DCN LAB PROJECT

01-135211-102

DATA COMMUNICATION & NETWORKING

BSIT 3A & B - Fall 2023

Project

Date of submission: 27 Dec 2023 (For BSIT3A)
Date of submission: 28 Dec 2023 (For BSIT3B)
Total Marks: 100
Group based assignment
Group size: 2 students

Department of Computer Sciences
BAHRIA UNIVERSITY, ISLAMABAD

**Group Members:**

Muhammad Hammad 102.

Wasla abbasi.

Muhammad ahsan waqar.

Assume you are a network engineer and hired by an organization to design their network for different departments including HR, Administration, Finance, Operation and IT etc. In addition, the organization has different labs and rooms in which the employees work and share data across the network. You are required to design and implement their organizational network in packet tracer according to the given sample scenario – network diagram.

Once you are done with topology designing now you are required to perform the following configurations

a) Configure hostname, clock time, set passwords and encrypt them

FACULTY BLOCK
VLAN90

STUDENT BLOCK
VLAN100
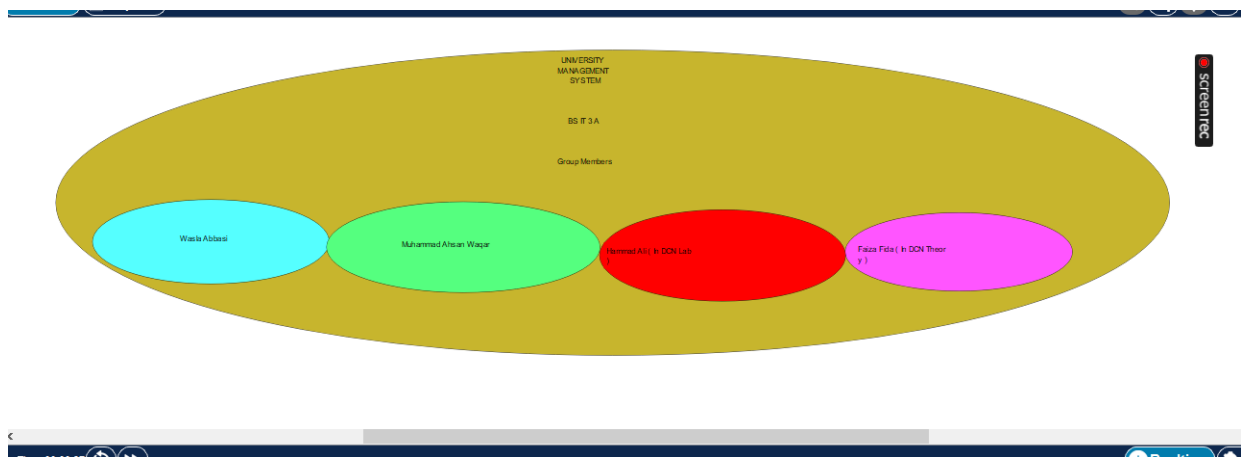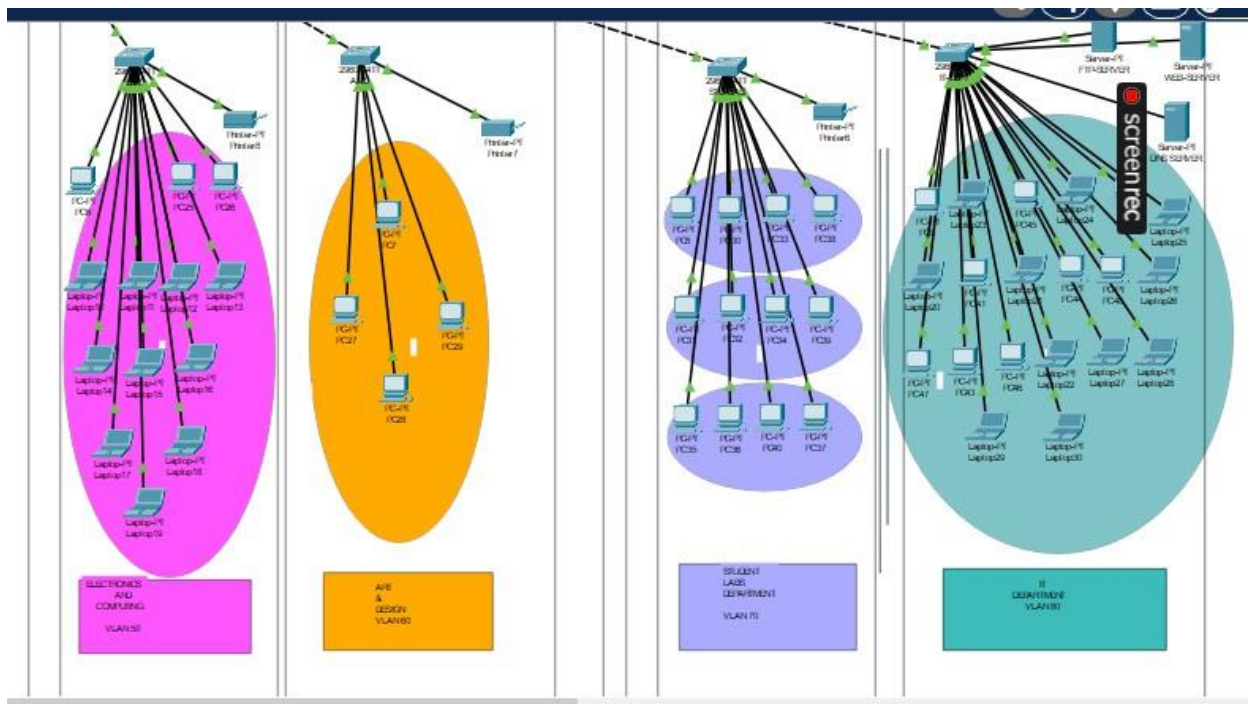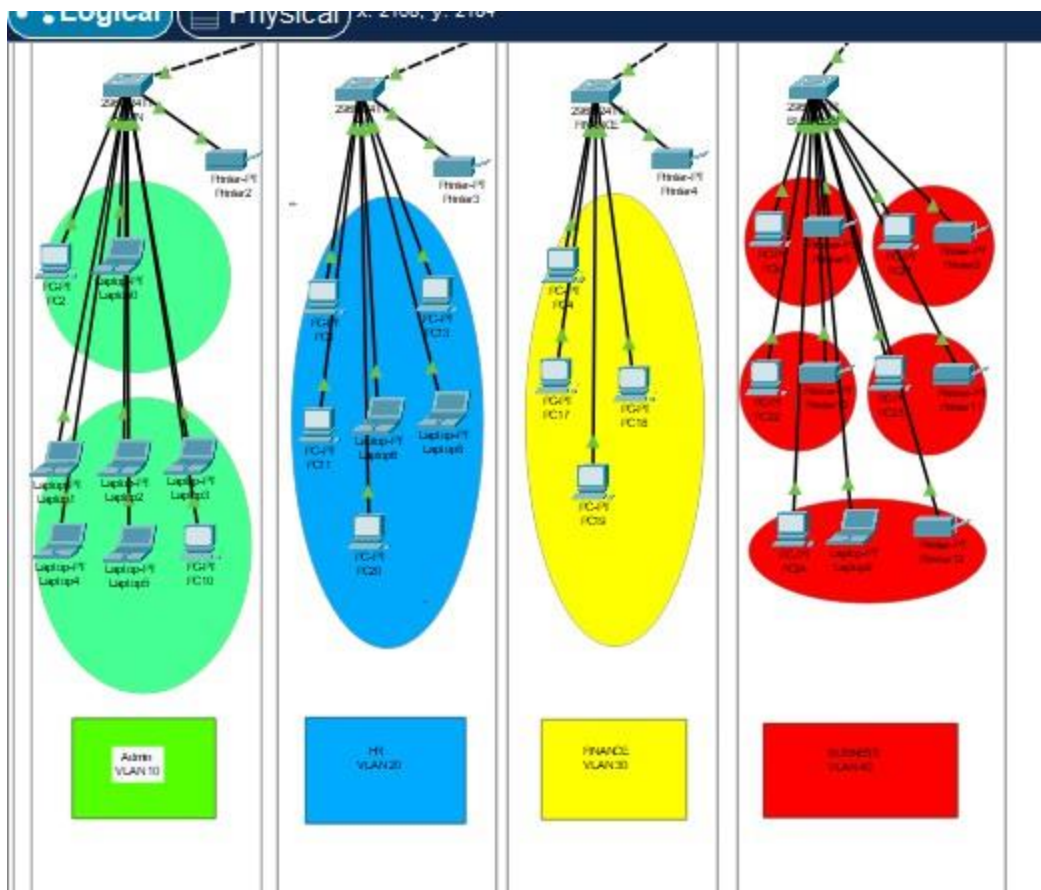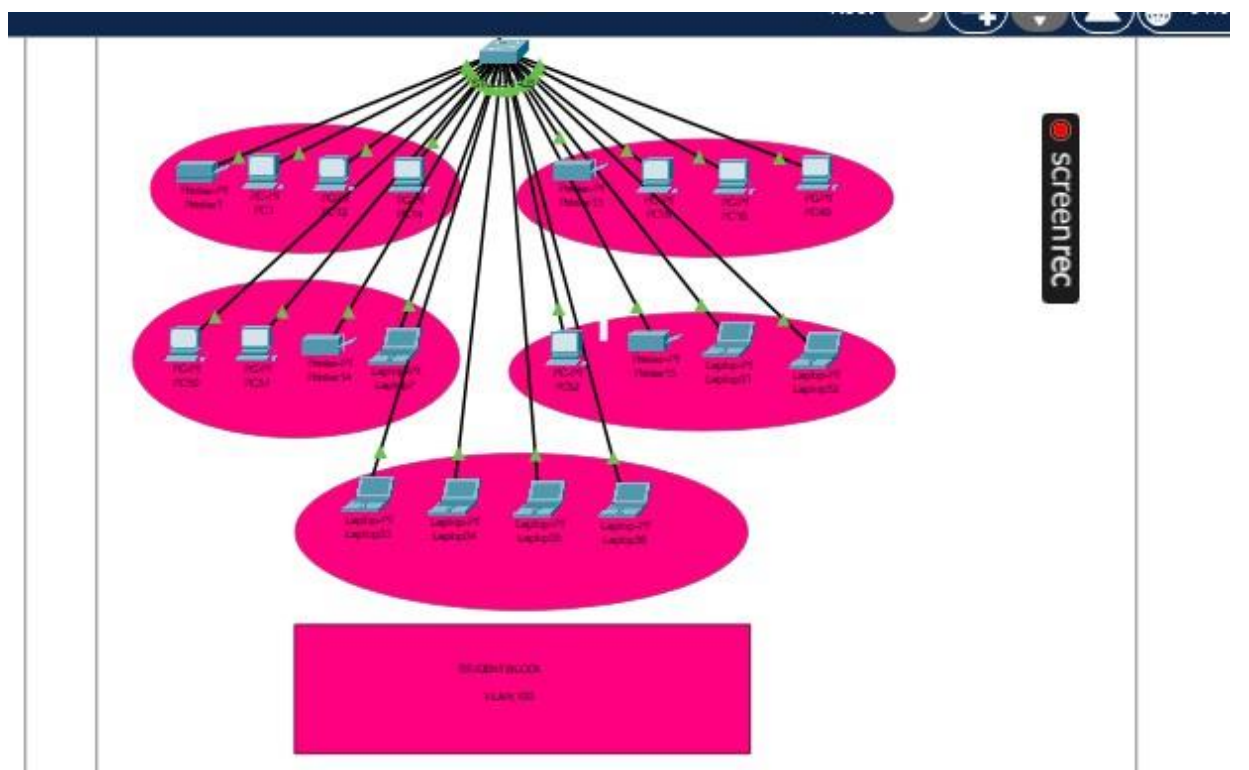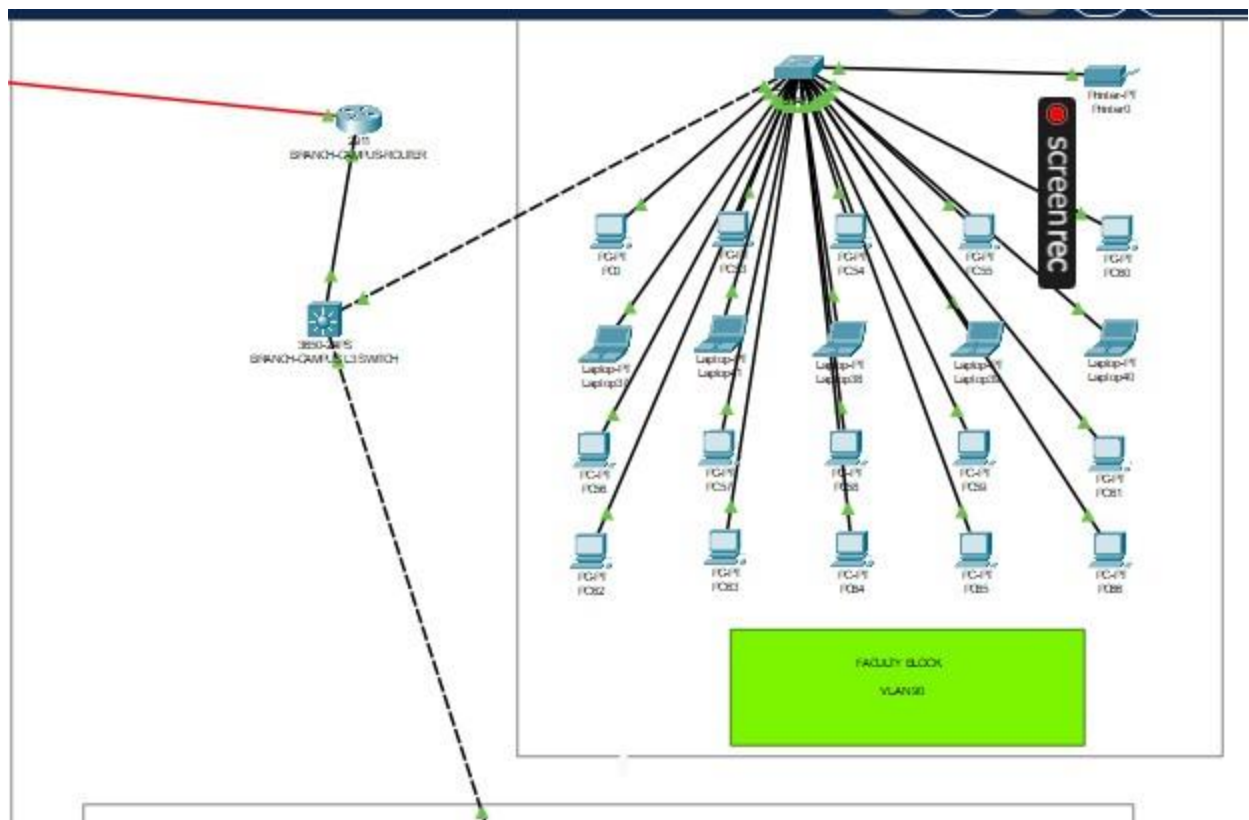
BRANCH-CAMPUS-ROUTER

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
System Bootstrap, Version 15.1(4)M4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2010 by cisco Systems, Inc.
Total memory size = 512 MB - On-board = 512 MB, DIMM0 = 0 MB
CISCO2911/K9 platform with 524288 Kbytes of main memory
Main memory is configured to 72/-1(On-board/DIMM0) bit mode with ECC disabled

Readonly ROMMON initialized

program load complete, entry point: 0x80803000, size: 0x1b340
program load complete, entry point: 0x80803000, size: 0x1b340

IOS Image Load Test
_____
Digitally Signed Release Software
program load complete, entry point: 0x81000000, size: 0x3bcd3d8
Self decompressing the image :
######################### [OK]
Smart Init is enabled
smart init is sizing iomem
                 TYPE        MEMORY_REQ
          HWIC Slot 2      0x00200000       Onboard devices &
          buffer pools     0x022F6000
-------------------------------------------------
                 TOTAL:      0x02AF6000
Rounded IOMEM up to: 45Mb.
Using 6 percent iomem. [45Mb/512Mb]

              Restricted Rights Legend

Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
```
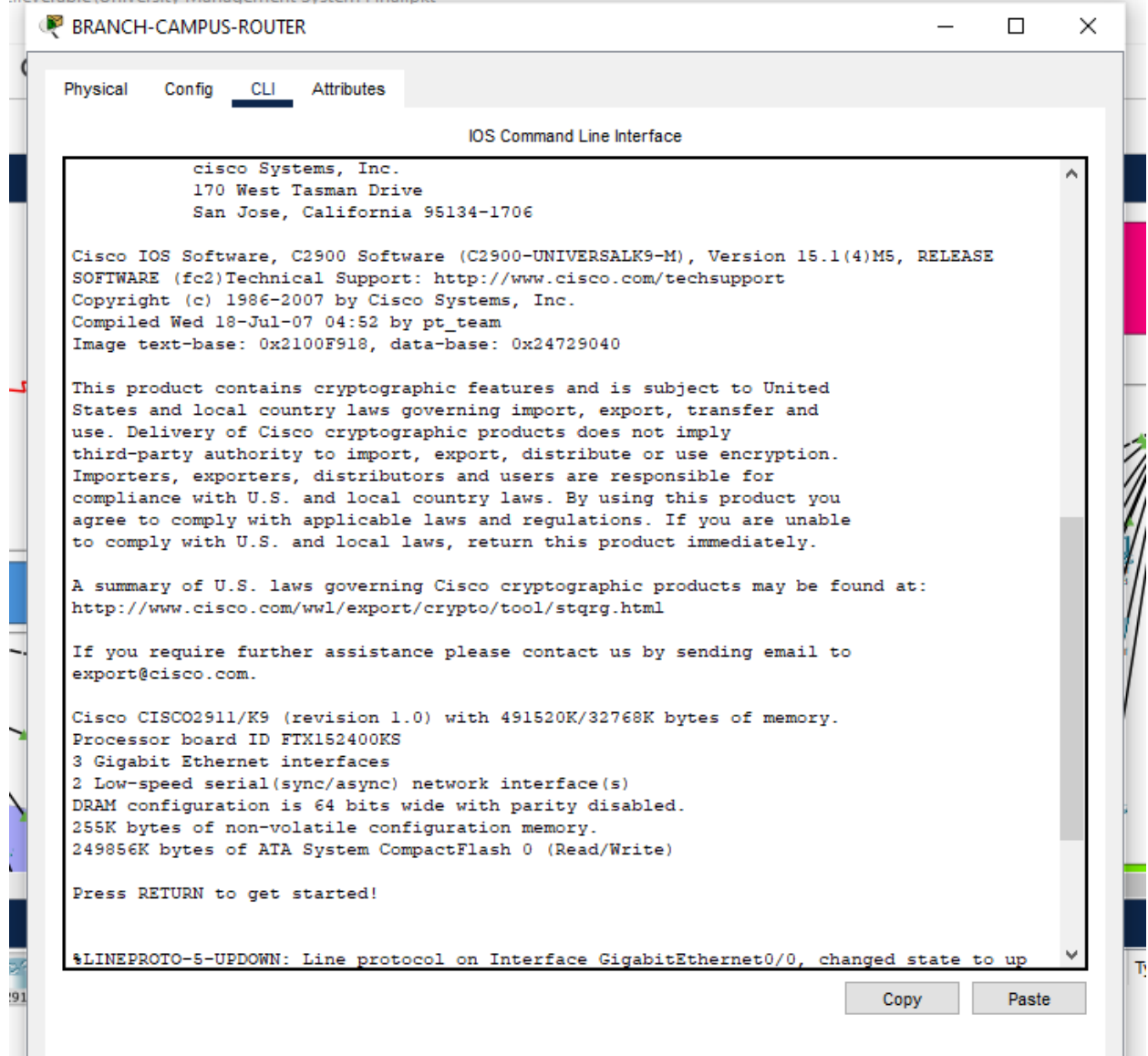
Copy   Paste

BRANCH-CAMPUS-ROUTER — ☐ ✕

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
            cisco Systems, Inc.
            170 West Tasman Drive
            San Jose, California 95134-1706

Cisco IOS Software, C2900 Software (C2900-UNIVERSALK9-M), Version 15.1(4)M5, RELEASE
SOFTWARE (fc2)Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Wed 18-Jul-07 04:52 by pt_team
Image text-base: 0x2100F918, data-base: 0x24729040

This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco CISCO2911/K9 (revision 1.0) with 491520K/32768K bytes of memory.
Processor board ID FTX152400KS
3 Gigabit Ethernet interfaces
2 Low-speed serial(sync/async) network interface(s)
DRAM configuration is 64 bits wide with parity disabled.
255K bytes of non-volatile configuration memory.
249856K bytes of ATA System CompactFlash 0 (Read/Write)

Press RETURN to get started!


%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
```

Copy   Paste

BRANCH-CAMPUS-ROUTER

Physical   Config   CLI   Attributes

IOS Command Line Interface

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%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.90, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.100, changed state to
up

%LINK-5-CHANGED: Interface Serial0/2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/2/0, changed state to up

Copy   Paste

IOS Command Line Interface

```
Press RETURN to get started!


%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up

%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.10, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.20, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.30, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.40, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.50, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.60, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.70, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.80, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up
```
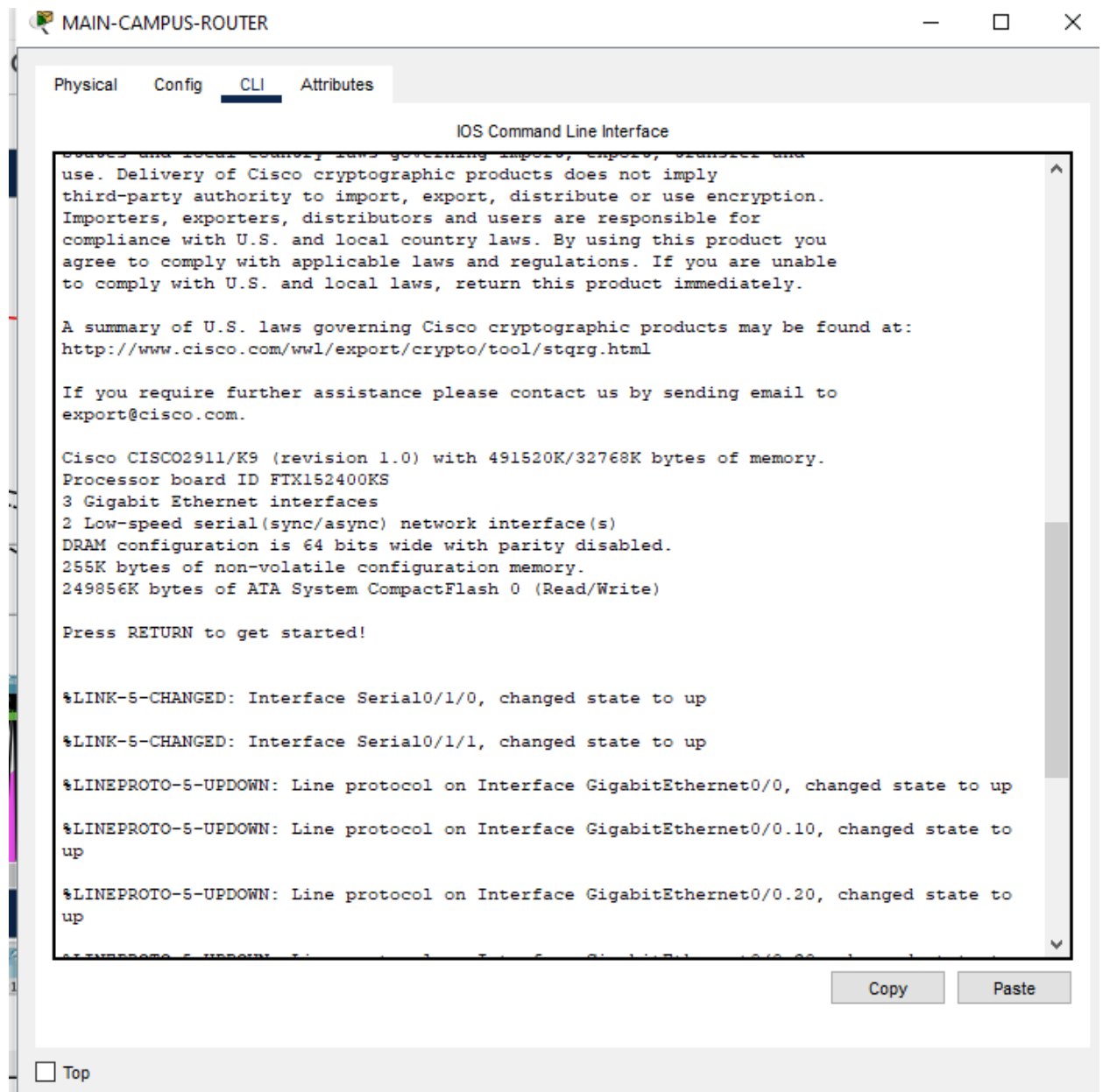
Copy   Paste

MAIN-CAMPUS-ROUTER   — ☐ ✕

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
use. Delivery of Cisco cryptographic products does not imply
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249856K bytes of ATA System CompactFlash 0 (Read/Write)

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%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.10, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.20, changed state to
up
```

Copy   Paste

☐ Top

b) Configure DHCP protocol on end routers connecting different end devices including workstations, Laptops etc.

PC9   —   □   X

Physical   Config   Desktop   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0   ∨

IP Configuration

⦿ DHCP   ◯ Static   DHCP failed. APIPA is being used.

IPv4 Address   169.254.0.1

Subnet Mask   255.255.0.0

Default Gateway   0.0.0.0

DNS Server   0.0.0.0

IPv6 Configuration

◯ Automatic   ⦿ Static

IPv6 Address   /

Link Local Address   FE80::290:21FF:FEB1:AA21

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5   ∨

Username

Password

Physical   Config   Desktop   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0   ⌄

IP Configuration

○ DHCP   ○ Static   DHCP request successful.

IPv4 Address   192.168.7.2

Subnet Mask   255.255.255.0

Default Gateway   192.168.7.1

DNS Server   192.168.7.1

IPv6 Configuration

○ Automatic   ● Static

IPv6 Address   _____   / _____

Link Local Address   FE80::20D:BDFF:FEEC:9CC4

Default Gateway   _____

DNS Server   _____

802.1X

☐ Use 802.1X Security

Authentication   MD5   ⌄

Username   _____

Password   _____

PC27 — □ ✕

Physical | Config | Desktop | Programming | Attributes

IP Configuration   X

Interface   FastEthernet0   ⌄

IP Configuration

◉ DHCP   ○ Static   DHCP request successful.

IPv4 Address   192.168.6.2

Subnet Mask   255.255.255.0

Default Gateway   192.168.6.1

DNS Server   192.168.6.1

IPv6 Configuration

○ Automatic   ◉ Static

IPv6 Address   /

Link Local Address   FE80::201:43FF:FE48:2387

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5   ⌄

Username

Password

☐ Top

c) Configure Routing Protocols (OSPF or RIP) between different routers

We have configured the rip version so that the routing information is stored on the branch router and communication can take place using the shortest path between the two devices and using the hop which counts the distance between the two devices.

d) Configure VLANs on Local Area Network to keep the communication isolated.

Admin
VLAN 10

HR
VLAN 20

FINANCE
VLAN 30

BUSINESS
VLAN 40

ELECTRONICS
AND
COMPUTING
VLAN 50

ART
&
DESIGN
VLAN 60

STUDENT
LABS
DEPARTMENT
VLAN 70

IT
DEPARTMENT
VLAN 80

STUDENT BLOCK

VLAN 100

PC83   PC84   PC85   PC86

FACULTY BLOCK

VLAN 90
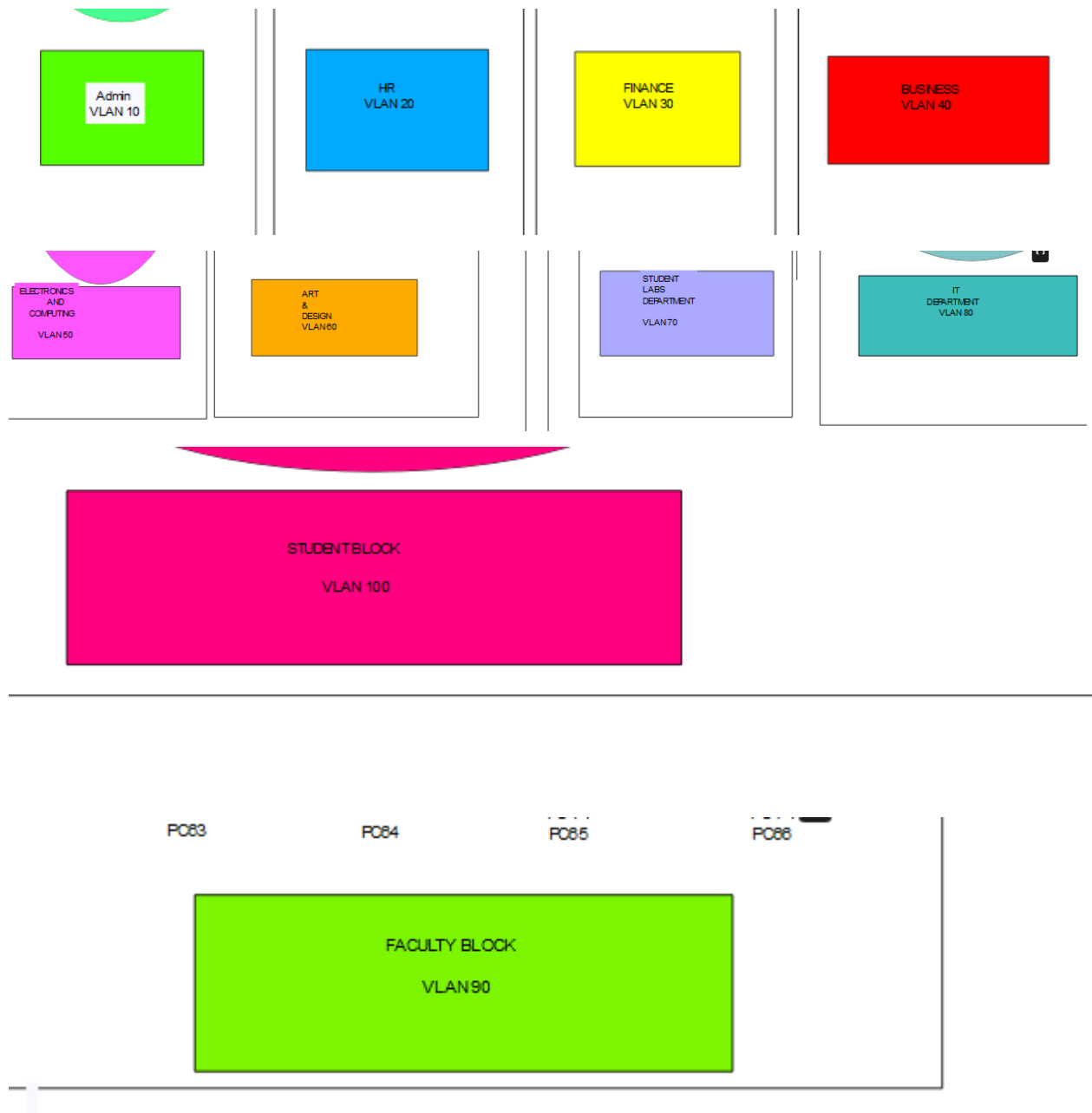
e) Store the configuration of different routers with a specified file name on TFTP server. Incase due to any certain disaster or issue you have made the backup for the configurations of routers.

Ans) We have used the ftp server in case of disaster recovery.
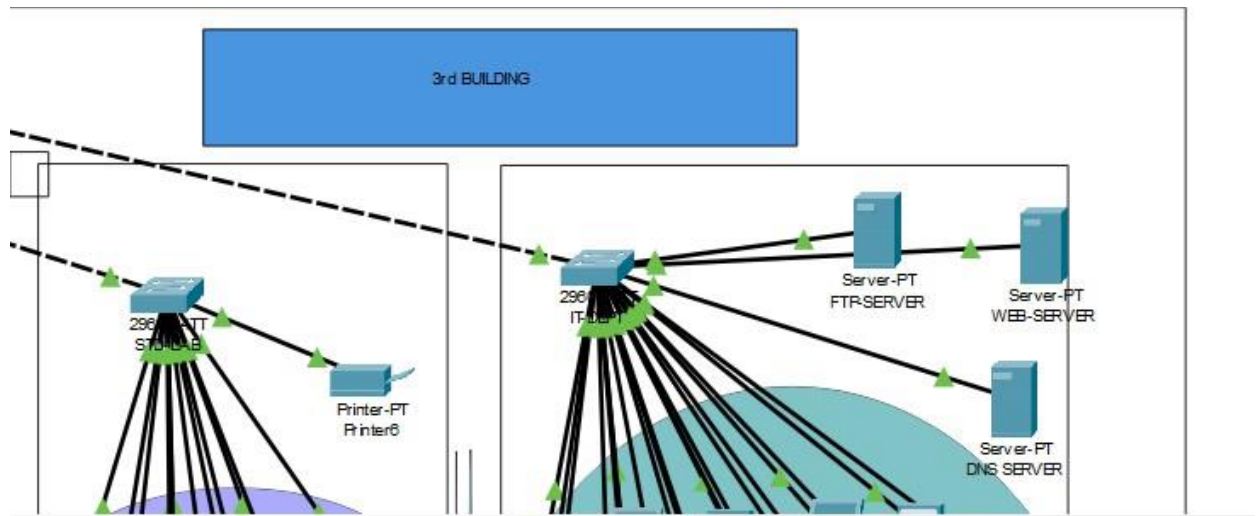
f) Subnet in at least two departments e.g., HR and IT

We have used the subnetting in the two departments.

Using the no of bits or no of users involved in it.

Laptop5   —   □

Physical   Config   Desktop   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0

IP Configuration

◉ DHCP   ○ Static   DHCP request successful.

IPv4 Address	192.168.1.2
Subnet Mask	255.255.255.0
Default Gateway	192.168.1.1
DNS Server	192.168.1.1

IPv6 Configuration

○ Automatic   ◉ Static

IPv6 Address	/
Link Local Address	FE80::201:63FF:FE65:5B63
Default Gateway	
DNS Server	

802.1X

☐ Use 802.1X Security

Authentication	MD5
Username	
Password	

Mandatory conditions

    g)   Use the CIDR IP addressing that should be in accordance with last 2 or 3 digits of your

           enrollment number, as shown below.

Laptop3   — □ ✕

Physical   Config   **Desktop**   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0 ⌄

IP Configuration

○ DHCP   ◉ Static

IPv4 Address   169.254.49.102

Subnet Mask   255.255.0.0

Default Gateway   0.0.0.0

DNS Server   0.0.0.0

IPv6 Configuration

○ Automatic   ◉ Static

IPv6 Address   /

Link Local Address   FE80::201:63FF:FE49:31B9

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5 ⌄

Username

Password

IP Addressing Scheme - CIDR		
Last 2 or 3 digits of your enrollment number must be used in your selected network address e.g., 10, 43, 110 can be used in the following different ways in your network address		
10.0.0.0/22	100.**43**.10.0/24	43.**110**.128.0/25
43.192.0.0/20	**110**.150.64.0/21	

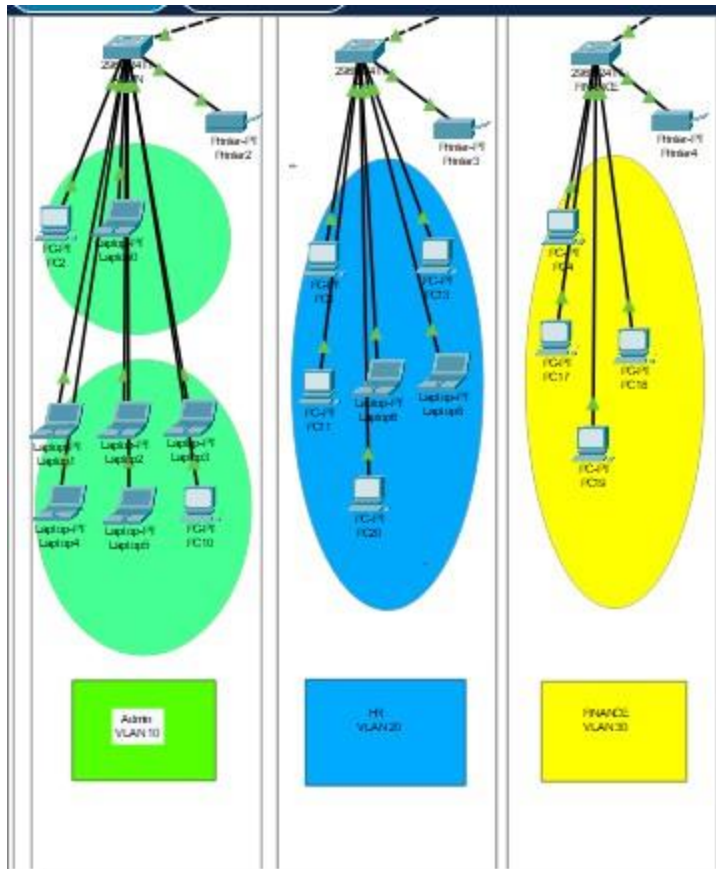h) All departments, Labs and rooms should have 5 hosts

Admin
VLAN 10

HR
VLAN 20

FINANCE
VLAN 30

BUSINESS
VLAN 60
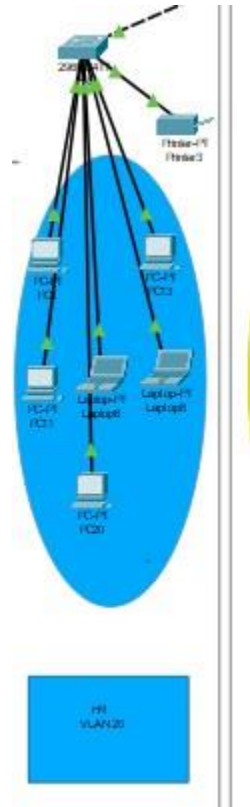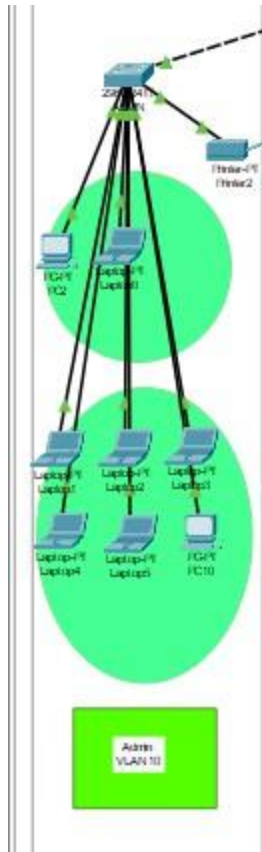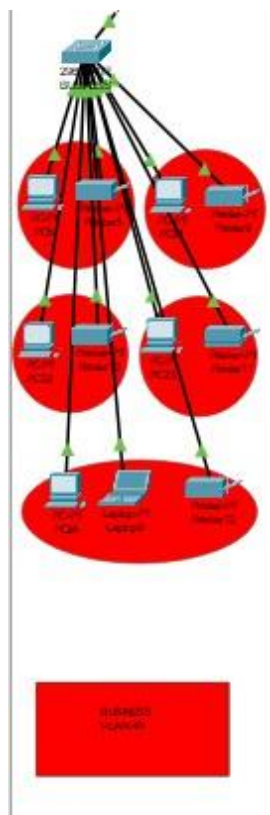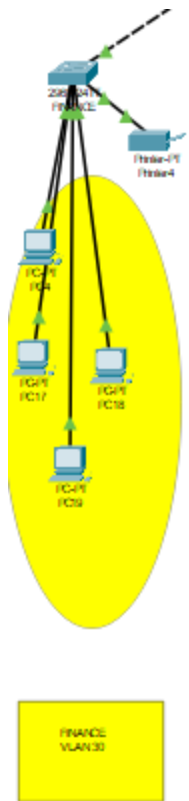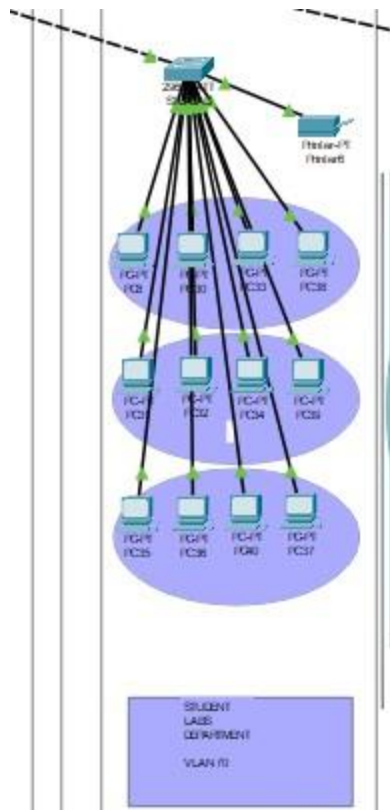
i) There must be 5 departments in the network

Admin
VLAN 10

HR
VLAN 20

FINANCE
VLAN 30

BUSINESS
VLAN 40

ELECTRONICS
AND
COMPUTING

VLAN 50

ARE
&
DESIGN
VLAN 60

STUDENT
LABS
DEPARTMENT

VLAN 70

IT
DEPARTMENT
VLAN 80
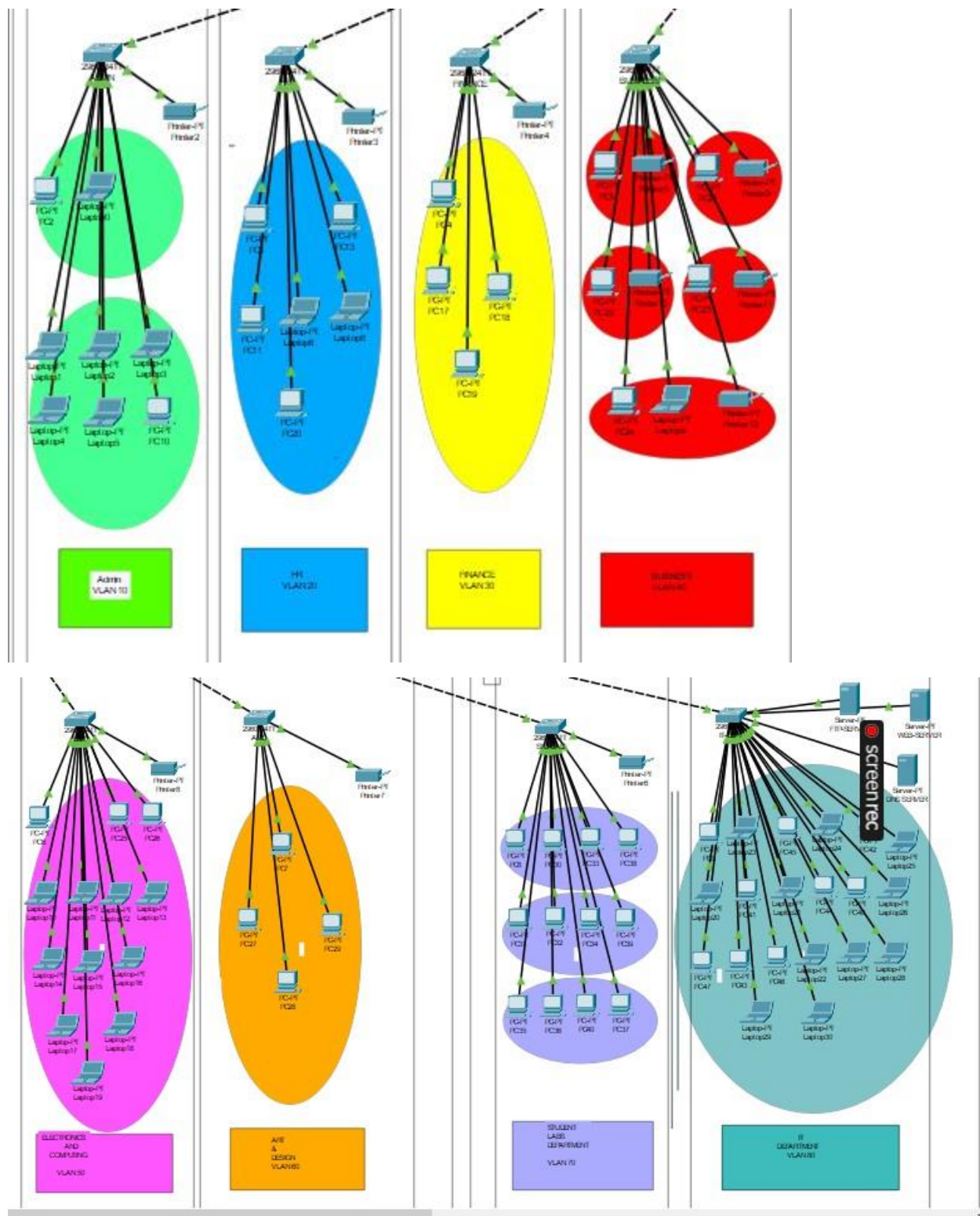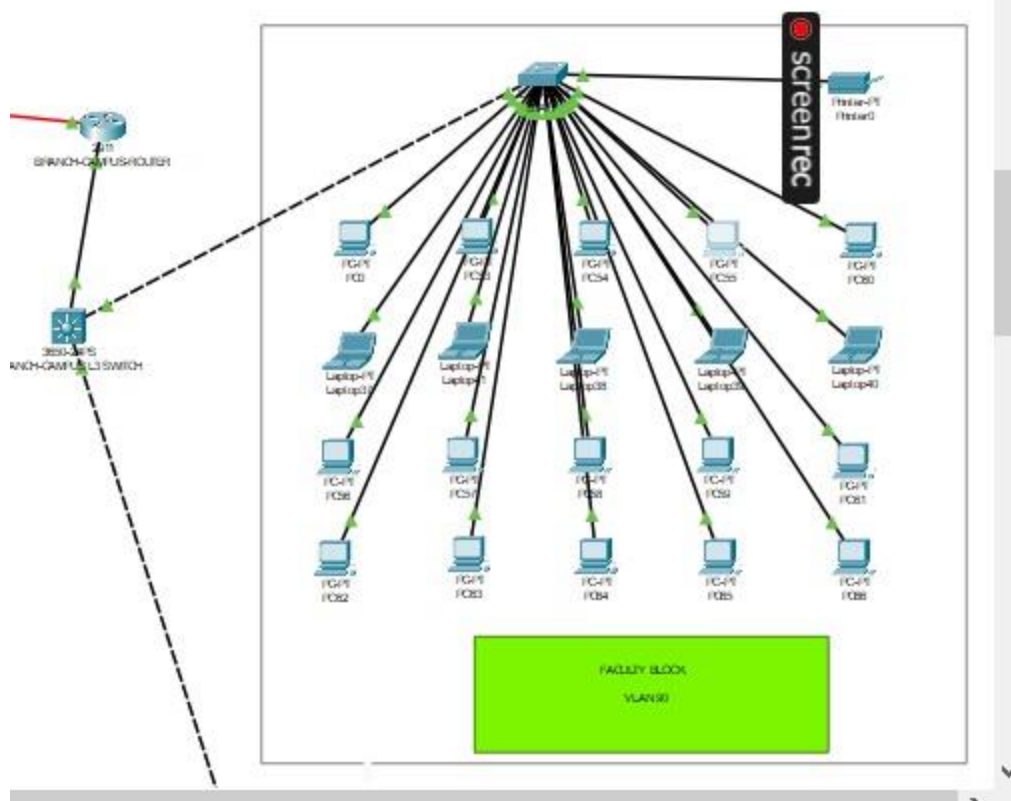
j) There must be 2 Labs and 3 rooms in any two departments

STUDENT
LABS
DEPARTMENT

VLAN 70

IT
DEPARTMENT
VLAN 80
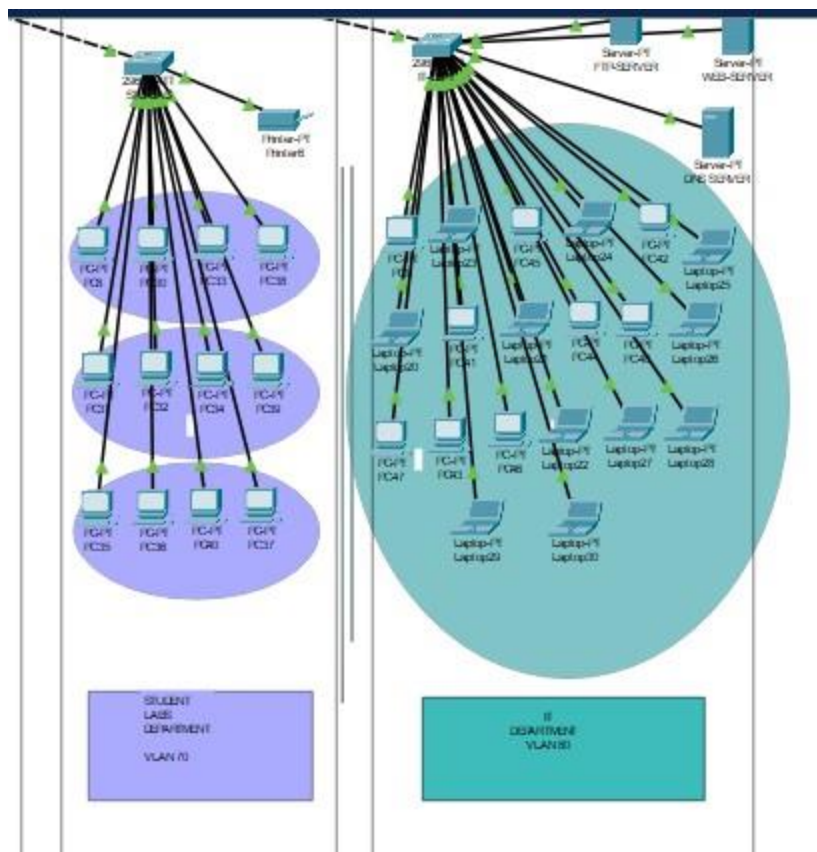
Lab Deliverables: The project should be complete and all hosts should be accessible, project implementation and understanding would be evaluated thorough viva voce of the project along with demonstration:

a) Proper configurations of hosts and DHCP   (20 marks)

Ans) The router will act dhcp server and assign the ips to the system.

PC9   — ☐ ✕

Physical   Config   **Desktop**   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0   ⌄

IP Configuration

◉ DHCP   ○ Static   DHCP failed. APIPA is being used.

IPv4 Address   169.254.0.1

Subnet Mask   255.255.0.0

Default Gateway   0.0.0.0

DNS Server   0.0.0.0

IPv6 Configuration

○ Automatic   ◉ Static

IPv6 Address   [   ] / [   ]

Link Local Address   FE80::290:21FF:FEB1:AA21

Default Gateway   [   ]

DNS Server   [   ]

802.1X

☐ Use 802.1X Security

Authentication   MD5   ⌄

Username   [   ]

Password   [   ]

Physical   Config   Desktop   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0   ⌄

IP Configuration

⦿ DHCP   ○ Static   DHCP request successful.

IPv4 Address   192.168.7.2

Subnet Mask   255.255.255.0

Default Gateway   192.168.7.1

DNS Server   192.168.7.1

IPv6 Configuration

○ Automatic   ⦿ Static

IPv6 Address   /

Link Local Address   FE80::20D:BDFF:FEEC:9CC4

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5   ⌄

Username

Password

b) Implementation of both OSPF and RIP between different routers   (30 marks)

enable

configure terminal

router ospf <process-id>

network <network-address> <wildcard-mask> area <area-id>

router ospf 1

network 10.0.0.0 0.255.255.255 area 0

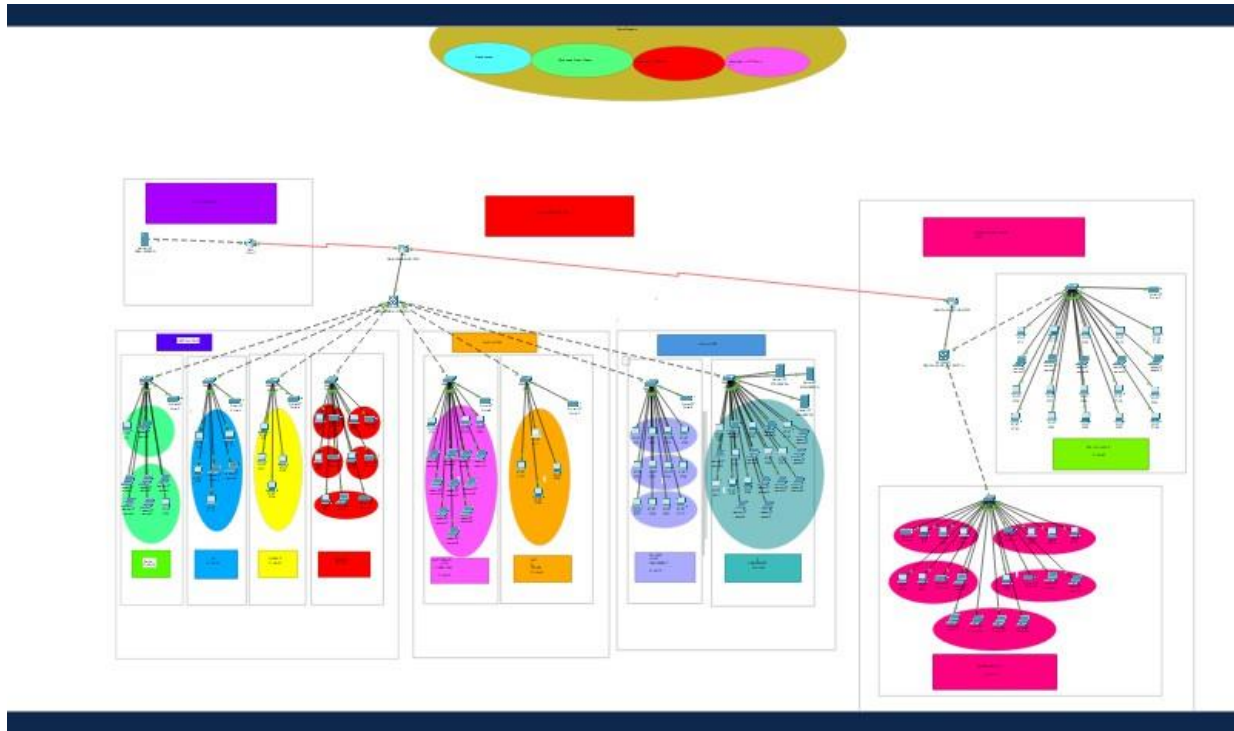router rip

version 2

network <network-address>

router rip
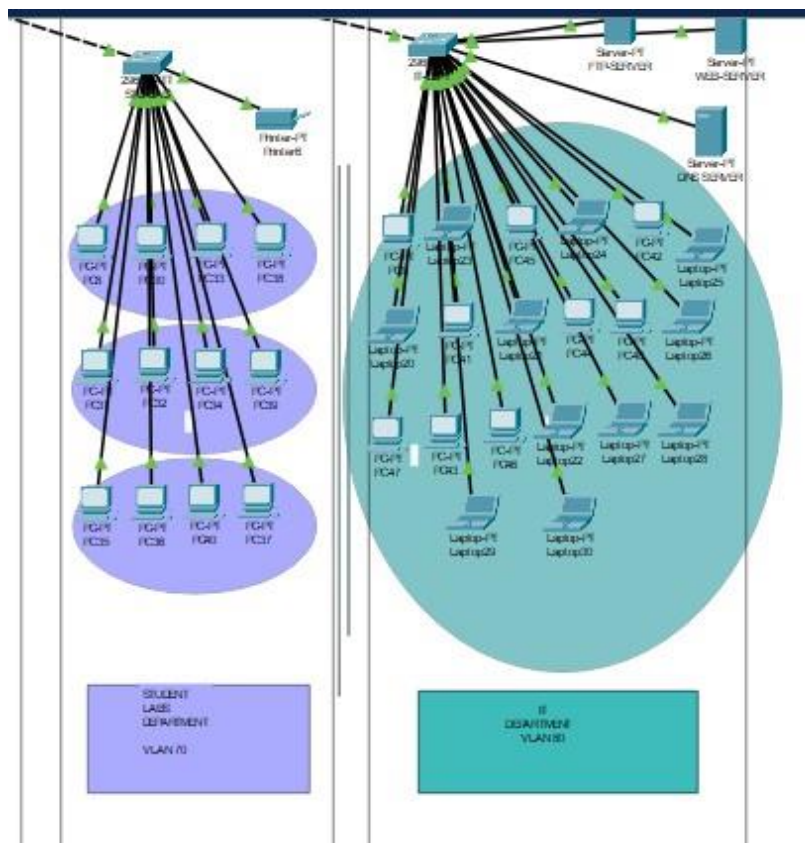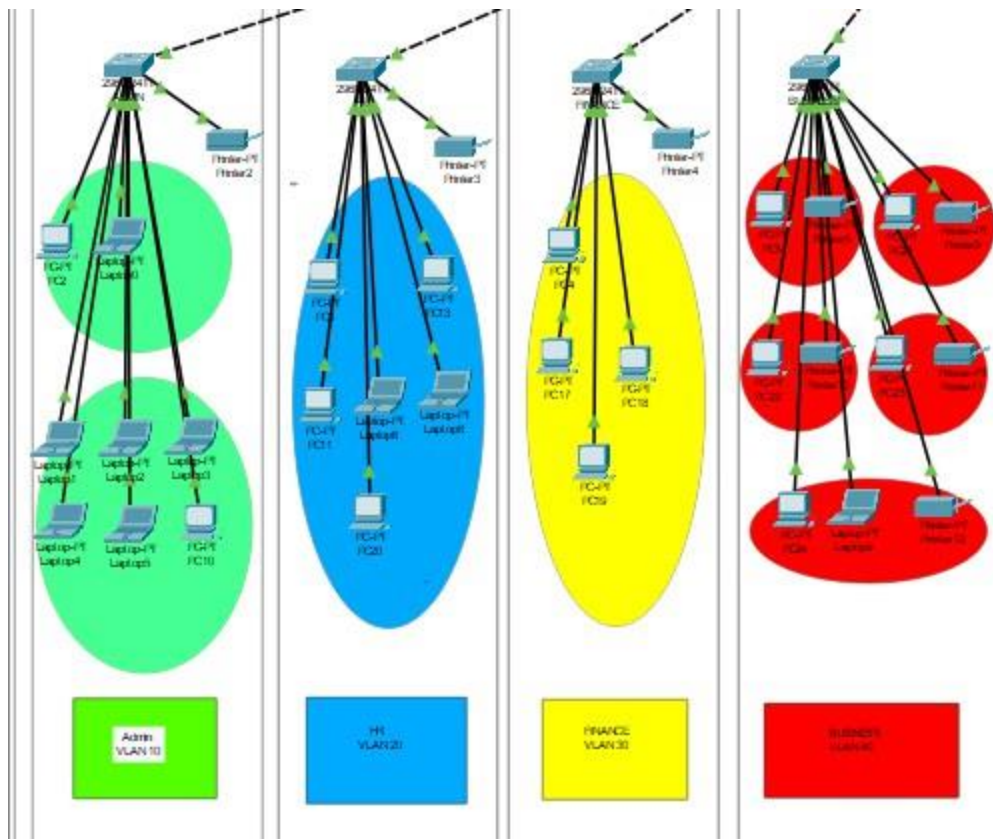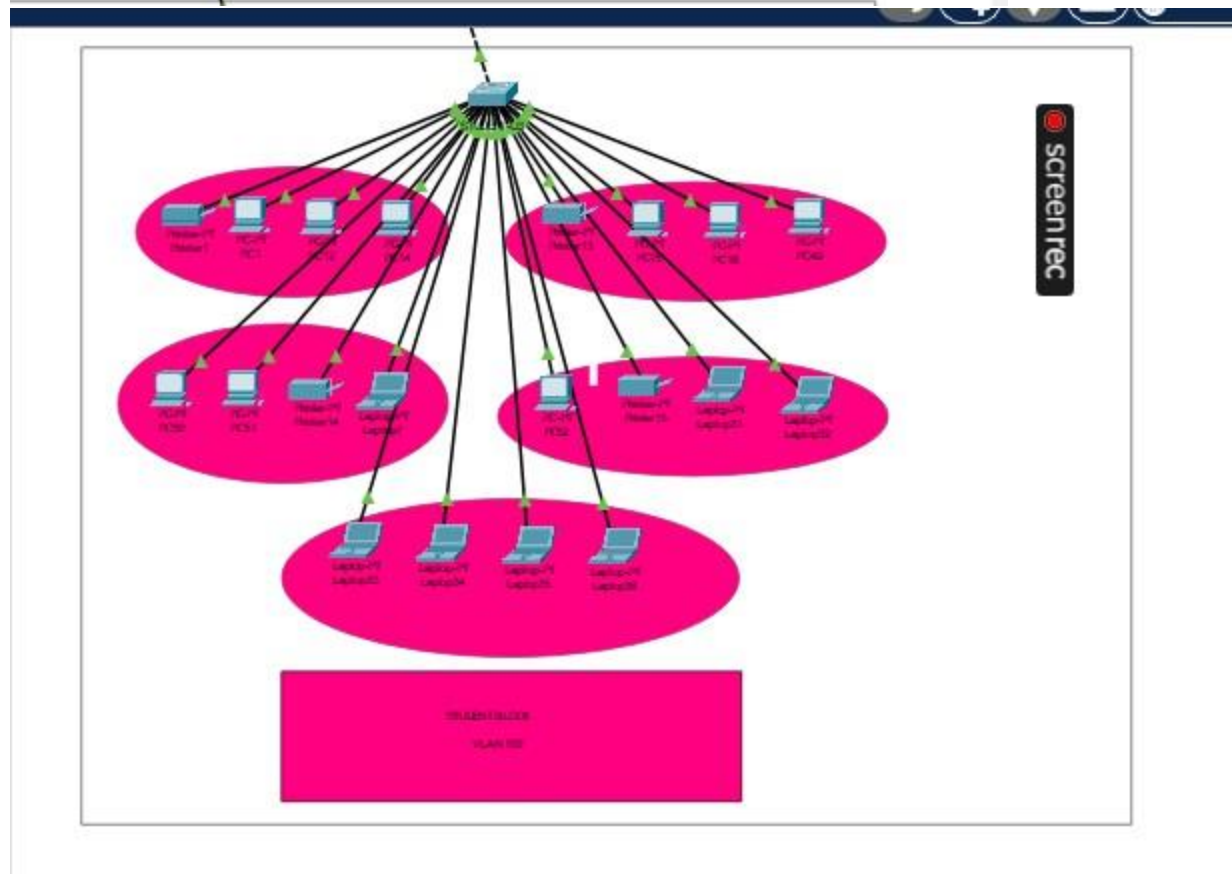
version 2

network 192.168.1.0

exit

write memory

c) VLANs on Local Area Network   (20 marks)

Admin
VLAN 10

HR
VLAN 20

FINANCE
VLAN 30

BUSINESS
VLAN 40

STUDENT
LABS
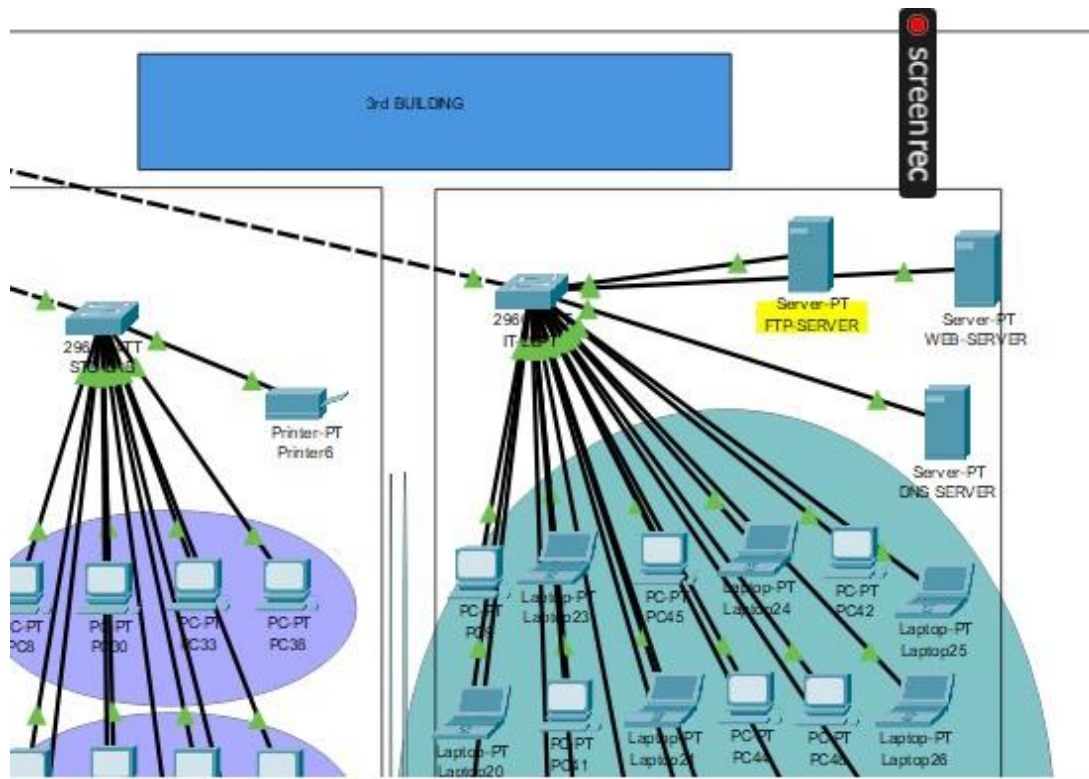DEPARTMENT

VLAN 70

IT
DEPARTMENT
VLAN 80

FACILITY BLOCK

VLAN90
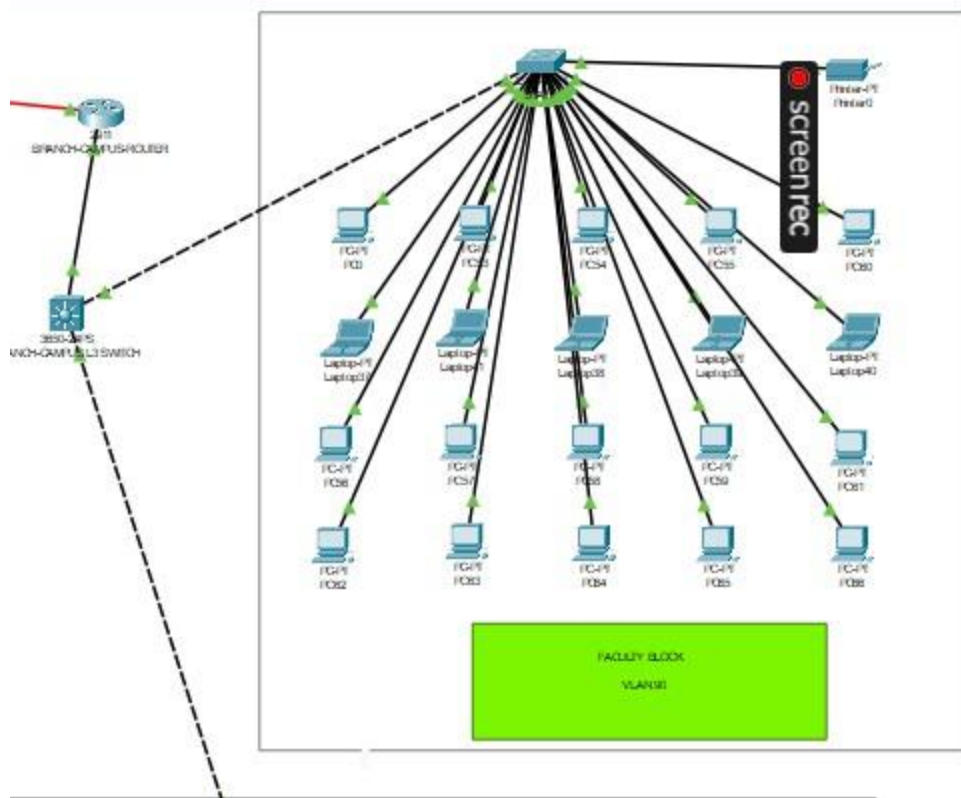
d) Implementation of TFTP server   (10 marks)

MAIN-CAMPUS-ROUTER

Physical | Config | CLI | Attributes

GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
SWITCHING
VLAN Database
INTERFACE
GigabitEthernet0/0
GigabitEthernet0/1
GigabitEthernet0/2
Serial0/1/0
Serial0/1/1

Global Settings

Display Name: MAIN-CAMPUS-ROUTER
Hostname: Router
NVRAM: Erase | Save
Startup Config: Load... | Export...
Running Config: Export... | Merge...

Equivalent IOS Commands

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.60, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.70, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.80, changed state to
up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up
```

e) Subnetting

The IP address 169.254.185.206 falls within the range of the Automatic Private IP Addressing (APIPA) space. APIPA addresses are in the range 169.254.0.1 to 169.254.255.254 and are typically assigned to devices when they are unable to obtain an IP address through DHCP (Dynamic Host Configuration Protocol). However, it seems like you mentioned a class-based approach. Please note that classful addressing is an older concept and is not commonly used in modern networks. Instead, subnetting based on CIDR (Classless Inter-Domain Routing) is more prevalent. However, if you're looking at this address from a classful perspective   The IP address 169.254.185.206 is a Class B address because it falls within the range of 128.0.0.0 to 191.255.255.255. In a class B address, the first two octets represent the network portion, and the last two octets represent the host portion.   So, for 169.254.185.206: •

Network portion: 169.254 •

Host portion: 185.206

Remember, in modern networking, subnetting is more commonly done using CIDR notation, which allows for a more flexible and efficient allocation of IP addresses.

Note: I'm not studying dcn class course.

Class/Theory Deliverables: You are required to document your project implementation. The report should be well formatted, well organized and should have the following content

- Cover page & Table of content (detailed)   (5 marks)
- Introduction : Your organizational organogram, network and department size in terms of number of hosts   (5 marks)
- IP Schemes   (10 marks)
    - Justify, the selection of your network IP block & departmental network addresses (based on your assumption of network size)
- Methodology – Network diagrams   (40 marks)
    - Complete network diagram (all router should be labeled with network addresses)
    - Each department's network diagram (fully labeled)
- You are required to recommend an appropriate router for your organization's WAN connectivity based on given router specifications. The maximum price range for the purchase is 5 million PKR including taxes. You have to recommend three routers from different manufactures that should meet at least 80% of specifications. However, price of all routers must be less than 5 million PKR. Generate the technical evaluation report of the routers based on given sample.   (30 marks)
- Difficulties faced in project implementation   (10 marks)

Sample Network Diagram
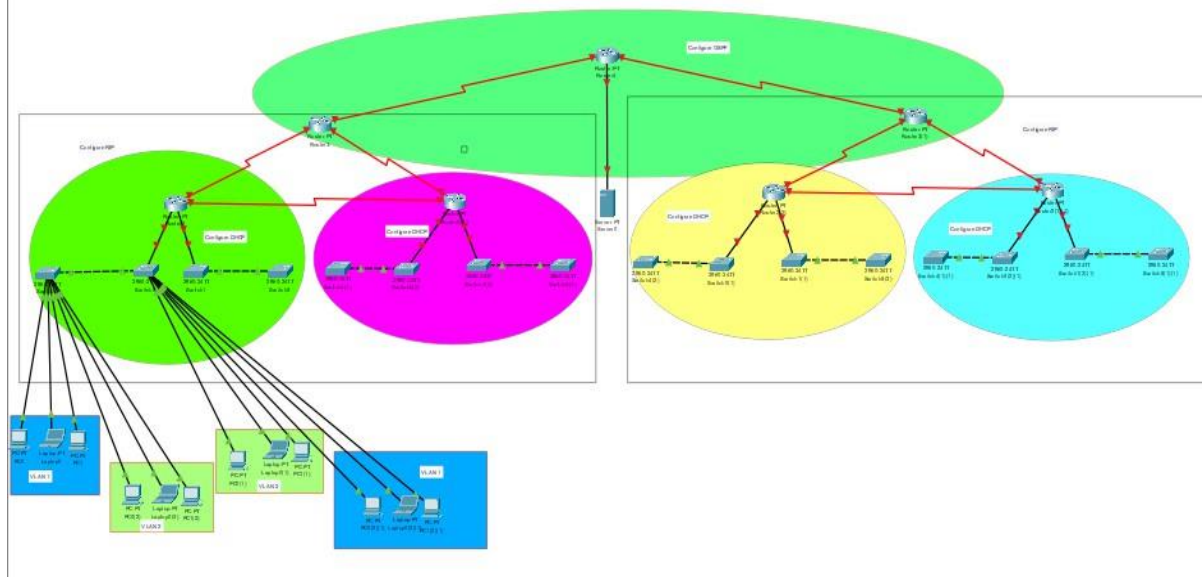
WAN Router Specifications: (Quantity - 1)

1. The router should support high availability and security features.
2. The router should have at least 4 x GE/SFP Combo ports + 2 x 10GE SFP+ WAN ports. Should include 2 x 1G Short range SFPs
3. At least 2 of the WAN ports should support Layer 2 connectivity and support PoE.
4. The router should have at least 3 slots that can be used for intel based compute, supporting up to 12 Cores, 128GB RAM and 16TB Storage
5. Router should have at least 3 x Interface slots, in addition to the above, supporting different interfaces such as LAN/WAN, E1/PRI, FXO/FXS etc.
6. Throughput of the router should be at least 1.5 Gbps and should be upgradable to more than 10 Gbps with simple license upgrade.
7. Should support at least 1000 VPNs simultaneously
8. Should support Call Control functionality with support for up to 400 IP Phones
9. Minimum 8 GB Flash (Expandable to 32 GB)
10. Minimum 8 GB DRAM (Expandable to 32 GB)
11. Should support Next Generation Encryption features as below:
    a. AES-128-GCM for Authenticated Encryption
    b. HMAC-SHA256 for Authentication
    c. ECDSA-P256 for Digital Signatures
    d. SHA, SHA-256, SHA-384, SHA-512
    e. ECDH-P256 for Key Establishment.
    f. RSA (748/1024/2048 bit)
    g. MD5
12. Router should support High availability (Active-Active, Active-Standby VRRP)
13. The router should support routing protocols such as RIP v1/v2, IS-IS, OSPF, BGP, PBR etc.
14. Should support Intelligent Routing and Application Visibility.
15. Should support IPv6.
16. Should support MPLS.
17. Should support Software Defined WAN.
18. Should support WAN optimization features as below:
    a. TCP Flow Optimization, Persistent LZ Compression
    b. DRE Compression
    c. Application Optimizations for file sharing, emails, web apps, enterprise apps etc.

TECHNICAL EVALUATION REPORT

Equipment: Storage Area Network (SAN) Server with 20 TB Capacity and Accessories

Sr	Description	Premier	Compliance	Outstart Tech	Compliance	Kokusai	Compliance
		HPE MSA 2050 SAN Dual Controller SFF Storage		**Dell EMC ME4024 Storage Array**		**HPE MSA 2060 Storage**	
1	Controller Cards: 10Gb iSCSI SFP + 8 Port Dual Controller iSCSI optics	Controller Cards: 10Gb iSCSI SFP + 8 Port Dual Controller iSCSI optics (**Q1J01B** - HPE MSA 2050 SAN Dual Controller SFF Storage)	Yes	Dell EMC PowerEdge SFP+ SR Optic 10Gbe 850nm - CNC 8 port dual controller for iSCSI SFP+ and/or FC	Yes	**R0Q76A** - HP MSA 2060 10GbE iSCSI SFF	Yes
2	Cables: DAC Cable, SFP+, Copper, 5M	Cables: DAC Cable, SFP+, Copper, 5M (**537963-B21** HPE Bladesystem c-Class 10Gbe SFP+ to SFP + 5m direct attach copper cable)	Yes	Included in Dell EMC ME4024 Storage		**JG081C** - HPE FlexNetwork X240 10G	Yes
3	Hard Drives: 10 x 2.4TB 10K RPM SAS 12Gbps 2.5 in hot-plug	Hard Drives: 10 x 2.4TB 10K RPM SAS 12Gbps 2.5 in hot-plug (**Q2R41A** - 10 x HPE MSA 2.4TB 12G SAS 10K SFF (2.5in) Enterprise 512e 3 Yr Warranty)	Yes	12 x 2.4 TB 10K RPM SAS 12 Gbps 512e 2.5in Hotplug Hard drive	Yes	**R0Q57A** - 10 x HPE MSA 2.4 TB SAS 12G Enterprise 10k SFF (2.5 in) M2 3ys Wty HDD	Yes
4	Power Supply: Redundant + Accessories	Power Supply: Redundant + Accessories (A0K03A - HPE C13 - C14 WW 250V 10A Gray 0.7m Jumper Cord)	Yes	Power Supply, 580W, Redundant - Jumper cord c13 - c14, 4M, 250v	Yes	Redundant power supply	Yes
5	Hardware Support Services: 3 Years - Next Business Day Onsite Service	Hardware Support Services: 3 Years - Next Business Day Onsite Service	Yes	3 Year ProSupport: Next Business Day Onsite Service	Yes	HPE 3Y Tech Care Basic Service	Yes

Sample Evaluation Report