

Exam Instructions:

- This exam contains 5 pages (including this cover page).
- This exam contains 3 parts.
- The use of any electronic device is not allowed during the exam.
- Use the following information to help with unit conversions:
 - 1 second = 1000 milliseconds (msec) = 1000000 microseconds.
 - 1 Mb = 1000 Kb = 1000000 bits.

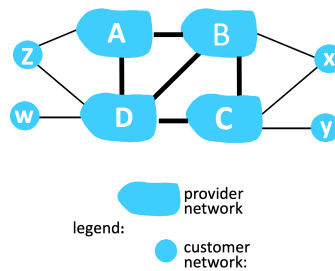
Name: _____**KSU-ID:** _____

Part	Designated Points	Scored Points
Part-1	15	
Part-2	10	
Part-3	15	
Total	40	

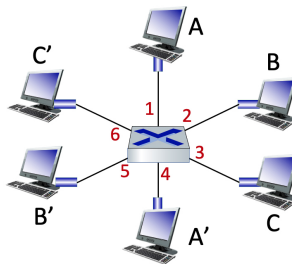
Part-1 (MC) 15 Points

1. What type(s) of delay contribute to the total nodal delay?
☐ (A) Processing delay. ☐ (B) Queuing delay. ☐ (C) Transmission delay. ☐ (D) Propagation delay.
☒ (E) **All of the mentioned.**
2. What type of guarantees does **TCP** offer?
☐ (A) Security. ☒ (B) **Reliability.** ☐ (C) Minimum throughput. ☐ (D) All of the mentioned.
☐ (E) None of the mentioned.
3. What type of guarantees does **UDP** offer?
☐ (A) Security. ☐ (B) Reliability. ☐ (C) Minimum throughput. ☐ (D) All of the mentioned.
☒ (E) **None of the mentioned.**
4. Which of the following is NOT an HTTP method?
☐ (A) POST. ☐ (B) GET. ☒ (C) **FORWARD.** ☐ (D) PUT. ☐ (E) None of the mentioned.
5. Which technique can be used to provide some information (state) across multiple HTTP connections?
☐ (A) Hot potato routing. ☒ (B) **Cookies.** ☐ (C) Cakes. ☐ (D) BGP. ☐ (E) None of the mentioned.
6. Which protocol is used to send emails?
☐ (A) IMAP. ☐ (B) POP. ☒ (C) **SMTP.** ☐ (D) BGP. ☐ (E) None of the mentioned.
7. The domain name system (DNS) is mainly used for mapping:
☒ (A) **Domain names and IP addresses.** ☐ (B) Domain names and MAC addresses. ☐ (C) IP and MAC addresses.
☐ (D) MAC addresses and network interface cards (NICs). ☐ (E) All of the mentioned.
8. Which of the following information is used for **TCP** demultiplexing?
☐ (A) Source and destination IP addresses. ☐ (B) Source port number. ☐ (C) Destination port number.
☒ (D) **All of the mentioned.** ☐ (E) None of the mentioned.
9. Where in a router is the destination IP address looked up in a forwarding table to determine the appropriate output port to which the datagram should be directed?
☒ (A) **At the input port.** ☐ (B) At the routing processor. ☐ (C) At the output port. ☐ (D) All of the mentioned.
☐ (E) None of the mentioned.
10. Suppose a datagram is switched through the switching fabric and arrives to its appropriate output to find that there are no free buffers. In this case:
☐ (A) The packet will be dropped (lost). ☐ (B) The packet will be sent back to the input port.
☐ (C) Another packet will be removed (lost) from the buffer to make room for this packet.
☒ (D) **The packet will either be dropped or another packet will be removed (lost) from the buffer to make room for this packet, depending on policy.** ☐ (E) None of the mentioned.
11. What is the purpose of the Dynamic Host Configuration Protocol (DHCP)?
☐ (A) To configure the interface speed to be used. ☐ (B) To get the 48-bit link-layer MAC address associated with a network-layer IP address. ☐ (C) To configure the set of available open ports (and hence well-known services) for a server.
☒ (D) **To obtain an IP address for a host attaching to an IP network.** ☐ (E) All of the mentioned.

12. Suppose that a network that is a customer of two different provider networks will not relay traffic between its two provider networks. How can a customer network such as x in the figure below implement that policy?



- (A) x will only advertise a route to itself to one of its provider networks B or C, but not both.
 (B) Provider networks B and C will learn from the eBGP protocol that both have a direct path to x but will agree to not send traffic to each other via x, since x is a customer network.
 (C) **x will not advertise to provider networks B or C that it has a path to the other provider network.**
 (D) It is impossible to implement this policy in the described setting.
 (E) x will ask y to advertise information on x's behalf.
13. Consider the network below with six nodes, star-connected into an Ethernet switch. Suppose that A sends a frame to A', A' replies to A, then B sends a message to B' and B' replies to B, and then A sends to B and B replies to A. In this sequence of frame transmissions, how many frames have appeared at the interface at C'? Assume that the switch's table is initially empty.



- (A) 0 (B) 1 (C) **2** (D) 4 (E) 6
14. Suppose that the 4-bit generator (G) is 1001, that the data payload (D) is 10011101 and that $r = 3$. What are the values of the 3 CRC bits?
- (A) 010 (B) **100** (C) 101 (D) 011 (E) None of the mentioned.
15. Suppose an Ethernet frame arrives to a self-learning Ethernet switch, and the Ethernet switch does not know which of its switch ports leads to the node with the given destination MAC address? In this case, what does the switch do?
- (A) Choose a port randomly and forward the frame there. (B) Drop the frame without forwarding it.
 (C) **Flood the frame on all ports except the port on which the frame arrived.**
 (D) Drop the frame without forwarding it. (E) Return the frame to the port which it came from.

Part-2 (T/F) 10 Points

1. HTTP is a stateless protocol.

(A) **True**

(B) False

2. Conditional GET of HTTP is used to get the terms and conditions of a given website.

(A) True

(B) **False**

3. Dynamic Adaptive Streaming over HTTP (DASH) provides a streaming client control over what encoding rate to request for a given video.
 (A) True (B) False
4. The network layer provides a logical communication medium between *processes* whereas the transport layer provides a logical communication medium between *hosts*.
 (A) True (B) False
5. The Internet checksum provides a very strong protection against bit errors.
 (A) True (B) False
6. With TCP's flow control mechanism, where the receiver tells the sender how much free buffer space it has (and the sender always limits the amount of outstanding, unACKed, in-flight data to less than this amount), it is not possible for the sender to send more data than the receiver has room to buffer.
 (A) True (B) False
7. Selective-repeat is a mechanism used by TCP to individually acknowledge all correctly received packets, even those that arrive out-of-order.
 (A) True (B) False
8. The longest-prefix match is a mechanism used by Ethernet switches to match the longest MAC address.
 (A) True (B) False
9. Hot-potato routing avoids sending packets towards the busiest (hottest) router in the network.
 (A) True (B) False
10. ICMP is primarily used for communicating network-level information.
 (A) True (B) False

Part-3 (Short Answers) 15 Points

11. Given the following forwarding table, use the **longest-prefix match** approach to determine the right link interface to which each of the IP datagrams below should be forwarded. Exactly **one** interface should be selected. (3 Points)

Destination IP Address Matching	Link Interface
* . * . * . *	1
10.10.100.0/22	2
10.10.100.0/24	3
10.10.128.0/17	4

A:

Destination IP Address	Forward to Interface
10.10.100.38	3
10.10.101.52	2
53.20.128.143	1

12. For each of the following sub-questions, fill in the correct values in the table to implement each policy. **Note:** use * to indicate wildcard (match anything). You may assume that only the following actions are permitted: **forward(x)** and **drop**, where **x** is the port number. (3 Points)

- (a) Block all network traffic destined to port 22.

MAC src	MAC dst	IP src	IP dst	Port src	Port dst	Action
*	*	*	*	*	22	drop

- (b) Forward network traffic destined to subnet 10.10.10.0/24 and source port number 25 to port 5.

MAC src	MAC dst	IP src	IP dst	Port src	Port dst	Action
*	*	*	10.10.10.*	25	*	forward(5)

13. Assume you have a device whose IP address is 53.17.111.36 and the subnet is /20.

- (a) What is the corresponding network address (for example, an IP address of 10.10.10.3 whose subnet is /8 means the network address is 10.0.0.0)? (1 Point)

A: 53.17.96.0

- (b) How many IP addresses can be allocated in the network above?
- Note:**
- you should NOT count the IP addresses typically reserved for network and broadcast addresses. You may write the answer in the form
- 2^x
- . (1 Point)

A: $2^{12} - 2^5$ **explanation:** there are 4 bits remaining in the third byte of the IP address, resulting in 2^4 distinct ranges for the 4th byte of the address, and each range of IPs in the 4th byte will not be able to allocate two IPs (.0 for network and .255 for broadcast), so $2 * 2^4 = 2^5$

14. Suppose we have
- host1*
- issuing the
- traceroute**
- command with the destination being
- host2*
- , and that the path between the two hosts consists of 2 routers.

- (a) How many ICMP packets need to be
- sent from host1**
- to execute
- traceroute**
- in this setting?
- Hint:**
- recall that
- traceroute**
- sends more than one packet to each hop. (1 Point)

A: 0 ICMP packets are sent from *host1* (it sends UDP segments), but it shall receive 9 ICMP packets.

- (b) In 2-3 sentences, explain how
- traceroute**
- uses the TTL field of an IP datagram. (2 Point)

A: **traceroute** sends UDP segments destined to the destination IP address – initially setting the TTL field to 1 so when it arrives at the first-hop router it gets dropped, and an ICMP packet (type 11, code 0) is sent back to the source. The source keeps increasing the value of the TTL field until the UDP segment reaches the destination. Each time the UDP packet gets dropped (when TTL reaches 0), an ICMP packet is sent to the source indicating that the UDP packet got dropped.

15. Suppose you manage a network over which you have full control and visibility, which routing algorithm (link-state or distance-vector) would best suite this setting? And why? (2 Points)

A: Link-state can be used since there is full control and visibility of the network. This allows each router to run its local version of Dijkstra and calculates best paths to all other routers in the network. As such, convergence can be much faster than if distance-vector were to be used.

16. Is processing an IPv6 datagram faster than processing an IPv4 datagram? Explain your answer in 2-3 sentences. (2 Point)

A: Yes, this is due to two main reasons: (a) IPv6's header length is fixed, and, most importantly, (b) it does not contain a checksum field, so routers do not need to re-calculate checksums everytime they receive an IPv6 datagram.