

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering



Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: EEX5534/ECX5234 Data Communications
Academic Year	: 2019/20
Date	: 30 th July 2020
Time	: 0930-1230hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Five (5)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is a **Closed Book Test (CBT)**.
6. Answers should be in clear hand writing.
7. Do not use Red colour pen.

Q1.(a) “As the COVID-19 pandemic has shut down business and entertainment venues, the world has gone online as never before making an extraordinary period in Internet history”

- (i) Briefly explain the different elements of Internet using a suitable diagram.
- (ii) Internet performs with TCP/IP protocol. Briefly explain the TCP/IP layered model and compare it with ISO/OSI model.
- (iii) List 4 main internet services which created high traffic during Covid-19 period.

(10 marks)

(b) The standard video quality or resolution of YouTube colour (8-bit x 3 colour) videos is 640 x 480 and these picture frames are transmitted at a rate of 30 frames per second.

- (i) Calculate the total number of bits per picture frame.
- (ii) Assume that a standard video compression scheme such as MPEG4 (H.264) is used for YouTube video gives an average 2000:1 compression (data reduction). If you are watching one of the above YouTube videos, how much data you are using per hour?
- (iii) If you have a 1GB data package, calculate how long you can watch YouTube videos in hours.

(10 marks)

Q2.(a) A communication system uses Cyclic Redundancy Check (CRC) error-detecting mechanism where $x^4 + x^3 + x + 1$ is used as the polynomial.

- (i) What is the degree of the polynomial?
- (ii) What is the binary representation of the polynomial?
- (iii) If the transmitted message sequence (generated after applying the above CRC mechanism) is 101100101001, find the original message and the Frame Check Sequence.
- (iv) If the 3rd bit from the left is inverted during transmission, show how this error will be detected by the receiver.
- (v) In what situations errors cannot be detected in this method?

(08 marks)

(b) Draw the encoded bit pattern of the data sequence 10010110 for the following coding schemes:

- (i) Polar Non Return to Zero Level (NRZ-L)
- (ii) Polar Non Return to Zero Invert (NRZ-I)
- (iii) Manchester
- (iv) Differential Manchester

(12 marks)

Q3. (a) With the increasing popularity of different mobile devices, the demand for Wireless LANs has been significantly increased.

- (i) Briefly explain the approach it uses for accommodating data transmission among multiple users at the Data Link Layer.
- (ii) Clearly highlight the similarities and differences of the method in (i) with the method used in Ethernet.

(08 marks)

(b) TCP and UDP are the two main protocols running in the transport layer of TCP/IP reference model.

- (i) Explain the differences between TCP and UDP and justify these differences with the help of their header structures.
- (ii) Three-way handshaking is the connection mechanism used in TCP protocol. Briefly outline this mechanism and explain the importance of this mechanism in TCP/IP.
- (iii) In cases where reliable transmission of data is not of primary importance, UDP would make a good transport protocol. Briefly explain an example for such a specific case.

(12 marks)

Q4. (a) SMTP is one of the most important application layer protocols in use today.

- (i) Describe the role of the DNS system in e-mail distribution by considering the process of sending an email from your personal account from your computer at home to a friend whose email address is xyz@pqr.abc.com. Use a suitable diagram for your description.
- (ii) A local DNS server typically discards cached name-to-address mappings when the time-to-live expires. What is meant by time-to-live and who determines the value of the time-to-live field?

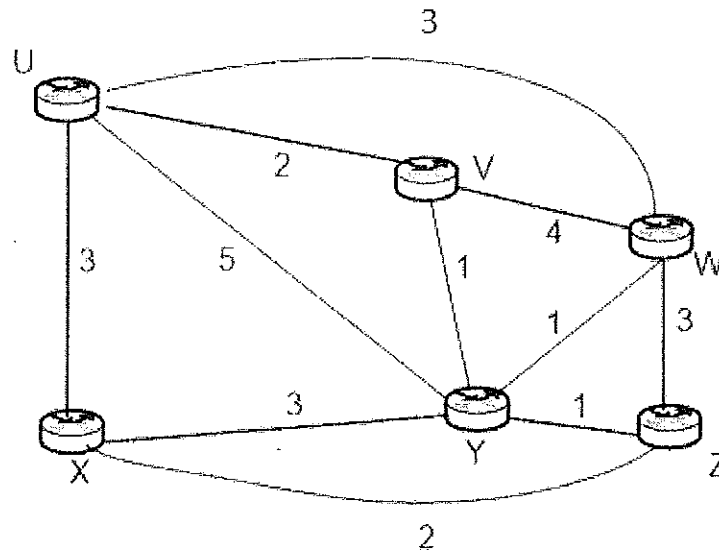
(12 marks)

(b) (i) Explain the difference between VLAN (Virtual Local Area Network) and VPN (Virtual Private Network) by giving an example scenario for each.

- (ii) Can the devices in two VLANs communicate with each other? Explain.

(08 marks)

- Q5. (a) Compare Link State routing and Distance Vector routing in terms of convergence time, memory and processing requirements with reasons. (03 marks)
- (b) Consider the network shown in Figure Q5. With the indicated link costs, use **Distance Vector routing algorithm** to find the shortest path from U to all other nodes. Show your work by preparing a table indicating the cost and the path considered for each node at each iteration. (12marks)



Fig, Q5

- (c) Explain Count-to-infinity problem that can happen in Distance Vector routing protocol with an example taken from the above network in Fig. Q5. (05 marks)

- Q6. (a) Compare the following:
- Stop & Wait protocol & Sliding Window protocol
 - Go-Back-N protocol and Selective Repeat protocol (04 marks)
- (b) Consider a communication channel that uses Go-Back-N ARQ protocol with a 2 bit sequence number. Use timing diagrams to show what happens in the following 3 scenarios. Comment on the possibility of identifying the correct frame at the receiver in each case.
- When $N = 5$ and the acknowledgements of the first set of N frames are lost.
 - When $N = 4$ and the acknowledgements of the first set of N frames are lost.
 - When $N = 3$ and the acknowledgements of the first set of N frames are lost.
 - Hence derive an expression for the sender's window size of Go-Back-N ARQ protocol.

(16 marks)

- Q7. (a)** An ISP is granted a block of addresses starting with 190.128.0.0/16. The ISP wants to distribute these addresses to three groups of customers as follows:
- Group A has 32 customers; each needs 128 addresses.
 - Group B has 64 customers; each needs 64 addresses.
 - Group C has 64 customers; each needs 32 addresses.

(i) Design the sub-blocks and give the slash notation for each sub block. (Present your answer by giving IP ranges of the first two customers and the last two customers of each group.) You need to show all the steps very clearly.

(ii) Find out

- A. Total number of addresses granted to ISP
- B. Total number of addresses allocated by the ISP
- C. Number of addresses still available after these allocations. *(12 marks)*

(b) (i) Briefly explain a methodology you apply for the transition of IPv4 addresses to IPv6 addresses.

(ii) Consider an entity needs to divide its address space into 8 subgroups each having 16 addresses.

With IPv6 address, 2051:005f:120d::/60, show how you can do the subnetting for this network. Show your work with the IPv6 address format and just giving the network address of each group.

(08 marks)

Q8. (a) Write short notes on the following:

- (i) Network routing in SDN
- (ii) RFCs in standardization of Internet protocols
- (iii) Multiprotocol Label Switching

(09 marks)

(b) Briefly explain why you need to have access technologies in a data network and categorize different types of access technologies according to the wired and wireless media. *(06marks)*

(c) Explain the operating principle of ADSL, highlighting how it has a higher download speed, compared to upload speed. *(05 marks)*

