University of Colombo, Sri Lanka

UCSC *University of Colombo School of Computing*

BACHELOR OF SCIENCE IN INFORMATION SYSTEMS

Second Year Examination — Semester II— UCSC AY20 [held in March/April 2024]

IS 2111 — Computer Networks

(2 Hours)

Answer All Questions

Number of Pages = 11 Number of Questions = 4

To be completed by the candidate								
Index Number								

Important Instructions to candidates:

- Students should answer in the medium of English language only using the space provided in this question paper.
- Note that questions appear on both sides of the paper. If a page or a part of this question paper is not printed, please inform the supervisor immediately.
- Write your index number CLEARLY on each and every page of this Question paper.
- This paper consists of 4 questions in 11 pages (including the Cover Page).
- Answer ALL questions.
- Calculators and any electronic device capable of storing and retrieving text including electronic dictionaries, smart watches and mobile phones are not allowed.
- Do not tear off any part of this answer book. Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate

To be completed by the examiners

1	
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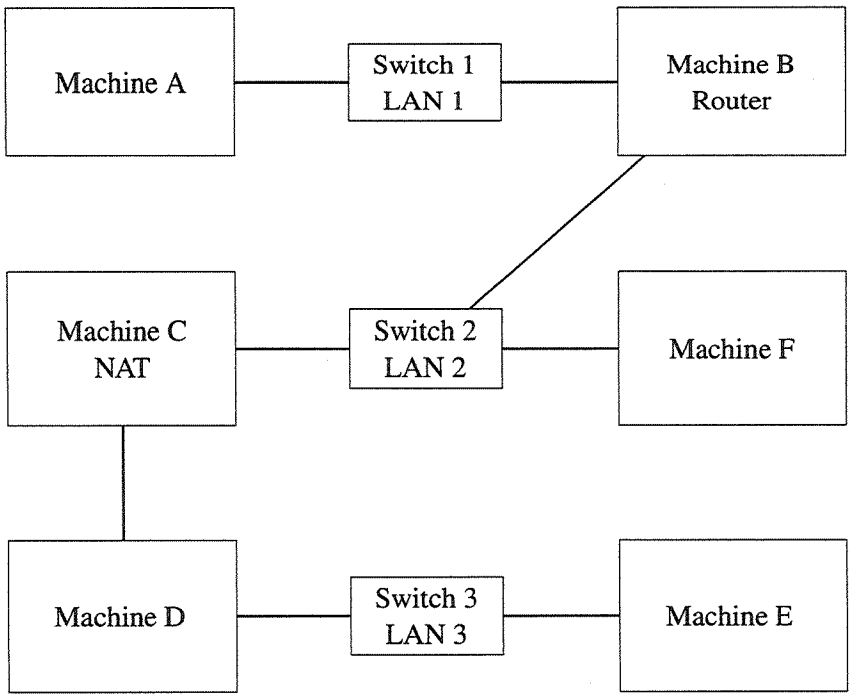
1. (a). A network is depicted in the following diagram. Only the machines shown in the diagram are in the network. The machines **A**, **B**, **F** and one interface of **C** are assigned IP adresses from a private IP address range. Private IP addresses are not routed outside LAN 1 and LAN 2. The machine **C** is a `Network Address Translator` (NAT) that connects a private network to a public network.

Use this diagram to answer the questions from 1(a)i to 1(a)x.



Web servers are running on the port 8080 on the machine **F** and port 80 on **E**. A browser on machine **A** creates a TCP connection, T_F, to the port 8080 the machine **F** and another TCP connection, T_E, to port 80 on the machine **E**. It sends two HTTP GET requests on these two connections. Both servers sent the reply to the GET request.

Using Wireshark on **F**, it was observed that **F** has only one TCP connection and all the IP datagrams comming to it has the source IP address **192.168.1.34**. Similarly **E** has only one TCP connection and all the IP datagrams comming to it has the source IP address **192.248.16.5**. One end point of the T_F has the IP address **192.168.1.66**. One end point of the T_E has the IP address **192.248.17.10**.

The subnet mask of the point to point link between **C** and **D** is **255.255.255.252**. The network interface of the machine **A** is configured with the subnet mask **255.255.255.224**. One interface of **C** is configured with the IP address **192.168.1.65/26**.

An ARP request to resolve the IP address **192.168.1.100** has received a reply with the MAC address **08:00:27:4f:e5:10** and an ARP request to resolve the IP address **192.168.1.35** has returned the MAC address **08:00:27:f9:cf:12**. Ethernet frames containing the IP datagrams of T_E received at **E** has the source MAC address **08:00:27:f9:cf:01**.

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i. What is the IP address of the machine **A**?

[3 marks]

ii. What is the broadcast IP address used in LAN 1?

[3 marks]

iii. What is the IP address of the default gateway assigned to the machine **A**?

[4 marks]

iv. What is the destination MAC address of the Ethernet frames carrying IP datagrams of the TCP connection T_E when they are on LAN 1?

[3 marks]

v. One interface of **D** is assigned the IP adress **192.248.17.1**. What is the IP address of the other interface of **D**?

[4 marks]

vi. An ARP request is sent by the machine **E** to resolve the IP address **192.248.17.1**. What is the MAC address that it gets as an answer to this request?

[3 marks]

vii. What is the source IP address of the IP datagrams containing the reply to the GET request sent on T_E, when they are received at **A**?

[3 marks]

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viii. What is the source MAC address of the Ethernet frames carrying the IP datagrams of the connection T_F, when they are received at **F**?

[4 marks]

ix. The source port assigned to the TCP connection T_E at **A** is 5050. However, when Wireshark is used to inspect T_E at **E** , it was found that the source port is 7000. What is the reason for this?

[5 marks]

x. What is the IP broadcast address used on the point-to-point link between **C** and **D**?

[3 marks]

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2. (a). i. What is the maximum possible data rate on a **noiseless channel** of bandwidth 1000 Hz? Justify your answer.

[3 marks]

ii. The signal to noise ratio of a channel is given as x dB and it's bandwidth is H Hertz. Give an expression for the maximum possible datarate of this channel?

[5 marks]

(b). A channel has a bit error probability p. The message bit 1 is sent encoded as 11 and the message bit 0 is sent encoded as 00 on this channel.

i. A message 1 is sent on this channel encoded as the bit string 11. What is the probability that the receiver receives the message correctly?

[3 marks]

ii. A message 10 is sent on this channel encoded according to the above scheme. What is the probability that the receiver receives this message correctly?

[4 marks]

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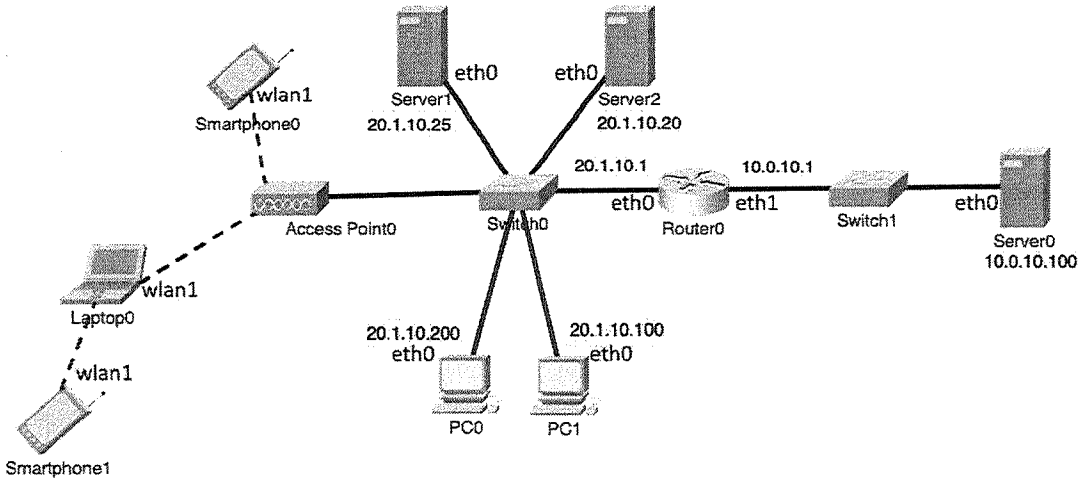
3. Consider the following network diagram when answering the given questions. The relevant IP address and MAC address details are given in the table. Some of the IP addresses are configured manually by the network administrator and some devices are configured to obtain IP addresses from a DHCP server.



Device	Interface	IP address	MAC Address
Router0	eth0	20.1.10.1/23	aa:aa:aa:00:00:01
Router0	eth1	10.0.10.1/24	aa:aa:aa:00:00:02
PC0	eth0	20.1.10.200/23	bb:bb:bb:00:00:01
PC1	eth0	20.1.10.100/23	bb:bb:bb:00:00:02
Server0	eth0	10.0.10.100/24	cc:cc:cc:00:00:01
Server1	eth0	20.1.10.25/23	cc:cc:cc:00:00:02
Server2	eth0	20.1.10.20/23	cc:cc:cc:00:00:03
Smartphone0	wlan0	(DHCP)	dd:dd:dd:01:00:01
Smartphone1	wlan0	(DHCP)	dd:dd:dd:01:00:02
Laptop0	wlan0	(DHCP)	dd:dd:dd:02:00:01

(a). The network administrator has issued the following command on **Server1** to assign the IP address.

```
sudo ip addr add 20.1.10.25/23 dev eth0
```

Write the corresponding **ifconfig** Linux command to assign IP address to the same device.

[3 marks]

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(b). Assume that the **Server1** is configured as a **DHCP server**. List the devices which can obtain IP addresses from the DHCP service running on the **Server1**.

[4 marks]

(c). What is the datalink layer communication protocol that can be used to communicate between **Laptop0** and **Access Point0**?

[2 marks]

(d). List down **three (3)** most important information broadcasted by the **Access Point0** which is required by the devices to initiate a link with the **Access Point0**.

[3 marks]

(e). **PC0** needs to communicate with the devices outside its local area network,

i. What is the appropriate default gateway for PC0?

[2 marks]

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ii. What is the Linux command used to configure the default gateway?

[4 marks]

(f). **PC0** is sending a 100MB file to **Server0**. Its application is using **FTP** as the application layer protocol and **TCP** as the transport layer protocol. Assume that there is a packet sniffer (Wireshark-like tool) between **Router0** and **Switch1**, and it is capturing the network traffic. The captured network traffic is exported as a **PCAP** file and given to you for further analysis.

i. What is the Wireshark filter that you can use to filter the network traffic generated from **PC0**?

[2 marks]

ii. Following figure shows a section of the Wireshark application where you can view some details of the datagram which is filtered by using the filter mentioned in the previous question that is generated by **PC0** and sending to **Server0**. What are the values that should be in the Blank A and Blank B.

```
> Frame 231: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface en0, id 0
v Ethernet II, Src: [redacted], Dst: [redacted]
    Destination: [redacted]
  > Source: <——BLANK A ——>
    Type: IPv4 (0x0800)
    Padding: 000000000000
  Internet Protocol Version 4, Src: [redacted], Dst: <——BLANK B ——>
  Transmission Control Protocol, Src Port: [redacted], Dst Port: [redacted], Seq: 1, Ack: 1, Len: 0
```

[4 marks]

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(g). **Server0** has Web server running on port 80. Browser running on **Laptop0** requests the home page (index.html) of the website hosted in the web server. One of the IP packets containing the response is lost by **Router0**. Should the browser request the webpage again without the intervention of the user. Justify your answer.

[4 marks]

(h). Write down the first line of the above mentioned request generated by the web browser of the **Laptop0** .

[2 marks]

4. (a). Fiber to the Home (FTTH) is a popular type of fiber networks. List two (2) other such types of fiber networks.

[4 marks]

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(b). Describe passive optical networks.

[4 marks]

(c). Compare Circuit Switching and Packet Switching networks in terms of their impact on the network during switch failures and the likelihood of network congestion.

[6 marks]

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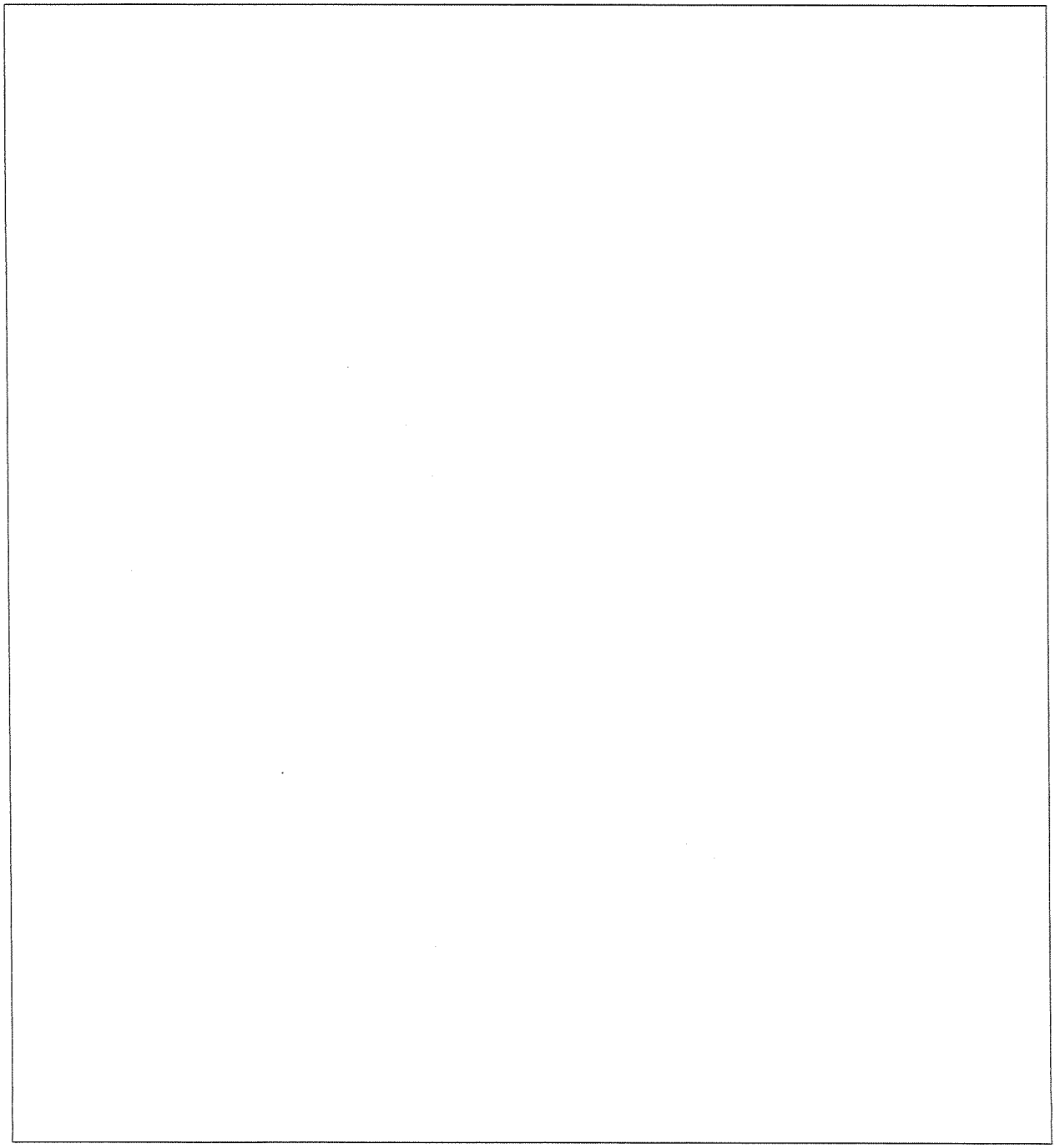
(d). Illustrate the GSM architecture by including the controllers and registers.

[6 marks]



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