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

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Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX5434 Data Communications & Networking**
Academic Year	: 2021/22
Date	: 22nd February 2023
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 **Six (6)** 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 handwriting.
7. Do not use Red colour pen.

Answer any 5 questions.

Q1. (a) State whether the following statements are True or False. For false statements, mention, how they should be corrected.

(i) According to the Nyquist theory, the sampling frequency should be less than twice the highest frequency contained in the signal.

(ii) In OSI model path determination and logical addressing is done by Data Link layer.

(iii) IANA is responsible for maintaining the registries of the Internet's unique identifiers, which include domain names, Protocol Parameters, and Internet numbers.

(iv) Process of adding control information to the data packet at each layer is called as data encapsulation. [04]

(b) Briefly explain the main function of the following devices and match them to the related layer in the OSI model.

(i) Hub
(ii) Router
(iii) Firewall
(iv) Network cards

[04]

(c) (i) Define Shannon's theorem and explain its significance in digital communication systems. [02]

(ii) An audio signal is recorded and stored digitally in an audio CD using Pulse Code Modulation at 44100 samples per second.

a. Find the maximum bandwidth of the audio signal which can be correctly reproduced using this sampling rate. [02]

b. If each sample is encoded as 24bits, find the data rate for the recording. [02]

c. If an audio CD can store up to 747 MB, how many minutes of the audio signal can you store in a CD? [03]

d. If the above audio data file which was stored in the full CD is to be transmitted over a channel with 4 MHz bandwidth and a 35-dB signal-to-noise ratio, find the capacity of the channel (Mbps). [03]

Q2. (a) (i) Differentiate Bit Stuffing vs Byte stuffing. [02]

(ii) The message 01111110111101111110 is to be sent by a host running a protocol with starting and ending flags and bit stuffing. The starting and ending flags are both 01111110 and they have not yet been added in the above bit stream.

What is the message actually sent after bit stuffing and after adding the starting and ending flags? [04]

(b) Draw the encoded bit pattern of the data sequence 110010101 for the following coding schemes:

(i) Manchester

(ii) Differential Manchester [06]

(c) The bit oriented message 110010101 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. [01]

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

(iii) A different message was sent between the same two systems and the message 101011001100 was received. Assuming that we used the same CRC-3 from above, determine whether the received message is correct. [03]

Q3. (a) Compare Stop & Wait, Go Back-N and selective Repeat ARQ protocols in terms of:

(i) Number of retransmissions in case of packet drop

(ii) System complexity

(iii) Bandwidth utilization if error rate is high [06]

(b) If k bits are used for the sequence number, define required sender window size and receiver window size for Stop & Wait, Go Back-N & Selective Repeat methods? Provide sufficient reasons for your answers. [06]

(c) Suppose that in a communication channel, we need to send a total of 8 packets (f1-f8). Here, transmission delay is one time unit long, time-out value is 3 time units, one way propagation delay is 0.5 time units and the processing times are negligible. If every 4th packet is lost during transmission, answer to the following questions. For each of the below 3 cases, show the timing diagrams.

(i) If we use Stop & Wait protocol and if every 4th packet is lost, how many transmissions, including retransmissions, will it take to send all the 8 packets? [02]

(ii) If we use GoBack-3 ARQ, how many retransmissions to be done to send all 8 packets correctly? [03]

(iii) If we use Selective Repeat ARQ with window size 3, how many retransmissions to be done to send all 8 packets correctly? [03]

Q4. (a) IP address depletion has been anticipated since the late 1980s, when the Internet started experiencing dramatic growth. This depletion is one of the reasons for the development and deployment of its successor protocol, IPv6.

(i) What is meant by IP address depletion? [02]

(ii) Justify with sufficient explanation, how the IPv6 protocol serves as a successor, to overcome the depletion issue of IP addresses. [02]

(iii) Briefly explain two ways for making already deployed IPv4-based network systems to be capable of handling IPv6 datagrams. [02]

(b) Assume that an ISP has an address block of 192.168.0.0/19. It has two customer networks of size 2000 nodes each and three customer networks of size 1000 nodes each.

(i) Assuming that the ISP allocates IP addresses sequentially from the beginning of its address space, what are the prefix allocations for these customers? [04]

(ii) The remaining customer networks have a size of 120 nodes each. How many remaining customer networks can be supported? [02]

(iii) For the first 5 networks (networks with 2000 users and 1000 users) mentioned above, find:

a. Subnet address in CIDR format
b. Subnet mask
c. Broadcast address

Clearly show the steps you follow in getting your results for the above questions. [08]

Q5. (a) Differentiate the following:

(i) Routing vs Forwarding
(ii) OSPF Vs RIP

[04]

(b) Figure Q6 shows a network which has six nodes and the cost for each interface is marked at a particular instance. Use **Distance Vector routing protocol** to determine the shortest path from **A** to all other nodes of the network by using a suitable table. [12]

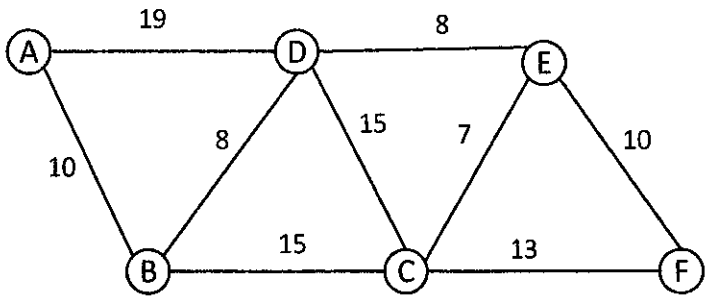

Figure Q5

(c) In certain failure situations, it has been observed that it takes an exceptionally long period to stabilize the network.

(i) What would be the reason for this kind of delay happening in Distance Vector routing? [02]

(ii) Suggest a method to mitigate the problem. [02]

Q6. (a) Use your knowledge of TCP and UDP to answer the following questions.

(i) State 3 features provided by TCP, that are not provided by UDP. [03]

(ii) Out of TCP and UDP, select which protocol would you use for each of the following network applications. Provide sufficient reasons for your selection. [06]

a. Online video conferencing such as Zoom meetings
b. Stored on demand video streaming
c. Text-based instant messaging app

(b) Briefly describe how the below mentioned WAN technologies operate and what specific advantages they provide.

(i) VPN (ii) MPLS [06]

(c) List 3 problems with the current networks and explain how SDN can provide a solution to these problems. [05]

Q7. (a) (i) Differentiate the following related to DNS:

a. Flat name space vs Hierarchical name space
b. Domain Name Server Vs Domain Name Resolver
c. DNS query message and DNS response message [03]

(ii) Describe the role of the DNS system in e-mail distribution using an example. [03]

(iii) "DNS TTLs are vital to websites that make constant changes and updates frequently." Justify this statement mentioning what DNS TTL is and how it affects the DNS process. [02]

(b) (i) The CIA Triad is a model that organizations use to evaluate their security capabilities and risk.

a. What are the parameters mentioned in CIA Triad? [03]

b. State to which of the CIA parameters, the below mentioned cyber attacks are mapped. Justify your answer with sufficient reasons. [06]

1. Denial of Service attacks
2. Financial fraud through modification of financial records
3. A data breach caused by hacking into computer systems to steal sensitive information, such as personal data, financial information etc.

(ii) Routers & Switches are the most vulnerable to security threats. Suggest 3 safety practices related to routers and switches that you can follow to safeguard your computer network. [03]

Q8. (a) Briefly explain in which situations you use the below mentioned protocols in Local Area Networks.

(i) CSMA/CD
(ii) CSMA/CA
(iii) Spanning Tree Protocol [06]

(b) A new school is being setup and there is a requirement for a local area network to be implemented with access from every classroom. There are to be 100 PCs in the computer labs and another 50 dispersed in various rooms around the building, as well as 20 laptops which teachers will expect to be able to use in any room. It is expected that each PC will require no more than 50Kbits/s. Cost is to be the primary design consideration.
You should consider the following design options:

1. 802.11b/g Wireless LAN
2. 100 Base T Ethernet using UTP wiring
3. Ethernet using fibre optic cable.

(i) State which of the above design options best suits the customer requirements, giving your reasons for choosing the design and rejecting other designs. [06]

(ii) Draw a network diagram illustrating all aspects stated in the scenario. [05]

(iii) The school is planning to get a high-speed Internet Connection. Several packages with different data rates are available. Suggest a suitable data rate and justify your selection. [03]

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