

CS-307 Computer Networks

Wednesday, Feb 3, 2021

Course Instructors

Dr. Muhammad Asim, Dr. Abdul Waheed and
Ahmed Nawaz

Serial No:

Final-Part A

Total Time: 1 Hour

Total Marks: 55

Signature of Invigilator

Abeera Fatima

Student Name

18i-0411

Roll No

D

Section

Abeera

Signature

DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

1. This is only the Part-A of the final exam, you have maximum one-hour and once you return it, you will be provided with the Part-B and Part-C.
2. Attempt on question paper. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
3. No additional sheet will be provided for rough work.
4. After asked to commence the exam, please verify that you have Eleven (11) different printed pages including this title page. There is only one question with 55 MCQs.
5. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	Part-A	Part-B	Part-C	Total
Marks Obtained	41			
Total Marks	55	50	40	145

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Question-1: [55 points]

Please cross (X) the correct answer, any answer not provided in the table below would not be considered.

Sr. No	A	B	C	D	E	Sr. No	A	B	C	D	E	Sr. No	A	B	C	D	E
01			X			26	-		X			51	X		X		
02	X					27	X					52			X		
03		X				28		X				53			X		
04			X			29		X				54			X		
05		X				30			X			55			X		
06	X					31	X										
07		X				32	X										
08		X				33			X								
09	X					34	-	X									
10		X				35	X										
11	X					36					X						
12		X				37		X									
13	X					38					X						
14	X					39					X						
15			X			40					X						
16	X					41		X									
17	X					42			X								
18		X				43	X										
19	X					44						X					
20	X					45					X						
21		X				46		X									
22		X				47		X									
23			X			48					X						
24	X					49	X										
25			X			50					X						

← copying
error
sorry

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1. Find the oddly matched HTTP status codes
 - a. 200 OK ✓
 - b. 400 Bad Request ✓
 - c. Moved permanently 301
 - d. 304 Not Found
2. DHCP belongs to which layer? Hint (or distraction): PTCL broadband router at our houses runs the DHCP protocol as well.
 - a) Application
 - b) Transport
 - c) Network
 - d) Link layer
 - e) Physical
3. Which of the following protocols have somewhat similar functionality (for the translation) as of the DNS protocol?
 - a) FTP
 - b) SMTP
 - c) ARP
 - d) CNN
 - e) None of the above
4. Why is IP Protocol considered as unreliable?
 - a. A packet may be lost
 - b. Packets may arrive out of order
 - c) Both (a) and (b)
 - d) Duplicate packets may be generated
 - e. All of the above
5. Which of the following is correct in VLSM?
 - a. Subnets must be in same size
 - b. No required number of subnets known
 - c) Can have subnets of different sizes
 - d. All of the above
 - e. None of the above
6. The IP network 192.168.50.0 is to be divided into 10 equal sized subnets. Which of the following subnet masks can be used for the above requirement?
 - a. 255.255.255.240
 - b. 255.255.0.0
 - c. 255.255.248.0
 - d. 255.255.255.0
7. Which of the following IP addresses can be used as (a) loop-back addresses?
 - a. 0.0.0.0
 - b) 127.0.0.1
 - c. 255.255.255.255
 - d. Both (a) and (b)
 - e. 0.255.255.255

DNS
Mac address → IP

(d)

class C. $4 \rightarrow 4 \text{ remaining}$

$$\begin{array}{r} 4 \\ 2 \\ \hline 2^2 = 4 \\ 2^3 = 8 \\ 2^4 = 16 \\ 2^5 = 32 \\ 2^6 = 64 \\ 2^7 = 128 \\ 2^8 = 256 \\ 2^9 = 512 \\ 2^{10} = 1024 \end{array}$$

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8. In the Go-Back-N window, when the timer of the packet times out, several packets have to be resent even though some may have arrived safely. Whereas in Selective Repeat window, the sender resends _____
- Packet which are not lost
 - Only those packets which are lost or corrupted
 - Packet from starting
 - All the packets
 - Hard to tell
9. In the slow-start algorithm, the size of the congestion window increases _____ until it reaches a threshold.
- Exponentially
 - Additively
 - Multiplicatively
 - Suddenly
 - Both (a) and (c)
10. In the congestion avoidance algorithm, the size of the congestion window increases _____ until congestion is detected.
- Multiplicatively
 - Suddenly
 - Additively
 - Both (a) and (e)
 - Exponentially
11. Which constructor of Datagram Socket class is used to create a datagram socket and binds it with the given Port Number?
- Datagram Socket(int port)
 - Datagram Socket(int port, Int Address address)
 - Datagram Socket()
 - Datagram Socket(int address)
 - None of the above
12. The client in socket programming must know which information?
- IP address of Server
 - Port number
 - Both IP address of Server & Port number
 - Only its own IP address
 - All of the above
13. Datagram is basically just a piece of information but there is no guarantee of its content, arrival or arrival time.
- True
 - False

14. Flow control slows down the sender when the network is congested. True.

- a. True: Congestion control slows down the sender when the network is congested. ✓
 b. False: Flow control slows down the sender when the receiver is slow.
 c. True but not reason in (a)
 d. False but not reason in (b)
 e. None of the above

cwnd, rwnd

(a)

15. Assume that two hosts A and B use public key cryptography to ensure confidentiality. The steps followed by the two hosts to send a message from A to B are given but NOT in order. Choose the correct order.

- i. The sender A encrypts the message using B's public key q, ii
ii. The receiver B decrypts the message using its private key.
iii. The receiver (B) generates a public/private key pair and sends the public key to the sender.. X
 a. i, ii, iii
 b. ii, iii, i
 c. iii, ii, i
 d. None of the above
 e. Difficult to tell

step three
incorrect.

16. What is the main advantage of the public key cryptography (e.g., RSA) over the symmetric key cryptography (e.g., DES)?

- a. There are no advantages
 b. Public key cryptography does not require sending any secret key over the network
 c. Public key cryptography requires sending any secret key over the network
 d. I don't think we have studied this

17. On classic Ethernet, the Maximum Transmission Unit (MTU) for an IP datagram is:

- a. 1500 bytes
 b. 65536 bytes
 c. 1024 bytes
 d. 64 bytes
 e. 8192 bytes

18. The Internet Control Message Protocol (ICMP) is used by:

- a. SNMP and NTP
b. DNS and ARP
 c. ping and traceroute
d. Web and email applications
e. FTP and email applications

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19. What is the difference between congestion control and flow control?

- a. Congestion control prevents overrunning buffers in the network, while flow control prevents overflowing the receiver's
- b. Flow control prevents overrunning buffers in the network, while congestion control prevents overflowing the receiver's
- c. Congestion control prevents overflowing buffers in the network, while flow control prevents overrunning the receiver's
- d. None of the above

20. If an IP packet experiences an error in transit towards a receiver, how does the source discovers such events?

- a. It relies on timeout event
- b. ICMP protocol is utilized for such purposes
- c. TCP protocol is utilized for such purposes
- d. Source will never discover IP datagram delivery issues

21. On a VLSM network, which mask should you use on a point-to-point WAN link in order to reduce the wastage of IP addresses?

- a. /26
- b. /28
- c. /30 → only network broadcast
- d. /32 → 0 addresses

(C) 30

22. ICMP messages are delivered reliably. Choose the correct option.

- a. True
- b. False
- c. Can't be guaranteed
- d. ICMP is not a correct term

23. Which of the following is an application layer service?

- a. Network virtual terminal
- b. File transfer, access, and management
- c. Mail service
- d. Both (b) and (c)
- e. All of the above

(d)

24. Which of the following applications allows a user to access and change remote files without actual transfer?

- a. DNS
- b. FTP
- c. Telnet
- d. None of the above

25. Devices on one network can communicate with devices on another network via a _____

- a. File server
- b. Utility server
- c. Printer server
- d. Gateway
- e. All of the above

26. State whether the following statements are true or false.

- i. In class B addresses, a total of more than 1 billion addresses can be formed. F
- ii. Class E addresses are reserved for future or experimental use. T

- a. True, False
- b. True, True
- c. False, True
- d. False, False

$2^{25} \times 2^{25}$

27. _____ is responsible for converting the higher level protocol addresses (IP addresses) to physical network addresses.

- a. ARP
- b. RARP
- c. BOOTP
- d. ICMP

28. The examples of Interior Gateway Protocols (IGP) are:

- i. Open Shortest Path First (OSPF)
 - ii. Routing Information Protocol (RIP)
 - iii. Border Gateway Protocol (BGP)
- a. i only
 - b. i, and ii only
 - c. i, and iii only
 - d. i, ii, and iii

29. The resources needed for communication between end systems are reserved for the duration of session between end systems in _____

- a. Packet switching
- b. Circuit switching
- c. Line switching
- d. Frequency switching
- e. None of the above

30. Which of the following fields in IPv4 datagram is not related to fragmentation?

- a. Flags
- b. Offset
- c. TOS
- d. Identifier

31. What should be the flag value to indicate the last fragment?

- a. 0
- b. 1
- c. TTL value
- d. None of the mentioned

32. The DHCP server can provide the _____ of the IP addresses.

- a. Dynamic allocation
- b. Automatic allocation
- c. Static allocation
- d. All of the above
- e. None of the above

(a)

33. To deliver a message to the correct application program running on a host, the _____ address must be consulted.

- a. IP
- b. MAC
- c. Port
- d. All of the above

Assume that in the case of a pipelined, reliable transport protocol, for which the sender can have up to N=4 unacknowledged packets, packets with sequence numbers 0-3 are transmitted. Only the packet with sequence number 2 gets lost during the transmission. Answer the following two questions.

34. What are the sequence numbers of the packets that are retransmitted in the case of Go-Back-N?

- a. 2
- b. 2, 3, and 4
- c. 2, and 3
- d. 3

0 - 3

35. What are sequence numbers in the case of Selective Repeat?

- a. 2
- b. 2, 3, and 4
- c. 2, and 3
- d. 3

36. Which one of the following is true for the TCP fast transmission algorithm?

- a. After receiving three duplicates ACKs, the sender waits for the timer to expire and then retransmit.
- b. After receiving two duplicates ACKs, the sender retransmit without waiting for the timer to expire
- c. After receiving four duplicates ACKs, the sender retransmit without waiting for the timer to expire
- d. None of the above

37. In a network, If P is the only packet being transmitted and there was no earlier transmission, which of the following delays could be zero?

- a. Propagation Delay
- b. Queuing Delay
- c. Transmission Delay
- d. Processing Delay

b

38. What is the three-way handshake sequence used to initiate TCP connections?

- a. ACK, SYN/ACK, ACK
- b. SYN, SYN, ACK/ACK
- c. ACK, SYN/ACK, SYN
- d. SYN, SYN/ACK, ACK

39. In a connection, the value of cwnd is 3000 and the value of rwnd is 5000. The host has sent 2000 bytes which has not been acknowledged. How many more bytes can be sent?

- a. 3000
- b. 2000
- c. 1000
- d. 5000

80

40. A Process A had 100 bytes space available in both its SendBuffer and the RecvBuffer. It then receives 20 bytes data from Process B and in the TCP segment received, the window size is mentioned as 200 bytes. What would be the window size Process A would put in the next segment it sends to Process B?

- a. 180
- b. 220
- c. 80
- d. None of the above

41. When an IP router between two Ethernet segments forwards an IP packet, it does not modify the destination MAC address.

- a. True
- b. False

42. Choose the correct example for a DNS type NS record.

- a. relay1.bar.foo.com, 145.37.93.126, Type
- b. gmail.com, gmail.bar.google.com, Type
- c. foo.com, dns1.foo.com, Type
- d. 145.37.93.126, relay1.bar.foo.com, Type

43. Choose the correct example for a DNS type A record.

- a. relay1.bar.foo.com, 145.37.93.126, Type
- b. gmail.com, gmail.bar.google.com, Type
- c. foo.com, dns1.foo.com, Type
- d. 145.37.93.126, relay1.bar.foo.com, Type

44. Which of the following statement is FALSE about TCP:

- a. It provides flow control
- b. It provides Network assisted congestion control
- c. It provides Multiplexing and demultiplexing
- d. All of the above
- e. None of the above

45. Skype makes use of which architecture?

- a. Client-Server
- b. Peer-to-Peer
- c. Both (a) and (b)
- d. None of the mentioned

b. Proprietary

46. The transfer of data from one sender to many receivers in a single send operation—is possible in TCP:

- a. True
- b. False
- c. Difficult to tell

network broadcast ?

47. The value of the rwnd variable never changes throughout the duration of the connection

- a. True
- b. False
- c. Difficult to tell

48. Which of the following statement is Not True about Go-Back-N protocol:

- a. Sender can have up to N unacked packets in pipeline
- b. Discard out of order packets at receiving end
- c. Receivers send individual ACK
- d. All of the above

49. Which of the following statement is Not True about Selective Repeat protocol:

- a. Sender can have up to N unacked packets in pipeline
- b. Sender buffers out of order packets
- c. Sender maintains timer for each unacked packet
- d. Receiver send individual ACK

50. Which one of the following is the multiple access protocol for channel access control?

- a. CSMA/CD
- b. CSMA/CA
- c. Both (a) and (b)
- d. Collision detection protocol

aloha

51. RIP protocol converges the network after

- a. Sharing DV's every 30 seconds
- b. It will never be converged
- c. Sharing DV's every 3 minutes
- d. No information will be shared

OSPC \rightarrow V.P⁰

52. DHCP offer message is sent in response to

- a. DHCP response
- b. DHCP ack
- c. DHCP discover
- d. DHCP request

discover
offer
request
ack.

53. Which is not an example of random channel access

- a. CSMA
- b. CSMA/CD
- c. ALOHA
- d. FDMA

54. Two connected routers are configured with RIP routing. What will be the result when a router receives a routing update that contains a higher-cost path to a network already in its routing table?

- a. The updated information will be added to the existing routing table Debug IP rip
- b. The update will be ignored and no further action will occur Debug IP route
- c. The updated information will replace the existing routing table entry
- d. The existing routing table entry will be deleted from the routing table and all routers will exchange routing updates to reach convergence

55. Which one of the following is the author of the course book: Computer Networking: A Top-down Approach?

- a. Jim Brooks
- b. William Stallings
- c. Jim Kurose
- d. Andrew S. Tanenbaum

please no

CS-307 Computer Networks

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Final-Part B**Parts B&C: 2 Hours****Total Marks: 50**

Wednesday, Feb 3, 2021

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Signature of Invigilator

Ahmed Nawaz

<u>Abeera</u>	<u>Fatima</u>	<u>18I-0411</u>	<u>D</u>	<u>Abeera</u>
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4. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	Q-1	Q-2	Q-3	Q-4	Total
Marks Obtained	8	10	19	10	47
Total Marks	10	10	20	10	50

Question No.1: [10 Marks]

1. A datagram of 3000 bytes arrives at a router and must be forwarded to a link with an MTU of 500 bytes. Suppose the original datagram is stamped with the identification number 291. Answer the following questions:

- a. At which point in the network does the fragmentation occur? [1]

at the router

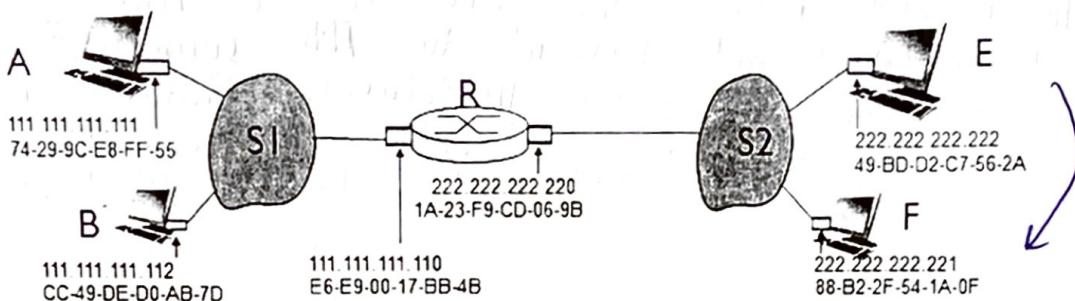
- b. Show the Fragment no, length including the IP header, fragmentation flag, and offset fields of the IP header of each fragment. [7]

Fragment no	Length	Frag flag	Offset
291	480	1	0
291	480	1	60
291	480	1	120
291	480	1	180
291	480	1	240
291	480	1	300
291	120	0	360

(5)

- c. At which location are the IP fragments reassembled? Explain your answer. [2]

In the end system (Network layer) Because
 In order to avoid the extra load on
 the router which is already catering to
 many services like congestion control, routing
 etc.

Question No.2: [10 Marks]

- a. Consider sending an IP datagram from Host E to Host F. Will Host E ask router R to help forward the datagram? If Yes then explain why? In the Ethernet frame containing the IP datagram, what are the source and destination IP and MAC addresses? [2]

No, the datagram will be forwarded by the switch connecting E and F as the switch also maintains a forwarding table and is connected to F on a link. source IP = 222.222.222.222
source MAC = 49-BD-D2-C7-56-2A
destination IP = 222.222.222.221 destination MAC = 88-B2-2F-54-1A or

- b. Suppose E would like to send an IP datagram to B, and assume that E's ARP cache does not contain B's MAC address. Will E perform an ARP query to find B's MAC address? If Yes then why? In the Ethernet frame (containing the IP datagram destined to B) that is delivered to router R, what are the source and destination IP and MAC addresses? [3]

IP
No, if E has the MAC address of B and the MAC address of the router's interface, E can add the routers MAC address with B's IP and the Router R will forward the packet to B. source IP = 222.222.222.222
source MAC = 49-BD-D2-C7-56-2A destination IP = 111.111.111.112
destination MAC = 1A-23-F9-CD-06-9B.

- c. Suppose Host A would like to send an IP datagram to Host B, and neither A's ARP cache contains B's MAC address nor does B's ARP cache contain A's MAC address. Further suppose that the switch S1's forwarding table contains entries for Host B and router R only. Thus, A will broadcast an ARP request message.

- a. What actions will switch S1 perform once it receives the ARP request message? [1]

The switch will update its forwarding table with A's MAC address and forwarding link.
Then broadcast the datagram.

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- b. Will router R also receive this ARP request message? If so, will R1 forward the message to Subnet 3? Provide reasoning.

~~It will receive the broadcasted request but it will not forward to subnet 3 because on the router IP datagram frames are replaced and source address is changed to the router's interface's mac address. (Subnet 3 has a separate network)~~

- c. Once Host B receives this ARP request message, it will send back to Host A an ARP response message. But will it send an ARP query message to ask for A's MAC address? Why? [1]

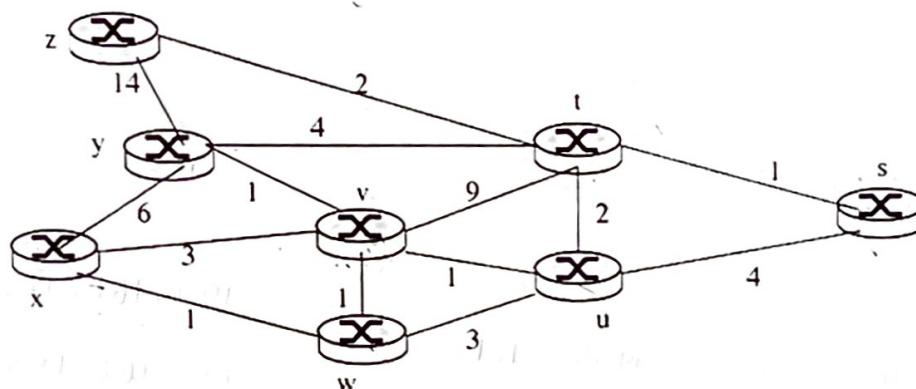
No because A's mac address was already provided in ARP request message so B already got it.

- d. What will switch S1 do once it receives an ARP response message from Host B? [2]

forward it to Host A after consulting its forwarding table which now has A's MAC address and connecting link entry.

Question No.3 [10+5+5=20 marks]:

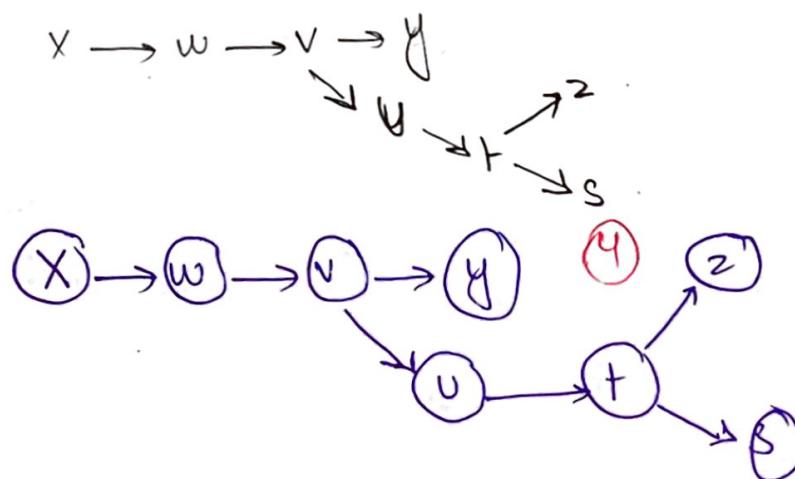
Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from x to all network nodes. (a) Show how the algorithm works by computing the table given below (b) draw the resulting shortest-path tree from x (c) provide the resulting forwarding table in x.



(a)

Steps	N	D(s),P(s)	D(t),P(t)	D(u),P(u)	D(v),P(v)	D(w),P(w)	D(y),P(y)	D(z),P(z)
1	x	∞	∞	∞	(3, x)	(1, x)	(6, x)	∞
2	wx	∞	∞	(4, w)	(2, w)		(6, w)	∞
3	vwx	∞	(11, t)	(3, v)			(3, v)	∞
4	yvwx	∞	(11, t)	(3, v)				(17, y)
5	uyvwx	(7, u)	(5, y)					(17, y)
6	tuyvwx	(6, t)						(7, t)
7	s tuyvwx							(7, t)
8	bstuyvwx							

(b) Resulting shortest-path tree



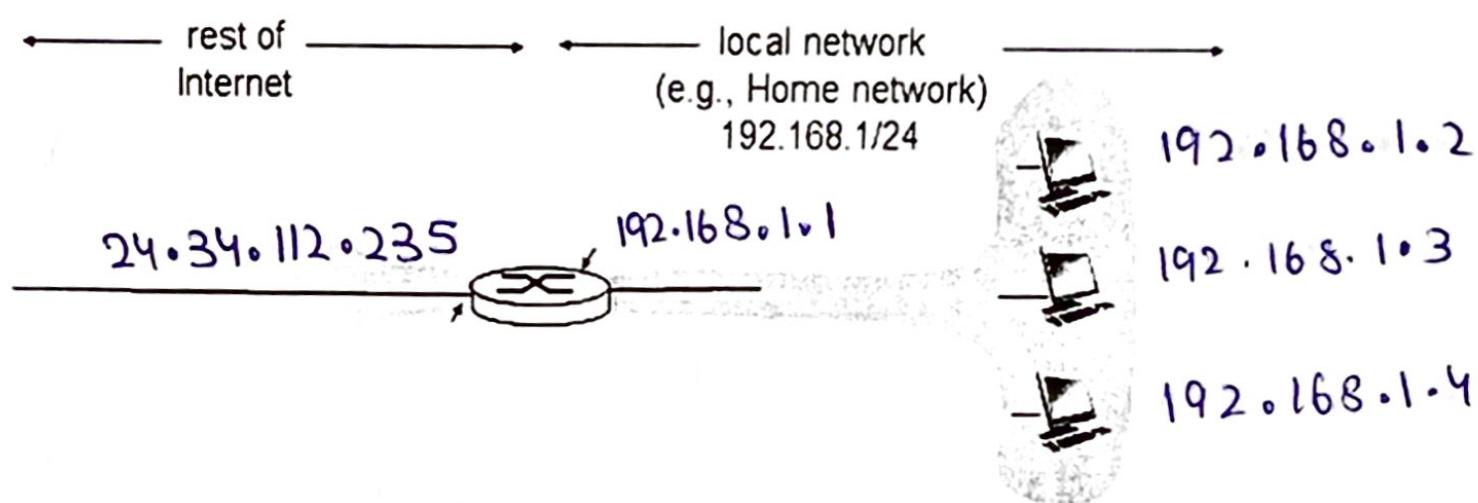
(c) resulting forwarding table

destination	link
s	(x, w)
t	(x, w)
u	(x, w)
v	(x, w)
w	(x, w)
y	(x, w)
z	(x, w)

Question No.4: [10 Marks]

Consider the network setup shown in the figure below. Suppose that the ISP instead assigns the router the address 24.34.112.235 and that the network address of the home network is 192.168.1/24.

- Assign addresses to all interfaces using the figure below of a home network
- Suppose each host has two ongoing TCP connections, all to port 80 at host 128.119.40.186. Provide the six corresponding entries in the NAT translation table.



NAT Translation Table			
WAN side		LAN side	
24.34.112.235	3335	192.168.1.2	21
24.34.112.235	3340	192.168.1.2	20
24.34.112.235	3345	192.168.1.3	21
24.34.112.235	3350	192.168.1.3	20
24.34.112.235	3360	192.168.1.4	21
24.34.112.235	3370	192.168.1.4	20

Address random port num.

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Serial No:

Final-Part C**Total Time:**

Parts B&C: 2 Hours

Total Marks: 40

Signature of Invigilator

Abeera Falima

Student Name

18I-0411

Roll No

D

Section

Abeera.

Signature

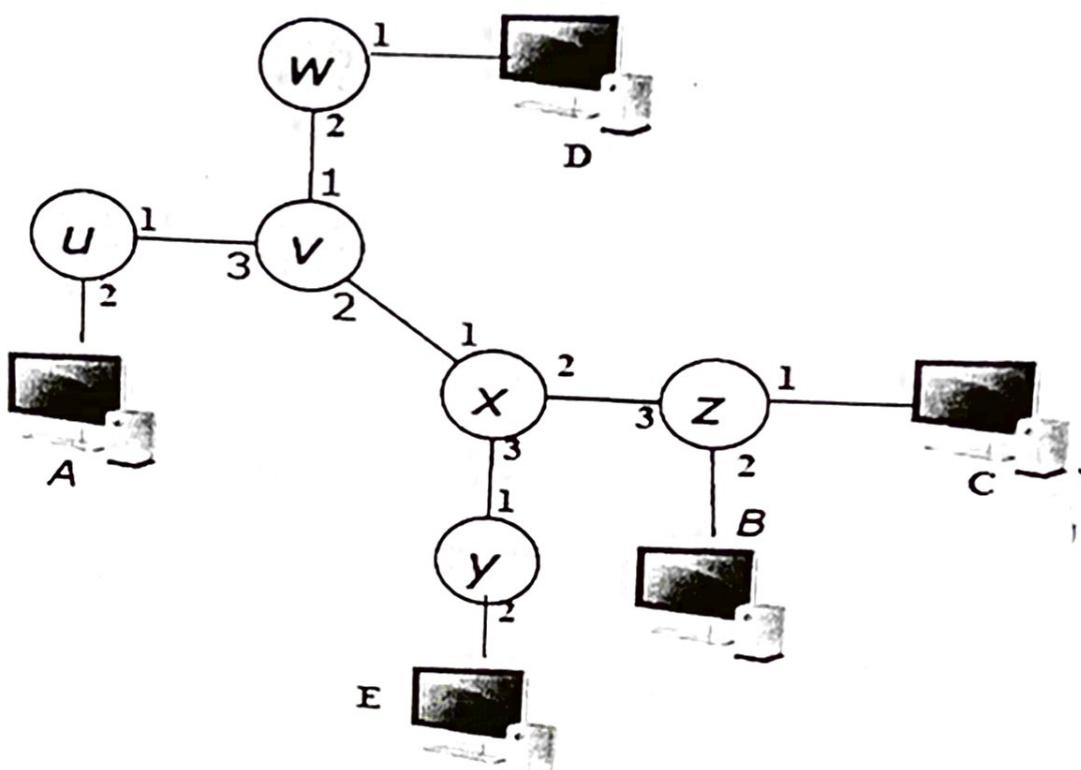
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Question No.5: [10 Marks]

The following diagram shows a switched Ethernet LAN (Labels next to switches show the physical port numbers). Assume that the switch tables are empty initially.



- (a) Suppose host A knows the IP address of host C but does not know its MAC address. In this case host A will send an ARP request message to resolve IP address of C to its corresponding MAC address. Which of the given switches will receive this ARP request message (Tick (✓) the switches in the provided table)? Also show the path that the ARP response message will traverse through (Tick (✓) the switches in the 2nd provided table)?

[03 Marks]

Recipient(s) of ARP Request sent by host A

	U	V	W	X	Y	Z
	✓	✓	✓	✓	✓	✓

Assumed table initially empty though switches can eventually resolve their tables on their own.

Switches participating in traversal of ARP response message

	U	V	W	X	Y	Z
	✓	✓		✓		✓

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- (b) Suppose host A knows the MAC address of host B and sends it a packet. Considering an empty forwarding table of switch v, which port(s) it will send the incoming frame destined for host B? [02 Marks]

host v will broadcast the packet to all its output links since it does only know the link to B. ports 1 & 2

Also suppose host A sends a packet to host B and host B sends a response. Show the contents of the switch/forwarding table at switch v after this session (Make entries into the provided Switch/Forwarding table accordingly). You may assume that A and B denote the MAC addresses of the corresponding hosts. [03 Marks]

MAC Address	Port Number
A	3
B	2

- (c) Suppose next moment, host D at switch w sends a packet to host C at switch z. Which switches in the network receive a copy of this packet? (Tick (v) the switches). [01 Marks]

Switches participating in traversal of message from host D to host C	U	V	W	X	Y	Z
	x	✓	✓	✓	✓	✓

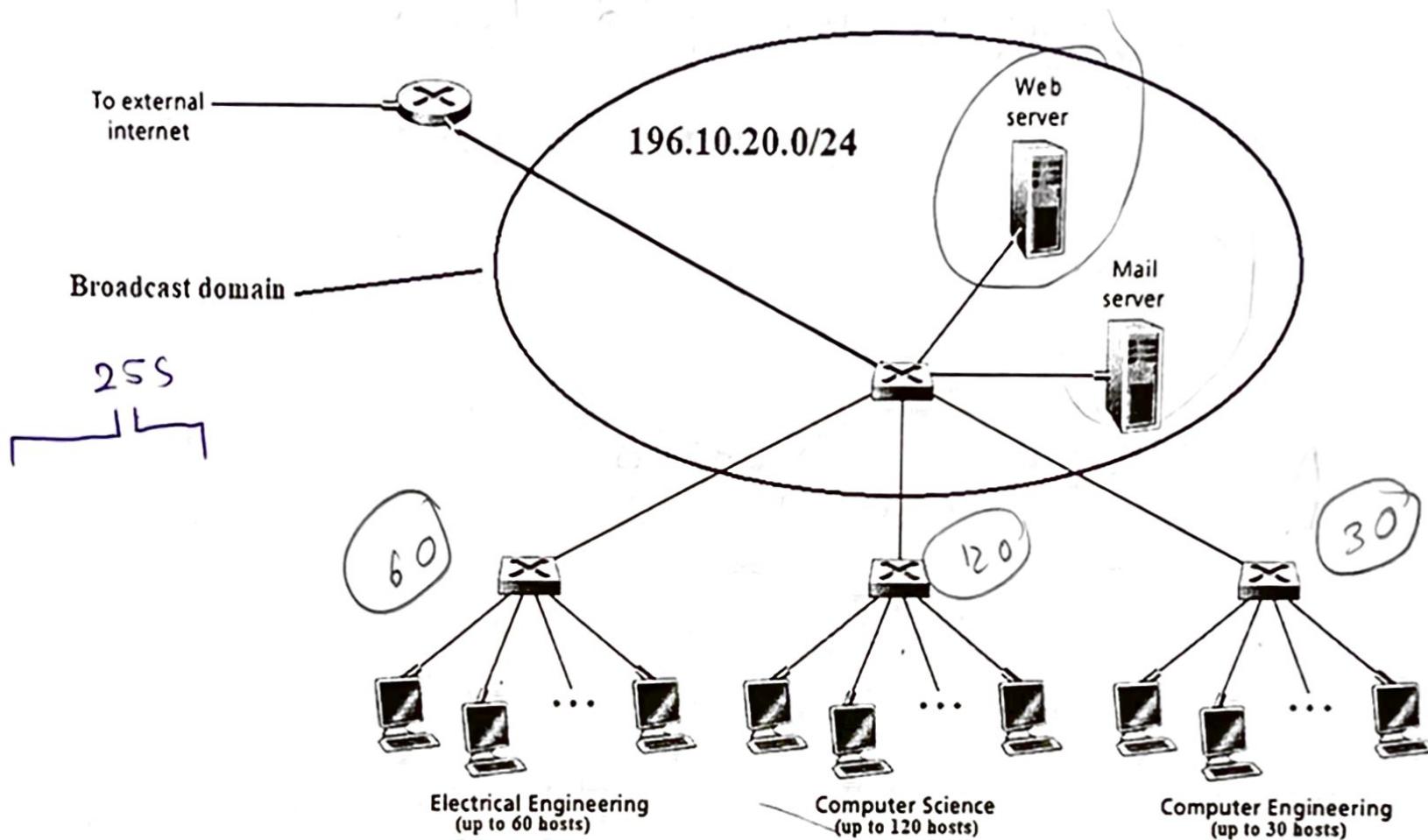
- (d) Next if host E at switch y sends a packet to host A, which switches receive a copy? (Tick (v) the switches) [01 Mark]

Switches participating in traversal of message from host E to host A	U	V	W	X	Y	Z
	✓	✓	x	✓	✓	x

0.5

Question No.6: [10 Marks]

Given the following diagram of a switched campus network represented by 196.10.20.0/24 network address, any link-layer broadcast (e.g. ARP request) sent by any host affects all the other hosts in the switched network.



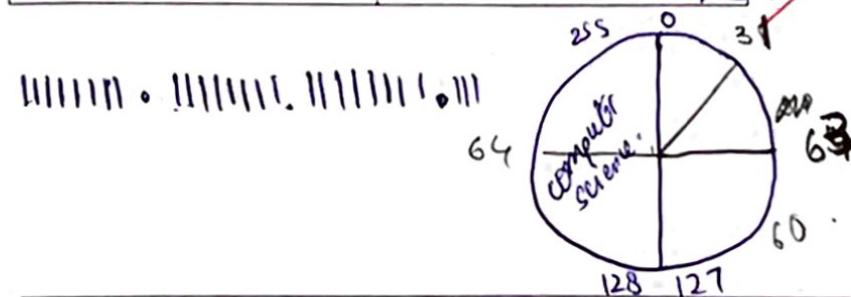
Being a network-engineer, you are given the task to design the network in a better way such that the size of the broadcast domain is reduced (e.g. any broadcast sent by a host from Computer Science department should not reach other departments and Servers). Part of your solution should be to have separate broadcast domains for Electrical Engineering, Computer Science, and Computer Engineering departments having max up to 60, 120, and 30 hosts respectively. Moreover, the servers (max 2) should also have a separate broadcast domain. Based on these guidelines, redraw the given campus network highlighting the network-addresses of Electrical Engineering, Computer Science, Computer Engineering, and Servers subnets and how to interconnect these generated subnets. Based on your solution and given the network address 196.10.20.0/24, make entries into the following tables accordingly.

Computer Science Subnet	
Network Address	196.10.20.0/28
Broadcast Address	196.10.20.15
Subnet Mask/Prefix	255.255.255.192/26

Electrical Engineering Subnet	
Network Address	192.10.20.64/26
Broadcast Address	192.10.20.127
Subnet Mask/Prefix	255.255.255.192/26

Computer Engineering Subnet	
Network Address	196.10.20.32/27
Broadcast Address	196.10.20.63
Subnet Mask/Prefix	255.255.255.224/27

Servers Subnet	
Network Address	196.10.20.0
Broadcast Address	196.10.20.31
Subnet Mask/Prefix	255.255.255.224/27



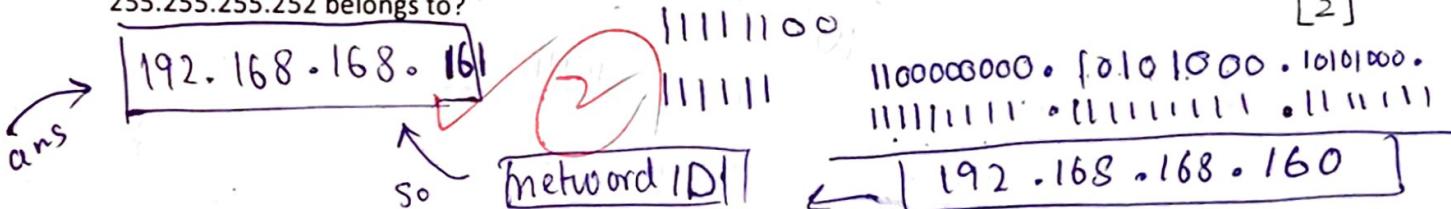
(9)

110000000000

Question No.7: [10 Marks]

Applying the concepts of subnetting, answer the following questions:

- i) What is the first valid host on the subnetwork that the node 192.168.168.161 having subnet mask 255.255.255.252 belongs to?



$$\begin{array}{r}
 10100001 \\
 1111100 \\
 \hline
 10100000
 \end{array}$$

$$\begin{array}{r}
 1100000000 \cdot 10101000 \cdot 10101000 \\
 11111111 \cdot 11111111 \cdot 11111111 \\
 \hline
 192 \cdot 168 \cdot 168 \cdot 160
 \end{array}$$

- ii) What valid host range is the IP address 172.29.225.44 having subnet mask 255.255.254.0 a part of?

$$\begin{array}{r}
 111111 \cdot 111111 \cdot 1111110 \cdot 00000000 \\
 172 \cdot 29 \cdot 225 \cdot 44 \\
 172 \cdot 29 \cdot 224 \cdot 1 - 172 \cdot 29 \cdot 255 \cdot 254
 \end{array}$$

(2) → valid range of hosts.

(172.29.0.0 is network ID and 172.29.255.255 is broadcast)

- iii) How many unique IP addresses can be assigned to hosts from the network 172.21.0.0/20?

$$172 \cdot 21 \cdot 0 \cdot 0$$

* Calculating valid IP addresses because assignable to hosts.

$$\begin{array}{r}
 2^{8+4} - 2 = 4094 \\
 172 \cdot 21 \cdot 0 \cdot 0
 \end{array}$$

(2) . 0000 0000

- iv) What is the broadcast address of the network 172.18.118.0/23?

$$\begin{array}{r}
 1111111 \cdot 1111111 \cdot 1111110 \cdot 00000000 \\
 172 \cdot 18 \cdot 119 \cdot 255
 \end{array}$$

(2) . 11101101 → last bit on.

- v) You are designing a subnet mask for the 172.31.0.0 network with a default subnet-mask of 255.255.0.0. You want 190 subnets with up to 180 hosts on each subnet. What subnet mask should you use?

$$172 \cdot 31 \cdot 0 \cdot 0 \rightarrow \text{class B IP address}$$

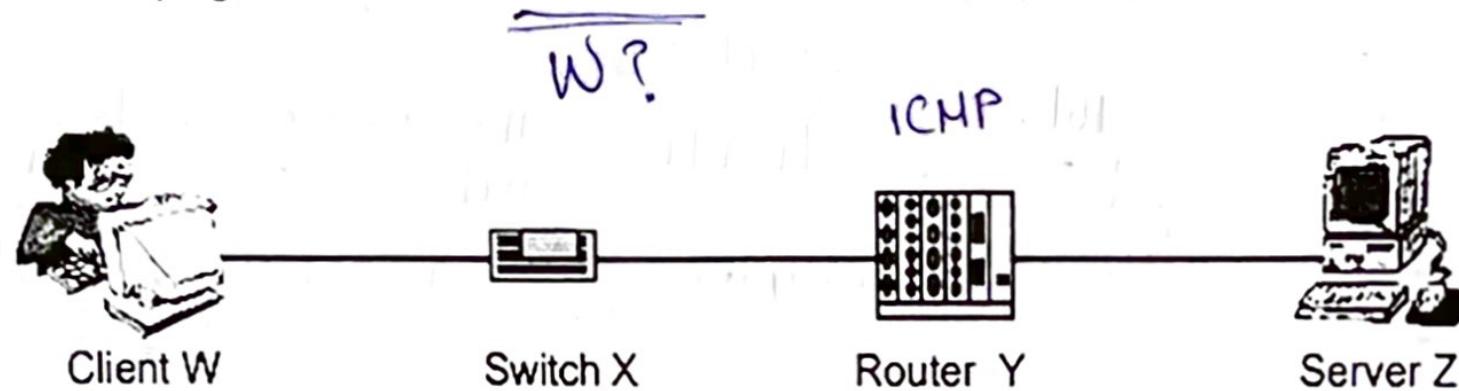
$$255 \cdot 255 \cdot 255 \cdot 0$$

borrow 8 bit $2^8 = 256$
for 190 subnets.
with max $2^8 = 256$ host
on each.

$$\begin{array}{r}
 11100001 \\
 11111110 \\
 \hline
 11100000
 \end{array}$$

Question No.8: [10 Marks]

We know that Traceroute program is being used to determine an end-to-end path over the network from a given source to a destination. For the following network diagram, explain what kind of packets (mention TTL values as well) are generated by the Client X, Switch X, Router Y and Server Z Whenever Traceroute program is executed on Client X? Describe the step-by-step procedure.



Client W will send 3 IP datagrams of different time to live values for example 1 hop, 2 hops, (the values keep increasing), with unreachable port numbers. Switch X will not generate any packets of its own, it will just forward the packets to router Y. At router Y due to an unreachable port number, it will generate an in-turn TTL EXPIRED error (3,15), which will propagate back to Client W. This process will continue until either

client W stops sending packets, the port is reached or the trace route packets run out of their time to live (hop-counts). Meanwhile Client W will be able to get the route of the packets and an avg RTT value from the router along with its address. If packets reach Server Z because their port numbers matched then they will be successfully delivered.