

Transmitted message (with checksum):
11010111

Enter the received message:
11010111

Received message is error-free ✅


=== Code Execution Successful ===
```

1) Error detecting code using CRC-CCITT (16-bits)

Algorithm:

1. Start
2. Input data
   read the generator polynomial, message bits.
3. Append zeros.
   degree of generator = k = (length of generator - 1)
   append k zeros to the end of the message.
4. Perform Binary Division (XOR)
   for each bit of the message
   * If the current bit is 1, perform XOR of that part of the message with the generator polynomial.
   * If the current bit is 0, skip that next bit.
   The result after the division gives the remainder.
5. Form transmitted Message
   append the remainder to the original message.
6. Receives side.
   Input the received message.
   Perform the same XOR using the same generator polynomial
   check the remainder obtained.
   -> If all bits in the remainder are 0 -> No Error.
   -> If any bits in the remainder is 1 -> Error.
7. End.

Output:

Enter the generator polynomial : 101
Generator polynomial (CRC-CCITT) : 101
Enter the message : 11010 1
Message polynomial appended with zeros : 11010100
Checksum (remainder) : 11
Transmitted message (with checksum) : 11010111
Enter the received message : 11010111
Received message is error-free