SOLUTIONS

Module:	Internet Protocols			
Module Code	EBU5403	Paper	A	
Time allowed	2hrs	Filename	Solutions_201617_EBU5403_A	
Rubric	ANSWER ALL FOUR QUESTIONS			
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Question 1

a. Give the name (not number) of the two layers which are in the OSI network stack but not the TCP/IP network stack?

[2 marks]

Session + Presentation

b. Give the name (not number) of the layer of the TCP/IP stack which:

[3 marks]

     i.   Transmits bits over a medium using the electronic, optical or mechanical properties of that medium.

(**1 mark**)

     ii.   Is responsible for moving packets from their original source on the network to their final destination.

(**1 mark**)

     iii.   Ensures that (if required) transmitted data arrives in order at the final destination, without loss or corruption.

(**1 mark**)

     i.   Physical
     ii.   Network
     iii.   Transport (1/2 marks if numbers not names given).

c. In Carrier Sense Multiple Access/Collision Avoidance, give the full name and briefly explain the role of ACK, RTS and CTS

[9 marks]

ACK = Acknowledgement is used to indicate that a message has been successfully received (1 mark expansion 2 marks definition)

RTS = Request to Send is used by a sender to ask for permission to send a message and reserve space on the channel (1 mark expansion 2 marks definition)

CTS = Clear to Send indicates the sender is allowed to send their message. (1 mark expansion 2 marks definition)

d. Put ACK, RTS, CTS and Data transmission into the correct order that they would be sent in a successful CSMA/CA transmission

[1 mark]

RTS, CTS, Data Transmission, ACK

e. Briefly define full-duplex, simplex and half-duplex transmission.

[4 marks]

Full duplex means a link can send in both directions at the same time.
Simplex means a link can send in only one direction.
Half duplex means a link can send in both directions but not in both directions at the same time (2 marks for this part, one for both directions, one for not at the same time).

f.   The figure below shows a learning bridge:
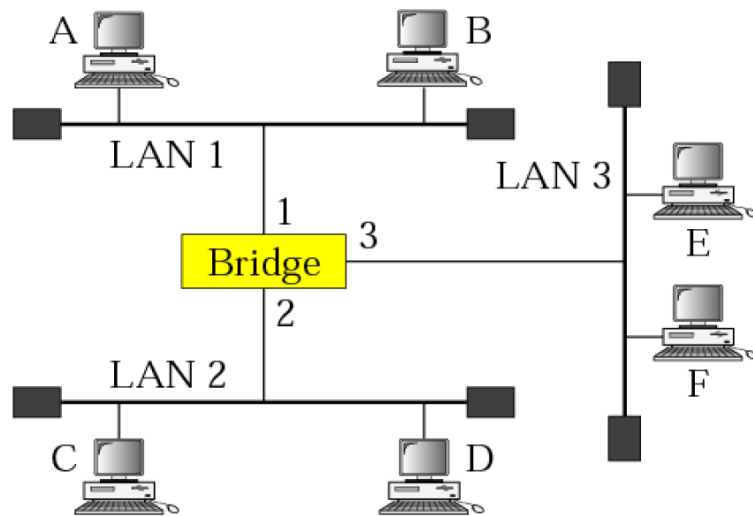
Its routing table is currently empty. Draw the routing table for the learning bridge after:
  i.   C sends a frame to B;
  ii.   Then D sends a frame to A;
  iii.   Then B sends a frame to A.

[6 marks]

Route	Port
C	2

Route	Port
C	2
D	2

Route	Port
C	2
D	2
B	1

2 marks for column headings: (Headings can be Route/Destination/Host/Source and Port/Interface)
1 mark for realising you need three tables
1 mark for final table containing routes to C, D and B only (order does not matter in table)
2 marks if the correct ports are used for the correct route

Question 2

a) Answer the following questions with regard to Internet Protocol version 4 (IPv4) addressing and Internet Protocol version 6 (IPv6) addressing.

[8 marks]

i)   Identify the IP class of a host with IPv4 address 227.34.78.1. Calculate all the subnetwork addresses of 227.34.78.0/26

(5 marks)

Class D (1 mark)

Network address: 227.34.78.0/26 (1 mark)

Subnetwork address: 227.34.78.64/26 (1 mark)

Subnetwork address: 227.34.78.128/26 (1 mark)

Subnetwork address: 227.34.78.192/26 (1 mark)

ii)   Below is the IPv4 mapped IPv6 address.

0.0.0.0.0.0.0.0.0.0.255.255.14.0.20.80

- Identify when IPv4 mapped IPv6 address is used.

When host that supports both IPv4 and IPv6 communicates with host that supports only IPv4 (1 mark)

- Convert it to Colon Hexadecimal Notation.
0::FFFF:0E00:1450 (2 marks)

(3 marks)

b) Answer the following questions related to routing.

[8 marks]

i) As referring to Figure 1, describe the undesirable behaviour that can arise between nodes A and B because of a link failure such as between nodes B and C. And explain how the split-horizon technique can be of benefit.
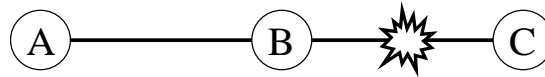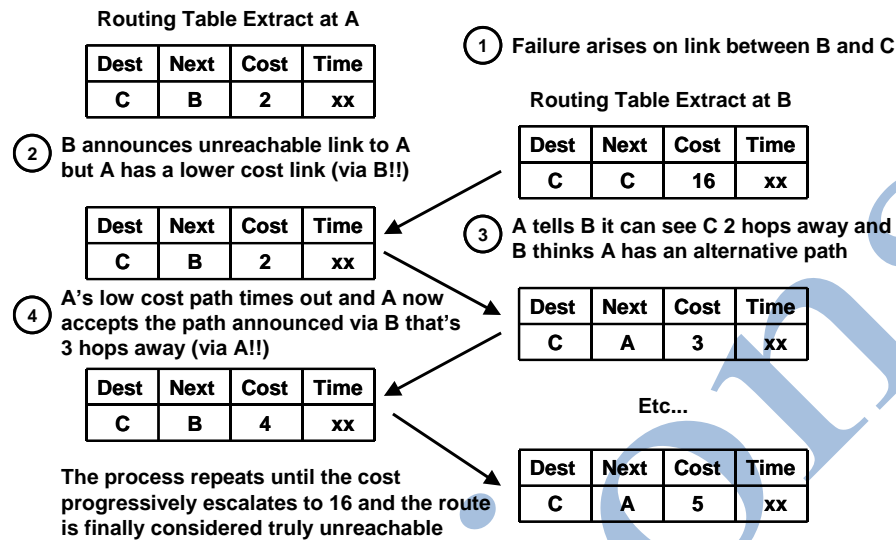
(4 marks)

Figure 1:- Split Horizon Illustration

The undesirable behaviour is illustrated below:

2 marks for correct diagram or correct description of each node.

The *Split Horizon* update mechanism means that a router does not broadcast routing information over the same interface over which it was received. This leads to a more rapid discovery of the unreachable path and thus improves convergence time. (2 marks)

ii) Briefly explain how the two following enhancements to Routing Information Protocol (RIP) that can be used to facilitate rapid re-convergence.

- Hold down timer

- Triggered updates

(4 marks)

Hold-Down Timer - Router does not change information about a route following a message indicating that the destination is unreachable (for 60 seconds) (2 marks)

Triggered Updates - Route changes require a router to issue a broadcast message rather than waiting for the normal broadcast interval (2 marks)

c) With reference to the topology shown in Figure 1, use Dijkstra's algorithm to generate the Shortest Path Tree originating from Node E and use it to construct the corresponding routing table. It is important to clearly show how you arrived at your answer.
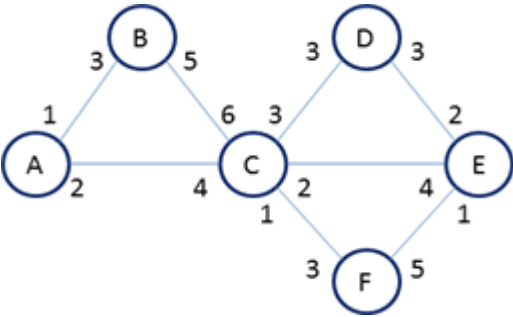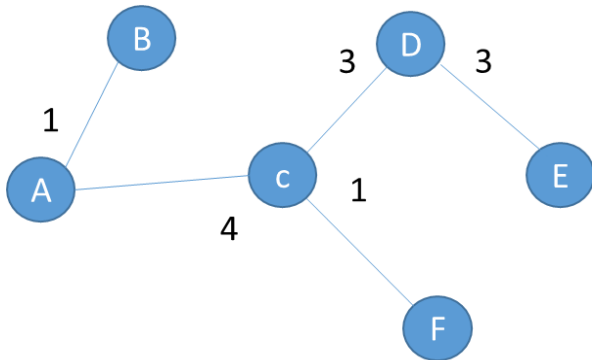
[9 marks]

Candidate	Cost to Root	Tree
		D,D,0
D,C,3	**3**	**D,D,0**
D,E,3	**3**	
D,E,3	**3**	**D,D,0**
~~C,E,2~~	~~5~~	**D,C,3**
C,F,1	**4**	
C,B,6	**9**	
C,A,4	**7**	
C,F,1	**4**	**D,D,0**
C,B,6	~~9~~	**D,C,3**
C,A,4	**7**	**D,E,3**
~~E,F,1~~	**4**	
C,B,6	~~9~~	**D,D,0**
C,A,4	**7**	**D,C,3**
		D,E,3
		C,F,1
~~C,B,6~~	~~9~~	**D,D,0**
A,B,1	**8**	**D,C,3**
		D,E,3
		C,F,1
		C,A,4
		D,D,0
		D,C,3
		D,E,3
		C,F,1
		C,A,4
		A,B,1

(2 marks for correct choosing candidate to the Tree; 2 marks for correct identification of Cost to Root; 1 mark for appropriate comments) Total of 5 marks awarded for an appropriate Dijkstra calculation;

2 marks for correct SPT

2 marks for correct routing table

Routing table

Destination	Next hop	Cost
D	-	-
C	C	3
E	E	3
F	C	4
A	C	7
B	C	8

Question 3

a) Answer the following questions with regard to Internet Control Message Protocol (ICMP).

[12 marks]

    i)   What is the purpose of ICMP? Explain how ICMP Type-3 messages are used for Path Maximum Transfer Unit (MTU) Discovery.

(4 marks)

ICMP enables a router or destination host to communicate with a source host, for example, to report an error in datagram processing. (2 marks)
Path MTU discovery uses the Type-3 Destination Unreachable ICMP messages as follows:
- TCP negotiates initial MTU size – usually
- TCP/IP sends datagram with Don't Fragment flag set
- If datagram is too large an ICMP Destination Unreachable is received
- Reduce Maximum Transfer Unit (MTU) and try again

(2 marks)

ii) Explain the main function of the ICMP Type-4 Source Quench message and explain why its use is not always advisable?

Type-4 Source Quench ICMP messages used for congestion control for overloaded routers. (2 marks)

ICMP Source Quench is sent to source for each discarded packet. Reception lowers packet rate in theory. However congestion can give rise to a storm of Type-4 messages towards the originating source – possibly compounding the problem. (2 marks)

(4 marks)

iii) Describe how ICMP's *traceroute* works for debugging.

(4 marks)

traceroute sends a series of packets for which it sets the IP "Time To Live" (TTL) hop-count field to different values. Setting the TTL to N will result in the Nth router generating a "Time Exceeded" ICMP message which it sends back to the originating host. (2 marks)

Because ICMP messages are sent using IP packets, traceroute can extract from their source address the IP address associated with the router at the Nth hop. (Strictly speaking it's not the IP address associated with the router, since routers have one IP address for each of their interfaces.) (2 marks)

b) Provide brief definition of the following terminologies related to Transport layer.

[7 marks]

i) Flow control

(3 marks)

Flow control protocol is required to prevent data items being discarded at consumer when over pushing by the producer. It involves preventing senders from overrunning the capacity of the receivers (2 marks).

Receiver controls the Send window size, and adjust its own Receive window, usually opening or closing to control the data flow (1 mark).

ii) Congestion control

(2 marks)

Congestion control prevents too much data from being injected into the network, thereby causing switches or links to become overloaded (2 marks).

iii) Error control

(2 marks)

Error control detects and discards corrupted packets; Keeps track of lost and discarded packets and resends them; Recognises duplicate packets and discards them; Buffers out-of-order packets until the missing packets arrive (2 marks).

c)   Explain how flow control can be used to prevent receive buffer overflow using a Sliding Window approach.

[6 marks]

(1 mark for each point)
Rx tells Tx how much data to send - window (sent in Acks).
Rx can vary window size (increase or decrease)
Reduce window to 1: stop-and-wait or zero to halt flow
Other window sizes allow for progressive flow control that can easily adapt to the rate of application layer pull.
ACK from Rx contains SN for data to be acknowledged
Tx can send (W - u) packets: where W is window size for Tx and u is the number of packets outstanding

Question 4

a) Explain the purpose of the following TCP segment header fields:

[8 marks]

    i)   Source / Destination Port Numbers

(2 marks)

    Used to identify source and destination application instances. (2 marks)

    ii)   SYN Flag

(2 marks)

    Used to signal the opening of a new TCP connection – 3-way handshake – causes Snum to be set at the receiver if connection accepted. (2 marks)

    iii) Data Offset
    Header is variable size so data offset is the number of 32bit chunks comprising a particular header. (2 marks)

(2 marks)

    iv) Acknowledgement Number
    Index value of the next byte expected in the ordered sequence of data to be received. By definition, all preceeding bytes must have been received to form a contigious stream up until this point. (2 marks)
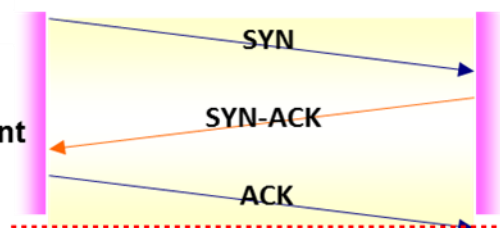
(2 marks)

b) With the aid of diagrams, explain how TCP maintains the transmission as a connection-oriented transport layer protocol.

[6 marks]

    TCP use three-way handshaking scheme to establish the bi-direction connection before transmitting data. While the termination process is carried out separately for two directions (2 marks).
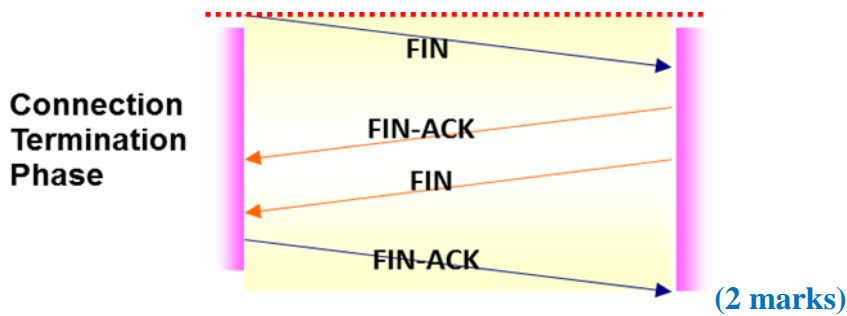

(2 marks)

(2 marks)

c) Answer the following questions with regard to Transmission Control Protocol (TCP).

[11 marks]

i) What can be deduced from the reception of duplicate acknowledgements? How is this information used in TCP Reno to maintain channel utilisation?

(5 marks)

The communication channel is unlikely to be congested as ACKs are still getting through (2 marks). Missequenced data will cause dup-ACKs so to prevent false triggers three dup-ACKs used (1 mark - extra).

Reno uses fast retransmit and fast recovery (2 marks). The aim is to prevent premature congestion window collapse (1 mark).

ii) Describe the mechanism of TCP's Path MTU Discovery.

(3 marks)

After connection, TCP uses minimum of outgoing I/F MTU or receiver advertised MSS (1 mark). DF bit set in segments (1 mark);

If ICMP "can't fragment" returned (1 mark), TCP decreases segment size and retransmits (1 mark).

iii) Why is the TCP transport service unsuitable for real-time data? Use a real-time voice flow as an example within your answer.

(3 marks)

The ability to resend missing segments is inappropriate for a service where low delay and jitter are required. For RT voice, the reception of "late" samples would not add to the quality. Delaying during this intervening time is worse than playing silence or repeating last sample (1 mark for each point)