THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

This exam paper must not be removed from the venue

Venue _____

Seat Number _____

Student Number |__|__|__|__|__|__|__|__|

Family Name _____

First Name _____

School of Information Technology and Electrical Engineering

EXAMINATION

Semester One Final Examinations, 2018

COMS3200/COMS7201 Computer Networks I

This paper is for St Lucia Campus students.

Examination Duration: 120 minutes

Reading Time: 10 minutes

Exam Conditions:

This is a Central Examination

This is an Open Book Examination

During reading time - write only on the rough paper provided

This examination paper will be released to the Library

Materials Permitted in the Exam Venue:

(No electronic aids are permitted e.g. laptops, phones)

Calculators - Any calculator permitted - unrestricted

Materials to be Supplied to Students:

None

Instructions to Students:

Additional exam materials (e.g., rough paper) will be provided upon request.

Answer ALL six questions. 120 marks total on the paper. Marks for each question are as indicated. Questions are to be answered in the spaces provided on this exam paper.

For Examiner Use Only

Question	Mark

Total _____

Question 1 (20 Marks)

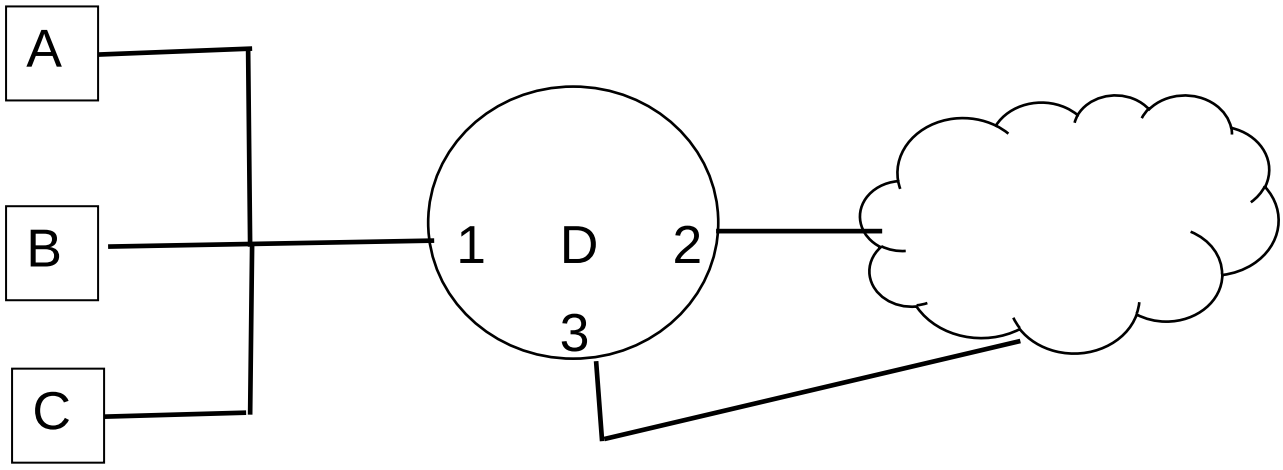

Figure 1.

Consider the network in figure 1.

A is a host with IP address 192.168.0.2

B is a host with IP address 192.168.0.3

C is a host with IP address 192.168.0.4

D is an Open Flow SDN switch with interfaces to three full-duplex links, numbered 1, 2, 3. These interfaces, also sometimes called ingress ports, are referred to as Link 1, Link 2, Link 3 below.
Link 1 connects to the LAN with A, B, C and has IP address 192.168.0.1
Link 2 connects to the Internet and has IP address 100.1.2.3
Link 3 connects to the Internet and has IP address 200.2.4.6

This question asks you to create some SDN Match/Action Rules

* = Don't Care in the Match rules

For simplicity here, MAC addresses are not included in the Match Rules.

For each question, one or two match rules with up to three actions each are needed.

Question 1 (cont).

Here is an example question and solution:

Q: Send all outgoing UDP messages from host A to host C port 700, regardless of the intended destination.

Match Rule					
Source IP	Dest IP	Source Port	Dest Port	Incoming Link	Protocol
192.168.0.2	*	*	*	1	UDP
Actions					
Dest IP ← 192.168.0.4					
Dest Port ← 700					
Forward (Link 1)					

Question 1 (a) NAT Functionality.

Translate TCP packets from Host A, port 80 into packets on Link 2 with external IP address 100.1.2.3 and port 51371, and also translate corresponding incoming packets on link 2 to Host A, port 80. (8 marks)

Match Rule					
Source IP	Dest IP	Source Port	Dest Port	Incoming Link	Protocol

Actions

Match Rule					
Source IP	Dest IP	Source Port	Dest Port	Incoming Link	Protocol

Actions

Question 1(b) Traffic Engineering

Forward any UDP packets from any host connected to link 1 out over link 2, and
Forward any TCP packets from any host connected to link 1 out over link 3
(8 marks)

Match Rule					
Source IP	Dest IP	Source Port	Dest Port	Incoming Link	Protocol

Actions

Match Rule					
Source IP	Dest IP	Source Port	Dest Port	Incoming Link	Protocol

Actions

Question 1(c) Firewall Function

Drop any packets from any source trying to connect to TCP port 25.
(4 marks)

Match Rule					
Source IP	Dest IP	Source Port	Dest Port	Incoming Link	Protocol

Actions

Match Rule					
Source IP	Dest IP	Source Port	Dest Port	Incoming Link	Protocol

Actions

Question 2 (20 marks)

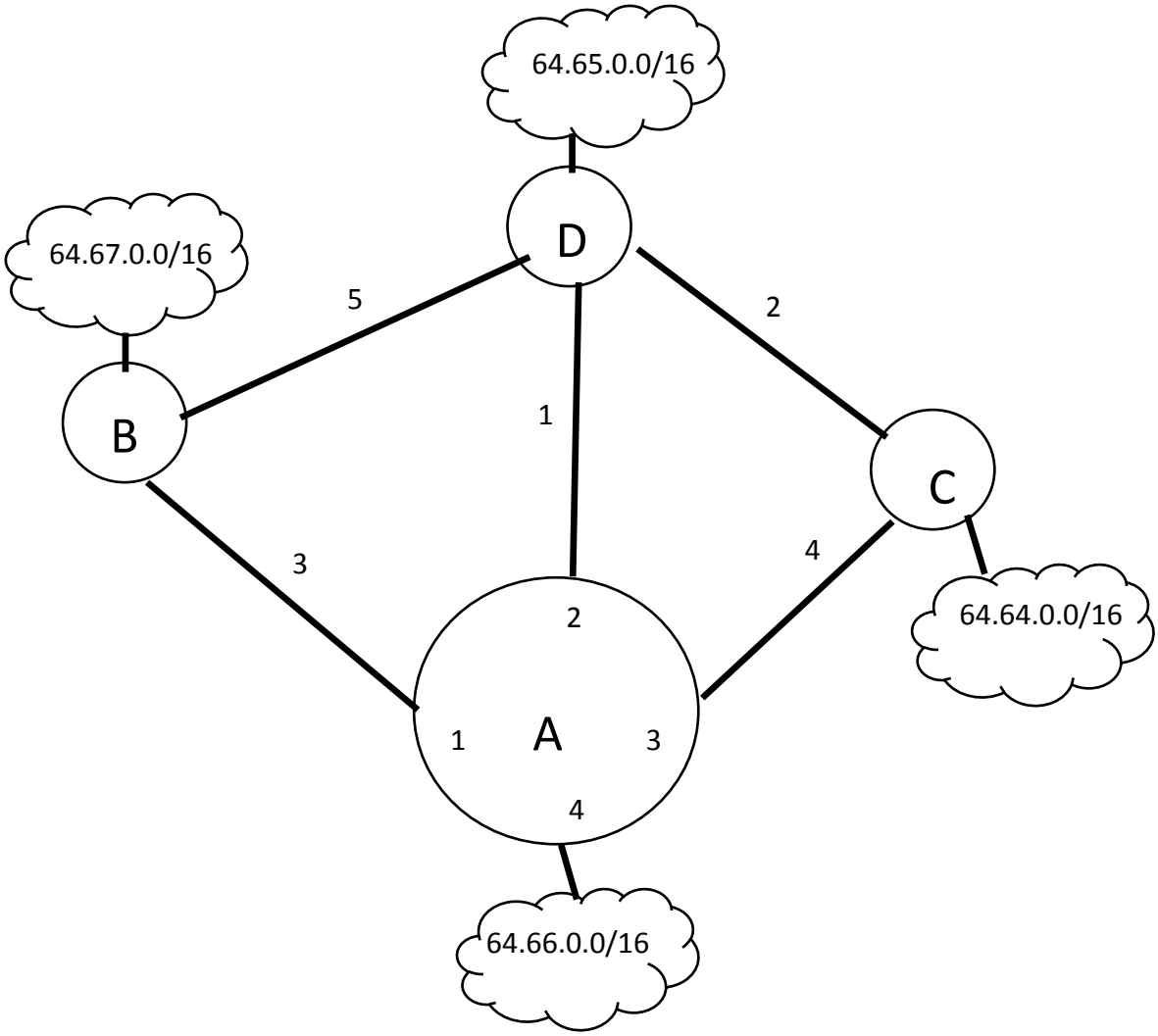

Figure 2

Consider the network in figure 2 above. There are 4 gateway routers A,B,C,D connected to each other with links with costs shown on those links.

Also, each router has an associated set of IP addresses for a local area network indicated pictorially as a cloud. The IP subnet for each LAN (e.g. 64.64.0.0/16 for C) is shown written on the cloud. Packets destined for addresses in each subnet are sent to the associated gateway router.

The following questions refer to the routing and forwarding tables in gateway router A, whose interfaces are numbered 1, 2, 3 and 4.

Question 2 (a)

Using Dijkstra's algorithm, or any other technique, identify the minimum cost of sending packets to any other router from A, and also identify the minimum cost path from A to each other router (e.g. ACDB is one path from A to B).
(10 marks)

Optional Space for Working

ANSWERS:

From A to	Minimum Cost Path	Cost	Send Packets on Interface 1,2,3, or 4?
A	A	0	n/a
B			
C			
D			

Question 2 (b)

Based on the IP subnet addresses associated with each of the gateway routers, create longest-prefix-first matching addresses which can be used to forward packets to each of A's output links based on the minimum cost paths devised in part (a). (10 marks)

There may be more than one matching rule per link.

One of the links can have an "otherwise" option, but this is not necessary.
A minimum number of entries is preferred.

The rules do not need to account for addresses which are not in any of the indicated subnet ranges.

Longest-Prefix-First Addresses	**Output Interface**
	1
	2
	3
0100 0000 0100 0010 **** **** **** ****	4

Question 3. (20 marks) (1 mark each for layer and function)

For each of the following protocols, list the network layer associated with that protocol, and give a short explanation of the function of that protocol.

If more than one layer is possible, any one correct answer will be acceptable.

You **DO NOT** need to write out the full protocol name, such as Hyper Text Transfer Protocol, and listing that name will not count as an explanation of the function.

Protocol	**Layer**	**Function of the Protocol**
HTTP	*Application*	*To request and receive web pages from a server.*
DNS		
POP		
SMTP		
SNMP		

Protocol	**Layer**	**Function of the Protocol**
ARP		
ICMP		
SSL		
BGP		
IEEE 802.3		
QUIC		

Question 4 (20 marks)

Here is a Wireshark trace of an Ethernet frame containing a DNS request. Note that like a normal Wireshark trace, this packet capture does NOT include the Ethernet Preamble and does NOT include the CRC check, so the trace starts with the Ethernet destination address.

```
08 bd 43 9a 59 98 18 03 73 22 da 3c 08 00 45 00

00 38 77 f9 00 00 80 11 00 00 c0 a8 00 11 d0 43

dc de d8 09 00 35 00 24 6e 11 00 08 01 00 00 01

00 00 00 00 00 00 06 67 6f 6f 67 6c 65 03 63 6f

6d 00 00 01 00 01
```

Decode the following fields in the headers in the frame and provide the decoded value in the indicated format (2 marks each)

Field	**Format**	**Decoded Value**
MAC Destination Address	Hex	08:bd:43:9a:59:98
MAC Source Address	Hex	
Destination IP	Dotted Decimal	
Source IP	Dotted Decimal	
IP Header Length	Decimal (bytes)	
IP Packet Length	Decimal (bytes)	
Protocol Field in IP header	Decimal	
UDP Source Port	Decimal	
UDP Destination Port	Decimal	
UDP Packet Length	Decimal (bytes)	
UDP Checksum	Hex	

Question 5 (20 marks)

For each of the following pairs of networking concepts, explain the difference between the two concepts (2 marks each).

Then name one specific mechanism or technique that is applicable to each of the two concepts. You only need to name the technique, further explanation is not needed. (1 mark for each mechanism).

Example:

Q: What is difference between packet-switched and circuit switched networks.
A: Circuit switched networks establish an end-to-end connection of fixed bandwidth, while packet-switched networks chop the stream into packets and route each one individually to the destination.
Q: Mechanism for Circuit Switched Networks
A: ATM networks
Q: Mechanism for Packet Switched Networks
A: TCP/IP networks

5(a) Q: What is difference between congestion control and flow control in the TCP transport layer protocol?
A:
Q: Mechanism for Congestion Control?
A:
Q: Mechanism for Flow Control?
A:

Question 5 (cont)

5(b) Q: What is difference between connectionless and connection-oriented transport layer protocols?
A:
Q: Mechanism or Protocol for connectionless transport?
A:
Q: Mechanism or Protocol for connection-oriented transport?
A:

5(c) Q: What is difference between confidentiality and authentication in secure data transport?
A:
Q: Mechanism for Confidentiality?
A:
Q: Mechanism for Authentication?
A:

Question 5 (cont)

5(d) Q: What is difference between Collision Detection and Collision Avoidance in Link Layer protocols?
A:
Q: Mechanism for Collision Detection?
A:
Q: Mechanism for Collision Avoidance?
A:

5(e) Q: What is difference between Public Key Encryption and Symmetric Key Encryption in secure data transport?
A:
Q: Mechanism for Public Key Encryption?
A:
Q: Mechanism for Symmetric Key Encryption?
A:

Question 6 (20 marks)

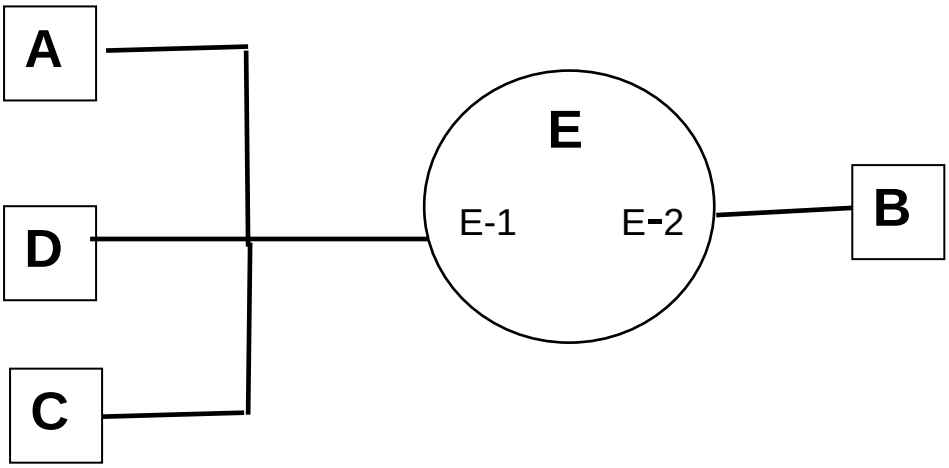

Figure 6

Consider the network in figure 6.

E is a gateway router with two interfaces E-1 and E-2. Assume that all the IP forwarding tables in E are up to date and complete.

The MAC address of Link Interface E-1 is E1:E1:E1:E1:E1:E1 which you can abbreviate with E1.

The MAC address of Link Interface E-2 is E2:E2:E2:E2:E2:E2 which you can abbreviate with E2.

A is a host computer, which just joined the LAN consisting of A, C, D, and E-1. It currently has no IP address.
A has MAC address AA:AA:AA:AA:AA:AA, which you can abbreviate with AA.

B is a webserver which is outside the LAN, connected to E-2.
B has MAC address BB:BB:BB:BB:BB:BB, which you can abbreviate with BB.

D is a DNS server on the LAN consisting of A, C, D, and E-1.
D has MAC address DD:DD:DD:DD:DD:DD, which you can abbreviate with DD.

C is a DHCP server on the LAN consisting of A, C, D, and E-1.
C has MAC address CC:CC:CC:CC:CC:CC, which you can abbreviate with CC.

The broadcast MAC address is FF:FF:FF:FF:FF:FF, which you can abbreviate with FF.

Assume that along with issuing IP addresses, the DHCP server provides the IP address of the gateway router and IP address of the DNS server in the same message.

Assume that initially all of the ARP tables in all of the device are empty, as are any DNS caches in A,B,C and E.

Assume C, D, E-1,E-2, B already have IP addresses assigned.

Now A wishes to read a small webpage from B (that fits in one packet). A knows B's hostname but not its IP address.

List, in order, the frames that will be transmitted between the various devices to enable this transfer, up until the webpage is received and the TCP connection disconnected.

1 mark each for correct frame up to 20 marks (so there are at least 20)

#	**Source MAC**	**Dest MAC**	**Contents of frame**
1	AA	FF	DHCP Discover broadcast message
2			
3			
4			
5			
6			
7			
8			
9			
10			

#	Source MAC	Dest MAC	Contents of frame
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			

#	Source MAC	Dest MAC	Contents of frame
24			
25			

END OF EXAMINATION

BLANK PAGE FOR WORKING OR FOR ADDITIONAL ANSWERS