Habib University

Course Title: Data Communication and Networking (EE 424/CE 341)

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Assignment No. 02

Release Date: 2nd Oct, 2024 **Due by:** 10th Oct, 2024 (23:59)

Total points: 100 **Points obtained:**

Student Name:	Student ID:	Section:

Purpose:

The purpose of this assignment is to help you apply the concepts of data communication modes, network models, protocol layering, and network types.

Instructions:

1. This assignment should be done individually.
2. All questions should be answered in **black ink only**. (Extra sheets can be used)
3. Scan your answer sheet and upload it on LMS before the due date.

Grading Criteria:

1. Your assignments will be checked by instructor.
2. You can also be asked to give a viva where you will be judged whether you understood the question yourself or not. If you are unable to correctly answer the question you have attempted right, you may lose your marks.
3. Zero will be given if the assignment is found to be plagiarized.
4. Untidy work will result in a reduction of your points.

Late submission penalty:

- 1-day late submission – 4% deduction of the maximum allowable marks
- 2-days late submission – 8% deduction of the maximum allowable marks
- No submission will be accepted after one week of the original deadline

CLO Assessment:

This assignment assesses students for the following course learning outcomes.

Course Learning Outcomes		CLO Assessed
CLO 1	To compare and classify different data signals, physical transmission medium, topologies, error and flow control at the data link layer of the computer networks.	✓
CLO 2	To orient different functionalities, protocols stacks and architecture of the Network, Transport and Application layers of data network models.	
CLO 3	To investigate different network-functionalities (e.g. security, computing, virtualization etc.), and relate it with the state-of-the-art research scenarios, for instance, Software Defined Networks (SDN) and Internet of Things (IoT).	

P#	Questions	Pts
1	a) Byte-stuff the following frame payload in which E is the escape byte, F is the flag byte, and D is a data byte other than an escape or a flag character. D D E E D D D F D D E D b) Bit-stuff the following frame data payload assuming that the flag bits are 01111110. 00011111110011111010001111111111110000111	2 x 10 = 20
2	Given the dataword and the divisor 10000010011000001000111011011011 1 for CRC-32: a) Show the generation of the CRC-32 codeword at the sender site (using binary division) when the dataword is "ABC" in ASCII. *Hint: Convert ABC to their ASCII equivalent in binary.* b) Perform checking of the generated codeword in part (a) at the receiver side by calculating the syndrome. Also provide the reason why the received codeword will be accepted by the receiver. c) Following codeword is received by a CRC-32 checker. Perform checking of the codeword and clearly indicate whether the codeword will be accepted or rejected by the receiver. 10000100100010101100001001011010010110110100001100111011	3x5= 15
3	Discuss the throughput of Pure and Slotted Aloha protocols and derive the condition to attain maximum throughput in these protocols.	10
4	Discuss, why it is necessary to consider minimum frame size in CSMA/CD Network and state the associated rule in terms of Tfr and Tp. Let's assume a bus network with only two stations, A and B, in which Tfr = 40 μs and Tp = 25 μs. Station A starts sending a frame at time t = 0.0 μs, and station B starts sending a frame at t = 20.0 μs. Answer the following questions if the frames from both station collide: a. Does station A detect collision? b. Does station B detect collision? c. For the given network Tp = 25 μs and data rate of 10Mbps, suggest the appropriate value of Tfr and minimum frame size so that both station can detect collision. For all parts, justify your answer with appropriate calculations / diagram wherever needed.	15

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<tr><td>5</td><td>Contrast different types of MAC addresses and state one use case for each type of MAC address in different LAN settings.</td><td>10</td></tr>
<tr><td>6</td><td>Explore the IEEE 802.3 Standard for 40Gbps and 100Gbps Ethernet and answer the following:

a) Describe the key technical features and advancements that differentiate 40Gbps and 100Gbps Ethernet from earlier Ethernet standards (such as 10Gbps Ethernet) with a particular focus on the following:

• Physical layer specifications (cabling, transceivers, and connectors).
• Modulation techniques and encoding schemes.
• Maximum transmission distances.
• Data rate
• Signal types

b) Discuss some common applications and use cases for 40Gbps and 100Gbps Ethernet in real-world networks.</td><td>2 x 10 = 20</td></tr>
<tr><td>7</td><td>Internet Checksum: Traditionally, the Internet has used a 16-bit checksum. The sender and the receiver follow the steps depicted in Table E.1. The sender uses five steps, but the receiver uses only four.

Table E.1 Procedure to Calculate the Traditional Checksum
<table><tr><th>Sender</th><th>Receiver</th></tr><tr><td>1. The message is divided into 16-bit words.
2. The value of the checksum word is initially set to zero.
3. All words including the checksum are added using one’s complement addition.
4. The sum is complemented and becomes the checksum.
5. The checksum is sent with the data.</td><td>1. The message is divided into 16-bit words.
2. All words are added using one’s complement addition.
3. The sum is complemented and becomes the new checksum.
4. If the value of checksum is 0, the message is accepted; otherwise, it is rejected.</td></tr></table>
Suppose following four 16-bit blocks of data (given in hexadecimal format) are to be sent as an Internet packet.

$4500\ 0073\ 0000\ 4000_{16}$

a) At the sender side, calculate the 16-bit checksum value for the given data and specify in hex format.
b) At the receiver side, verify with the help of the checksum that the received packet is error-free.
c) Additionally, can you find out what is the syndrome value used in Internet checksum for verification.</td><td>4 + 4+2 = 10</td></tr>
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