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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 Data Communications**
Academic Year	: 2020/21
Date	: 8th February 2022
Time	: 14.00 - 17.00 hrs
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.

Answer any 5 questions.

Q1. (a) The main goal of data communication and networking is to enable exchange of data between any two points in the world. Briefly explain how layered models like OSI model contribute to achieving this goal. [02]

(b) Relate the following terms with the operation of the layers of the OSI model.
(i) Protocol
(ii) PDU
(iii) Encapsulation/Decapsulation [03]

(c) Briefly explain the main function of the following protocols and match them to the related layer in the OSI model.
(i) DNS (ii) FTP (iii) UDP (iv) CSMA/CD
[04]

(d) (i) *"Shannon's Theorem gives an upper bound to the capacity of a link."* Explain the above statement with sufficient details. [02]

(ii) A television signal (video and audio) has a bandwidth of 4.5MHz. This signal is sampled, quantized and binary coded to obtain a PCM signal.

A. Determine the sampling rate if the signal is to be sampled at a rate 20% above the Nyquist rate. [01]

B. The samples are quantized into 1024 levels in order to provide a high quality signal. Determine the number of binary pulses required to encode each sample and the bitrate (bps) of this encoded signal? [03]

C. Suppose that the above television signal is sent through a wireless channel where the Signal to Noise ratio varies from 20dB to 40dB due to interference from other sources. Use Shannon's formula to find the maximum channel capacity and comment on the wireless channel's ability to successfully deliver the television signal. [05]

Q2. (a) Critically discuss the need for having two separate layers for "Transport" and "Network" in OSI model. Illustrate your answer with suitable examples. [05]

(b) UDP (User Datagram Protocol) is often used for multimedia streaming (sending audio & video over the network). Explain in detail the features of UDP that make it suitable for this purpose. [05]

(c) Explain in detail why TCP (Transmission Control Protocol) is heavily used for data transfers and other application protocols like HTTP. [05]

(d) Some transport layer protocols are considered to be unreliable. Provide reasons for this statement and explain a possible way of eliminating that unreliability. [05]

Q3. (a) Draw the encoded bit pattern of the data sequence 1001101101 for the following coding schemes:

(i) Polar RZ
(ii) Manchester
(iii) Differential Manchester [09]

(b) A communication system uses Cyclic Redundancy Check (CRC) method for error control. A bit oriented message 11001101 is to be transmitted from a sender to a receiver.

(i) Using an even parity error detection scheme, calculate the parity bit and show the bit stream that would be transmitted. [03]

(ii) Instead of parity check the CRC method is used for error detection. Show the sender calculation for the message using the generator polynomial $x^3 + x^2 + 1$. Show your work clearly and indicate the final bit stream to be transmitted. [04]

(iii) A different message was sent between the same two systems and the message 10101100110 was received. Assuming that we use the same CRC polynomial as in (ii) above, determine whether the received message is correct or not. [04]

Q4. (a) Consider an Ethernet network with CSMA/CD protocol, which is having a bit rate of 1Mbps and maximum network span of 10 km with no repeaters. The propagation delay of the medium is 4.5 ns/m.

(i) Briefly explain the process followed by CSMA/CD protocol to minimize collisions. [03]

(ii) What is the minimum frame size (in bits) necessary to ensure that CSMA/CD will work properly for the above network? Explain your reasoning. [03]

(iii) Using Gigabit Ethernet we can get the bits out ten times faster than normal Ethernet. For the above network show how it is possible to increase the data rate 10 times faster by maintaining the same minimum frame size? [03]

(b) Compare CSMA/CD with the multiple access technique used with IEEE 802.11 WiFi LAN standard. [03]

(c) "Modern network administrators configure switches into virtual local-area networks (VLANs) to improve network performance by separating large Layer 2 broadcast domains into smaller ones."

(i) Explain the term "broadcast domain" mentioned here and how it affects the network performance. [03]

(ii) Demonstrate what a VLAN is by using an example and use that to show how VLANs divide a large broadcast domain into smaller ones. [03]

(iii) List out 4 advantages of VLANs. [02]

Q5. (a) Reliable data delivery transport protocols employ several mechanisms including acknowledgement, checksums, sequence numbers, retransmissions, and retransmission timers. Briefly explain how these mechanisms contribute towards reliable data delivery. [05]

(b) Show how the reliability mechanisms Go-Back-N and Selective-Repeat algorithms follow to ensure that all the data sent by the transmitted are delivered to the receiver. What overhead information are included in each? [05]

(c) Consider a communication channel that uses Go-Back-N ARQ protocol with a 3 bit sequence number. It uses the window size as 6. Data frames with sequence numbers 1, 2, 3, 4 and 5 have been sent and the sender just received acknowledgements for frames 1 and 2. Frames 6, 7, 8, 9 and 10 are waiting to be sent.

(i) Draw the time diagram showing this scenario. [03]

(ii) Which frame/s can the sender send before it must wait for the next ACK from the receiver? Explain. [03]

(iii) The data transmission continues and suppose the sender transmitted segments 18,19,20, 21, 22 and 23; however, segment 20 got lost. What segment(s) would the sender need to retransmit? Explain your answer. [02]

(iv) If Selective-Repeat protocol is used as the ARQ method for the above link what segment/s would the sender need to retransmit in the situation mentioned in (iii) above? Explain. [02]

Q6.

(a) Assume that you are the network administrator of QtyFood which is a food processing and marketing company. Your company has 6 divisions; Manufacturing, Purchasing, Marketing, Finance and Human Resources(HR) and they have separate local area networks for each. The maximum number of network users of each division is as in the following table.

Division	Number of users
Manufacturing	160
Purchasing	60
Marketing	300
Finance	175
HR	100

The head of IT has given the IP block 10.10.0.0/21 for the above network. Provide the complete IP address plan for the above network. Your answer should include the network address, subnet mask, broadcast address and possible range of addresses for each subnet. [14]

(b) If you are using IPv6 addressing in this network, following features can be incorporated.

(i) Larger address space

(ii) Simple header format

(iii) Address Auto-configuration [06]

Briefly explain each and show how they are advantageous compared to IPv4 taking into consideration the current trends in networking and other technologies.

Q7. (a) (i) Briefly explain how distance vector method updates the routing table information.
(ii) Explain a problem that can be encountered during a node failure in this algorithm using an example.
(iii) What advantages do you find in Link State routing algorithm compared to Distance Vector method? [07]

(b) Use Distance Vector routing protocol to determine the shortest path from A to all other nodes of the network shown in figure Q6. Hence find the shortest path from A to F. Show how the algorithm works by using a suitable table. [13]

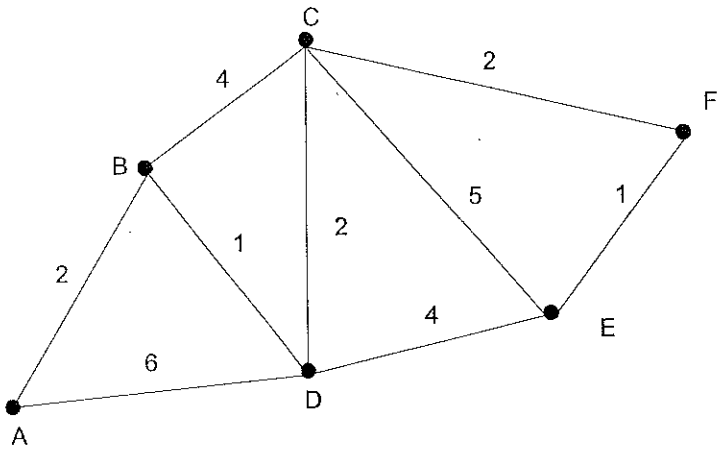

Figure Q7

Q8. (a) (i) "DNS is designed to be a distributed database as opposed to a centralized one." Critically discuss this statement explaining the reasons. [04]

(ii) Explain how caching improves the performance of DNS. What are the negative effects of caching? [03]

(iii) Assume that you are accessing the web site: www.ics.talenta.ac.nz from a computer at OUSL premises abc.ou.ac.lk. Clearly explain the steps to be followed in the DNS name resolving process and the DNS servers involved. State any assumptions you make. [05]

(b) Write short notes on the following technologies highlighting what problems they are addressing related to the field of computer networking:

(i) NAT (ii) ADSL (iii) SDN (iv) VPN [08]