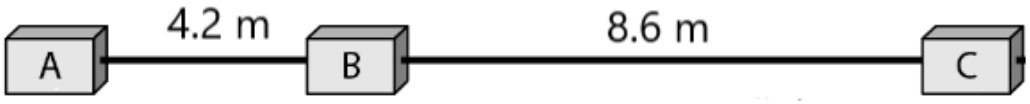
Optional Assignment 7: Chapter 10 & 12

Question 1



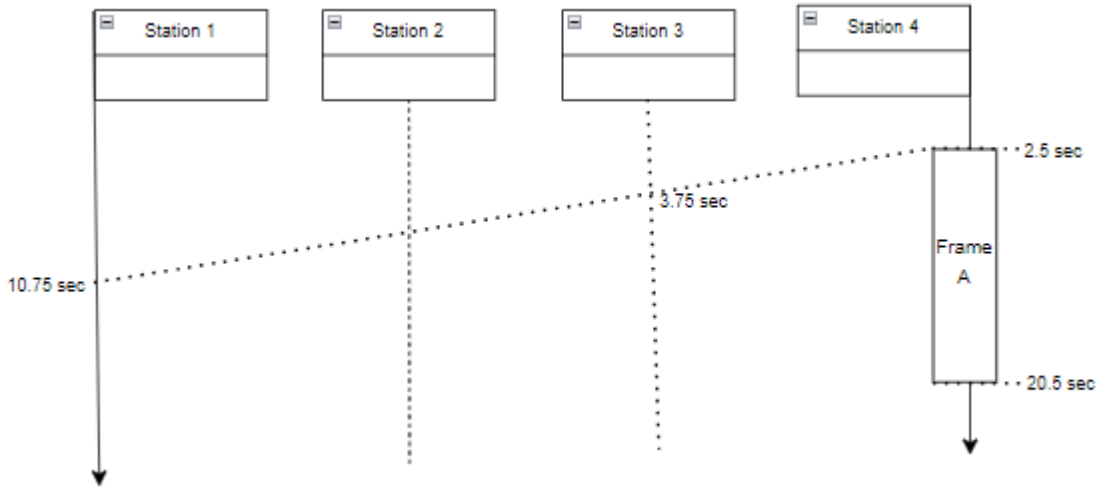
THREE stations are sharing a **10 Mbps** communication link using **CSMA/CD** protocol. Distance between the stations are shown in the figure. Propagation speed of the medium is **2106m/s**.

(a)	Find the **vulnerable time period** in this setting.
(b)	What should be the **minimum frame size** in this communication link?
(c)	Suppose station A starts sending a large frame at time **t = 10s**, and finishes at time **t = 20s**. Station B generates a frame at time **t = 12s**, and starts sensing the channel **non-persistently** (sense, wait for **1s**, sense again, wait for **2s**, sense again, wait for **3s**, and so on). Station C generates a frame at time **t = 15s**, and starts sensing the channel **persistently each 0.6 s**. Which station will be able to transmit its frame first? Explain why.
(d)	If the stations were using **slotted ALOHA** protocol instead, what would be the **vulnerable period** for the minimum frame size found in question (b)?

Question 2

a)	For a **4B/6B** block coding scheme, • How many codewords are generated for the corresponding datawords? • How many different pairs of Codewords can be created? • If the minimum hamming distance is 5, how many errors can be corrected?
b)	A sender and receiver are using the CRC method for error control. Given the divisor is **11011** and the dataword is **101011010**, find the codeword that is sent to the receiver using **Polynomial Division.**
c)	Now, on the receiver side verify if the received data was corrupted or not during the transmission using **Binary Division.** State your conclusion along with the reasoning.

Question 3

a)	A 1000-bit frame is to be sent through a 2 kbps channel. What is the vulnerable time for **Pure ALOHA** in this scenario?
b)	 Prove by showing calculations that the minimum frame size is less than the actual frame size in a multipoint channel with a data rate of 15 Mbps
c)	If the number of attempts is 4 and maximum propagation time is used to calculate the Back-off time then, calculate the Back-off time. Assume that the random number is the median number of the available range

Question 4

a)	For a **5B/7B** block coding scheme, • How many codewords are generated for the corresponding datawords? • How many different pairs of Codewords can be created? • If the minimum hamming distance is 7, how many errors can be corrected?
b)	A sender and receiver are using the CRC method for error control. Given the divisor is $\mathbf{x^4 + x^3 + x + 1}$ and the dataword is $\mathbf{x^8 + x^6 + x^4 + x^3 + x}$, find the codeword that is sent to the receiver using **Binary Division.**
c)	Now, on the receiver side, verify if the received data was corrupted or not during the transmission using **Polynomial Division.** State your conclusion along with the reasoning.

Question 5

1. Prove that the distance between two stations is proportional to vulnerable time for both CSMA and CSMA/CD. Point out an advantage of using CSMA/CD over CSMA.
2. 6 stations are transmitting data using CSMA/CD where the channel has a bandwidth of 30 Mbps. The stations are arranged in the following sequence. A-B-C-D-E-F. It takes 0.30 seconds for the first bit of A to reach station C. The distance between the stations is,

   A to B = 10 meter
   B to C = 5 meter
   C to D = 20 meter
   D to E = 10 meter
   E to F = 20 meter

   - Calculate the propagation speed, and propagation delay for the worst-case scenario for stations A and D.
   - Calculate the minimum frame size.
   - Or, if B starts transmitting at time 0s and E starts transmitting at 0.2s, when will B detect collision given the frame size is big enough to detect the collision?

Question 6

1. Prove that the frame size is proportional to vulnerable time for both pure ALOHA and Slotted ALOHA. Determine how Slotted ALOHA is better than pure ALOHA if both of their vulnerable time are proportional to the frame size.
2. 5 stations are transmitting data using CSMA/CD where the channel has a bandwidth of 20 Mbps. The stations are arranged in the following sequence. A-B-C-D-E. It takes 0.5 seconds for the first bit of A to reach station C. The distance between the stations is,

   A to B = 5 meter
   B to C = 10 meter
   C to D = 15 meter
   D to E = 10 meter

   - Calculate the propagation speed, and propagation delay for the worst-case scenario for stations A and C.
   - Calculate the minimum frame size.
   - Or, if A starts transmitting at time 0s and D starts transmitting at 0.1s, when will A detect collision given the frame size is big enough to detect the collision?

Question 7

Dataword	Codeword
00	0010
01	0110
10	1001
11	1101

1.

- Suppose we are using a 2B/4B block coding scheme. What is the error detection and correction capability of this scheme? Hint: Use hamming distance and show the calculation.
- Suppose the receiver received the data as 1111. **Determine** if the original dataword can be retrieved from it or not? **Show** calculations.
- Explain single bit error and burst error with examples.

2. a) Given the dataword $x^7 + x^5 + x^3 + x^2 + 1$ and the divisor $x^4 + x^2 + x + 1$, **show** the generation of the dataword and divisor at the **sender** side **using binary division**.

b) From the generated binary dataword and divisor generate the codeword from the sender end using binary division.

3. Suppose we are using a (2,4) encoding scheme and the assignment of datawords to codewords are as follows:

Dataword	**Codeword**
00	0010
01	1001
10	1101
11	1100

- What is the minimum Hamming distance?
- How many bits can be rectified and detected?
- The receiver receives 1111. Explain what type of error this is. Can this codeword be corrected?
- Why is it important to introduce redundancy in block coding and how does this ensure reliable data transmission?

Short Questions

Chapter 5:

1. What is the disadvantage of amplitude shift keying modulation?
2. What is the disadvantage of frequency shift keying modulation?
3. Why is PSK better than ASK and FSK?
4. Distinguish between coherent and non-coherent frequency shift keying.
5. Define on-off keying.
6. Define QAM.

Chapter 6:

1. Why is the guard band necessary in FDM?
2. Define interleaving. Why frame synchronization is needed for synchronous TDM?
3. Distinguish between synchronous and statistical TDM. Why does statistical TDM need addressing?

Chapter 10:

1. What is the difference between single bit error and burst error?
2. If we want to detect up to 3 bits error, what should be the minimum hamming distance?
3. If we want to correct up to 3 bits error, what should be the minimum hamming distance?
4. When does CRC fail to detect errors in a sent data?
5. Suppose we are using a block coding scheme with a (2, 4) code. How many datawords can be encoded? How many codewords will be invalid?

Chapter 12:

1. Why is the vulnerable time in slotted ALOHA halved of the pure ALOHA?
2. Why is the vulnerable time in pure ALOHA doubled of the slotted ALOHA?
3. What is the vulnerable time for Slotted ALOHA and why?
4. Distinguish between 1-persistent and non-persistent methods.
5. Explain the difference between pure ALOHA and slotted ALOHA.