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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/ECX5234 Data Communications**
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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) ***"The TCP/IP model is basically a shorter version of the OSI model."***

(i) Both TCP/IP and OSI model have a layered architecture. Explain the meaning of layered architecture model and its necessity in data communication. [04]

(ii) Justify the statement given in italic providing reasonable facts. [03]

(b) Assume that there are 100 thousand households in a city, and that each household has two HDTVs, and that each HDTV is used to watch 4 hours of video per day. Assume that each (compressed) video stream runs at 9Mb/s. If all households are watching TV at the same time, but all watching video on-demand (i.e. data is delivered unicast to every household), find the total peak aggregate data rate delivered to all houses in a day. [05]

(c) A communication medium reliably transmits frequencies between 0 and 25KHz.

(i) By using binary signals, show that it is not possible to transmit 400Kbps of information along this line.

(ii) Suggest a technique that you can use for transmitting 400Kbps along the above line.

You need to justify your answers with necessary calculations and assumptions. [08]

Q2.(a) In Cyclic Redundancy Check (CRC), a sequence of redundant bits, called cyclic redundancy check bits, are appended to the end of data unit so that the resulting data unit becomes exactly divisible by a second, predetermined binary number.

(i) If the length of a message is k and the transmitter generates a n-bit sequence as the FCS, using CRC, find an expression for the length of the pattern P and the length of the bit pattern to be transmitted as the message. [02]

(ii) A message was sent between two nodes of a communication system and the message 10101100110 was received. Assuming that we used CRC error detection scheme using the generator polynomial $x^3 + x + 1$ determine whether the received message is correct or not. [06]

(b) (i) Briefly explain why line coding is required in communication systems. [02]

(ii) Draw the encoded bit pattern of the data sequence 1001011001 for the following coding schemes: [09]

I. Non Return to Zero (NRZ-I)
II. Manchester
III. Differential Manchester

(iii) Give one advantage and a disadvantage of Manchester codes. [01]

Q3. (a) In a deployed CSMA/CD network, would it be possible to increase or decrease the duration of the slot time (minimum frame period)? Justify your answer. [03]

(b) Consider the simple network depicted in the figure Q3 shown below.

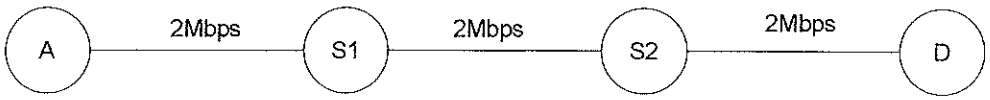


Figure Q3

Suppose a message that is 8Mb long that is to be sent from Host A to Host D with two packet-switches in between. The data rates of each layer is given as in the Figure Q3. Ignore propagation, queuing, and processing delays.

(i) Consider sending the message from A to D without message segmentation. How long does it take to move the message from Host A to the first packet switch(S1)? Assuming that each switch uses store-and-forward packet switching, what is the total time to move the message from A to D? [03]

(ii) Now suppose that the message is segmented into 800 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from A to the first switch? [03]

(iii) When the first packet is being sent from the first switch to the second switch, the second packet is being sent from A to the first switch. How long will the second packet be fully received at the first switch? [05]

(iv) How long does it take to move the whole message file from A to B when message segmentation is used? [03]

(v) Compare the above result in (iv) with your answer in part (i) and comment. [03]

Q4. (a) The Domain Name System (DNS) has a hierarchical inverted tree structure which is called the DNS namespace.

(i) Explain how DNS operates using its hierarchical inverted tree structure using the standard terminology used for each level of the hierarchy.

(ii) Explain the importance of the cache server and TTL in DNS operation. [10]

(b) Suppose you are employed at the Open University, having an email address, abc@ou.ac.lk, sends an email to one of your friends whose email address is xyz@yahoo.com. Assuming "ns.ou.ac.lk" and "ns.yahoo.com" are the DNS servers of OUSL and Yahoo respectively, answer the following:

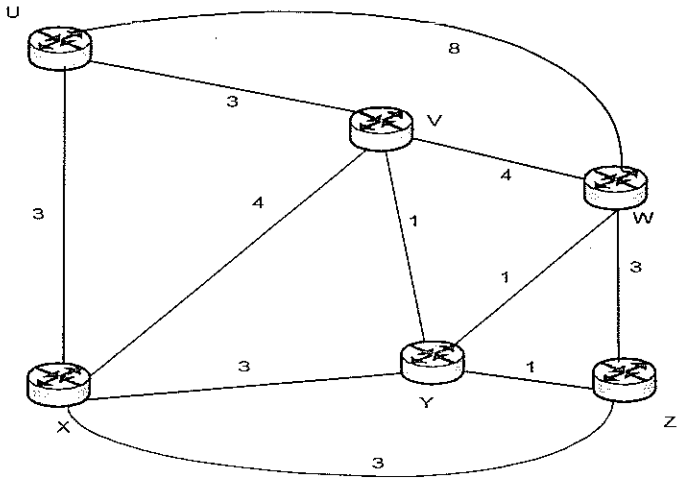
(i) Identify all the DNS transactions that will take place for the purpose of this email delivery.

(ii) What mechanisms can be used to ensure the delivery of email even in the presence of temporary server inaccessibility?

State your assumptions clearly, if any. [10]

Q5. (a) (i) State the principle of Link State routing. [02]

(ii) Consider the network shown in Figure Q5. With the indicated link costs, use **Link State 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. [12]



Fig, Q5

(b) (i) Explain what is meant by *convergence* in routing. [02]

(ii) Briefly explain why Link State routing protocols converge faster than distance vector protocols. [03]

(iii) Suggest a method to reduce the long convergence time in Distance Vector protocols. [01]

Q6. Read the following scenario carefully and answer the given questions.

HealthCare is a leading hospital in the city which has 8 floors and patient rooms are on floors 5 through 8 of the hospital building. It has newly purchased IT related advanced medical equipment and the medical staff would like to access those systems using laptops from any of the patient rooms. With the new facilities, doctors and nurses should be able to access patient medical records, x-rays, prescriptions, and recent patient information. The hospital purchased new servers and placed them in the data center. The wireless LAN (WLAN) has approximately 25 laptops, and about 15 more are due in six months. The servers must have high availability.

Hospital's current network has 8 segments connected to a single router that also serves the Internet. You were given the present IP address assignment details as in the Table Q6. The router is running Routing Information Protocol Version 1 (RIPv1). The back-end new servers are located in the same segment as those used on floor 1.

Suppose you have been appointed as the IT Manager at HealthCare Hospital, and responsible for managing the network. You were requested to propose a new network solution as the available network does not meet the hospital's current requirements. The hospital management is planning

to get the maximum use of technology for its services, and therefore, the management has allocated funds for network improvements.

As the IT manager, you need to draft a proposal to upgrade the network with fast switches and to provide faster access to the servers. The proposal should also cover secure WLAN access on floors 4 through 8. Include an IP addressing scheme that reduces the number of Class C networks the hospital uses.

Floor No,	Number of servers	Hosts	IP address
1	12	40	200.167.1.0/24
2	0	45	200.167.2.0/24
3	0	40	200.167.3.0/24
4	0	39	200.167.4.0/24
5	0	20	200.167.5.0/24
6	0	17	200.167.6.0/24
7	0	14	200.167.7.0/24
8	0	15	200.167.8.0/24

Table Q6: IP address allocation of present network

(i) Sketch the network diagram for the current network. [05]

(ii) List the current requirements that the HealthCare hospital is looking for with the upgraded network. [03]

(iii) According to the present IP address allocation, does the hospital use IP addresses effectively? [02]

(iv) With the present requirements propose your IP address plan (with IPv4) for the upgraded network. You need to show the new address assignment with a table similar to Table Q6. [10]

Q7. (a) List 3 problems with current networks and explain how SDN can provide a solution to these problems. [08]

(b) SDN uses flow based forwarding which is theoretically equivalent to circuit switching. Explain possible consequences of a node or link failure in this scenario. [05]

(c) List the advantages and disadvantages of setting up a SDN for a Campus Network. A Campus Network is a Local Area Network (LAN) that spans multiple buildings in a single geographical location. [07]

Q8. (a) Compare the 3 ARQ techniques Stop & Wait, Go-back-N and Selective repeat according to their efficiency in a noisy channel. [06]

(b) Consider a device A, sending frames to device C via another device B. Devices A and B use a Go-back-N sliding window protocol with sending window size equals to 3. Devices B and C use Selective Repeat sliding window protocol with sending window size and receiver window sizes are equal to 4. There is a total of 7 frames (starting with F0 and ending with F6) to be sent from device A to device C. The following information is given:

Frame Transmission Time = 1 sec
One-way Propagation Delay (on each link) is 1 sec.
Transmission Time for Acknowledgment = 0 (negligible)
Processing/Queuing Delay = 0 (negligible, at any node)
Time-out (at both devices A and B) is 4 seconds.
Acknowledgements are sent on a link per link basis.
No accumulative acknowledgements are used.

Sketch the Timing diagram for frame transmissions over links A→ B and B→ C under the following scenario:

(i) F1 got lost in its first transmission from A→ B
(ii) The acknowledgement of F4 got lost in its first transmission from A→ B
(iii) F4 got lost in its first transmission from B→ C

Clearly show the necessary details in your diagrams and provide any assumptions you made. [14]