TRANSMISSION ERRORS

In Communication Networks External electromagnetic signals can cause incorrect delivery of data. By this, data in the communication Networks can be received incorrectly, data can be lost or unwanted Communication Networks data can be generated. Any of these problems are called transmission errors in communication networks.

These errors can be divided into two types :
1. Single-bit error
2. Burst error

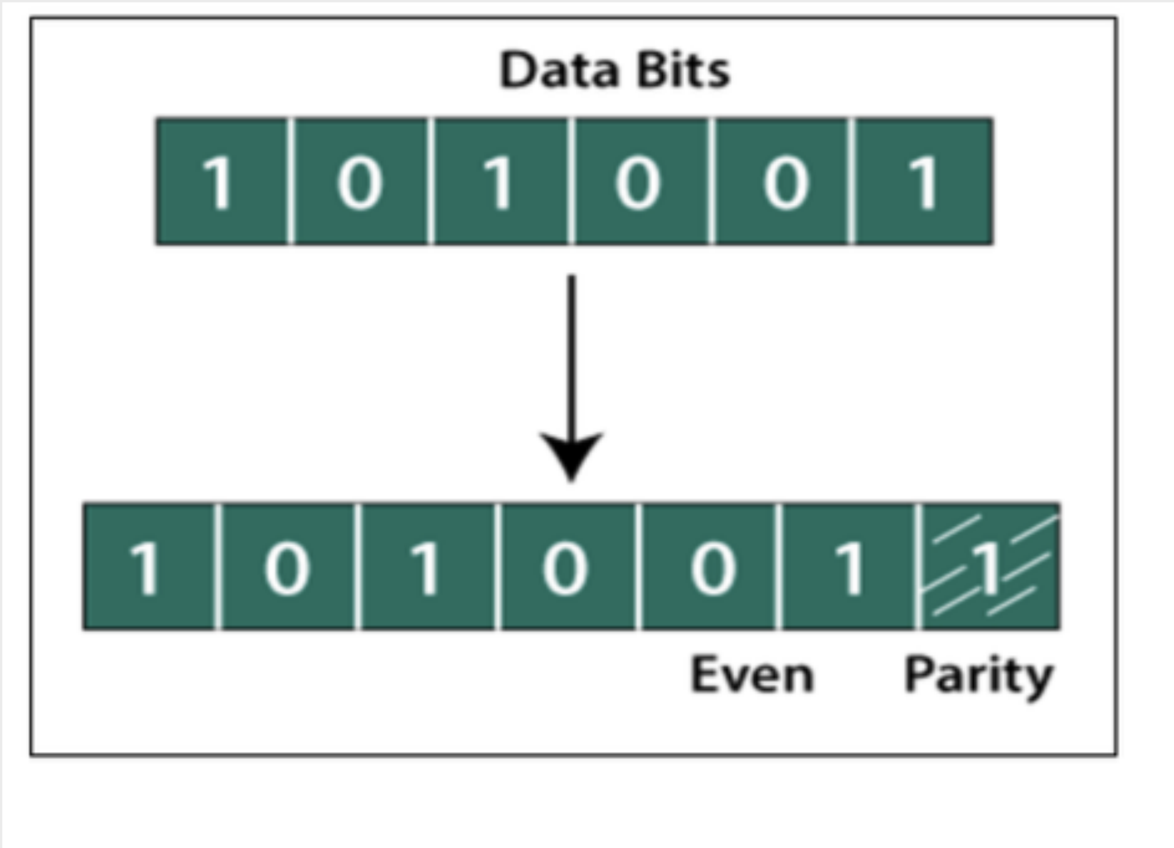
Single-bit Error
The term single-bit error means that only one bit of given data unit (such as a byte, character, or data unit) is changed from 1 to 0 or from 0 to 1
0 1 0 1 0   Sent
0 1 1 1 0   Received

Burst error:
In the burst error, one or more than one bits is changed in the frame. For example, the sender sends the data (01010100) in the frame, and the receiver receives the data (11010100) in the frame.

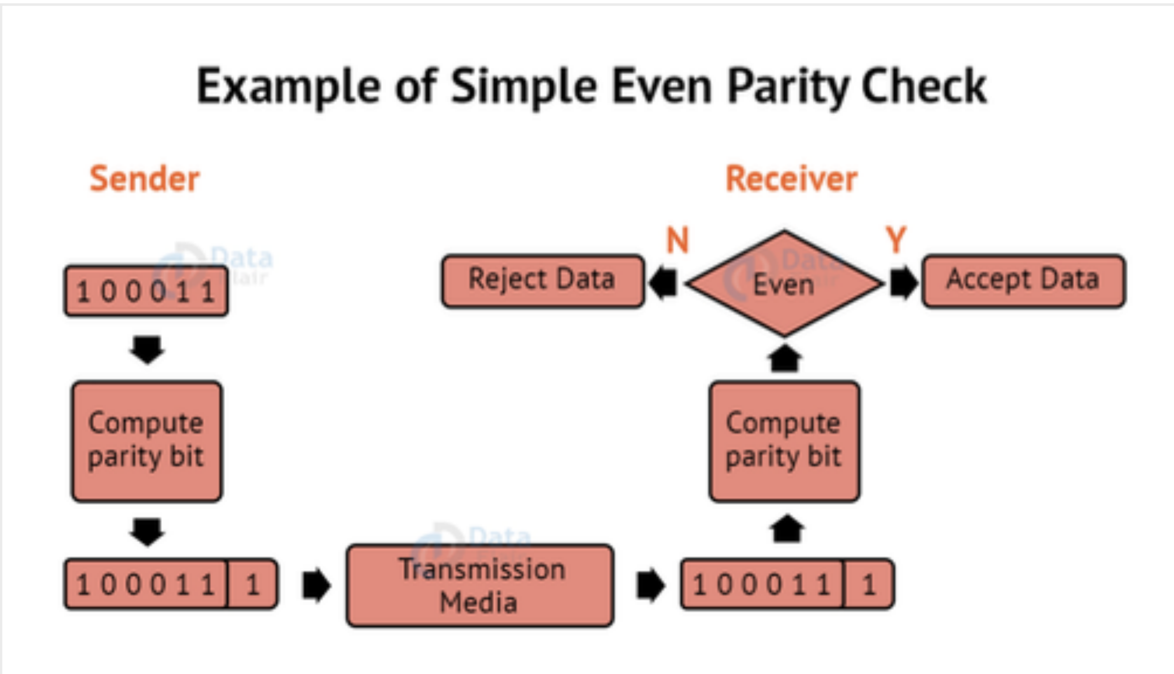
01010110 sent
10101011 received

Error Detection Techniques:

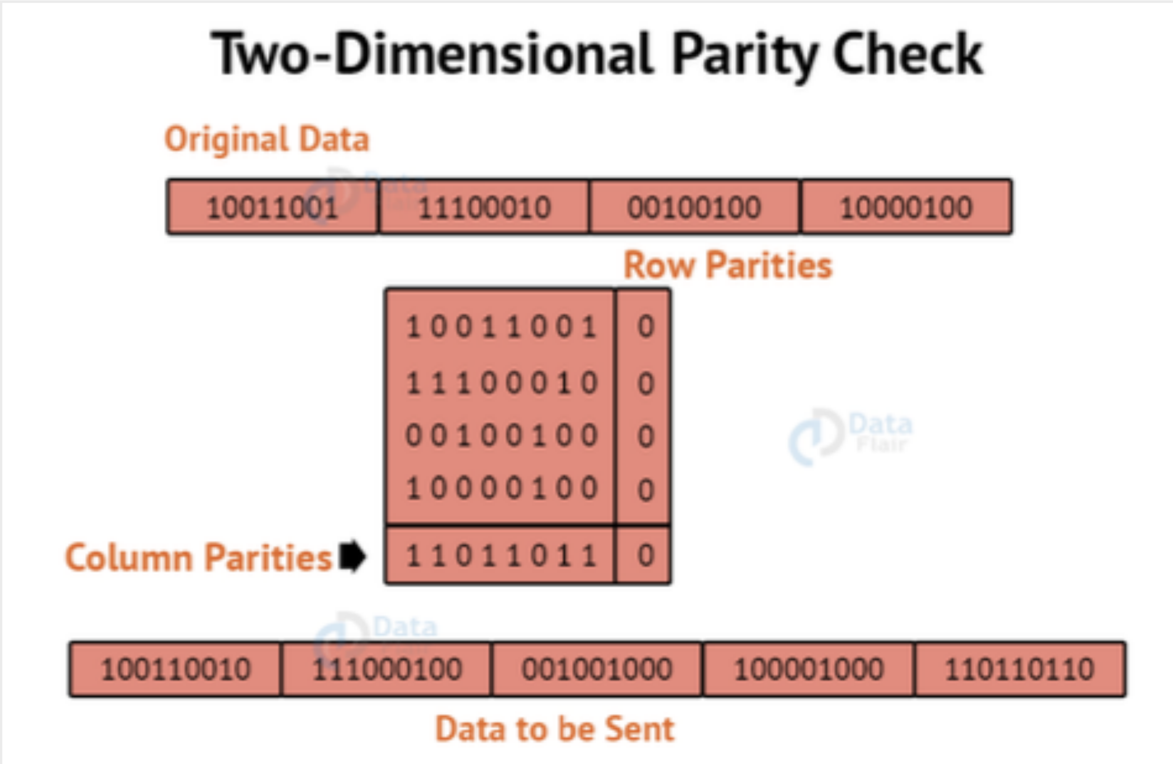
1. Simple Parity Check:
• One extra bit is transmitted in addition to the original bits to make the number of 1s even in the case of even parity or odd in the case of odd parity.
• While creating a frame, the sender counts the amount of 1s in it. If even parity is utilized and the number of 1s is even, one bit with the value 0 is added. In this manner, the number of 1s remains even. If the number of 1s is odd, a value 1 is added to make it even.



• The receiver just counts how many 1s are in a frame. If the number of 1s is even and even parity is utilized, the frame is regarded as uncorrupted and approved. Even if the number of 1s is odd and odd parity is utilized, the frame is not damaged.
• The receiver can identify a single bit flip in transit by counting the number of 1s. However, when more than one bit is incorrect, it is extremely difficult for the receiver to identify the problem.

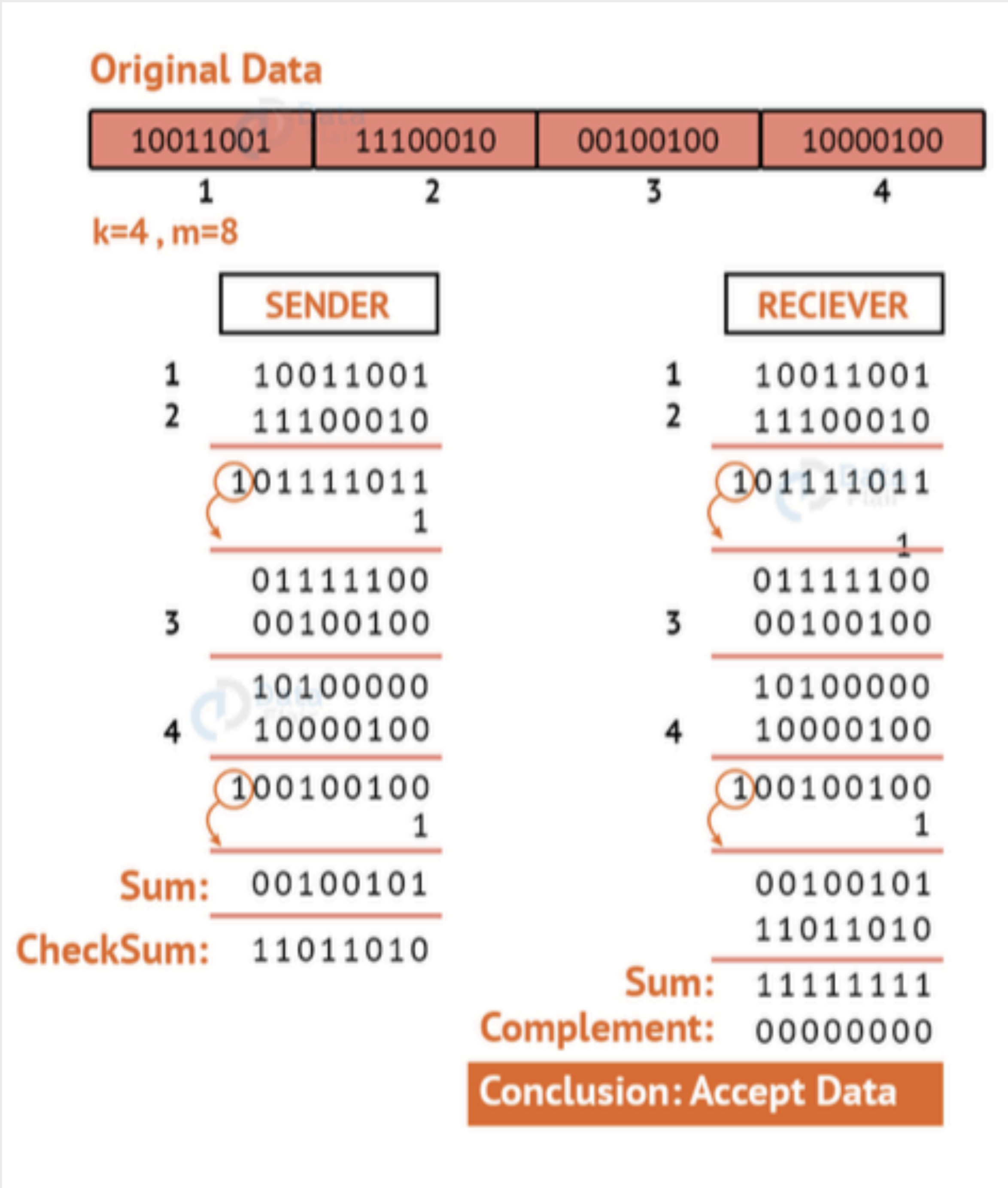


2. Two-Dimensional Parity Check:
For each row, parity check bits are calculated, which is identical to a basic parity check bit. For each column, parity check bits are computed and transmitted together with the data. These are compared with the parity bits calculated on the received data at the receiving end.



3. Checksum:
The data is split into k segments of m bits each in the checksum error detection technique. To get the total, the segments are summed at the sender's end using 1's complement arithmetic. To obtain the checksum, a complement of the sum is taken.

In simple words we will divide our data in k packets and calculate the decimal value for each of the packet & calculate the sum of all & add the value at the 9th packet, at the end we will calculate the sum with receiver’s date packets checksum it must me zero right if everything ok?



Cyclic Redundancy Check-

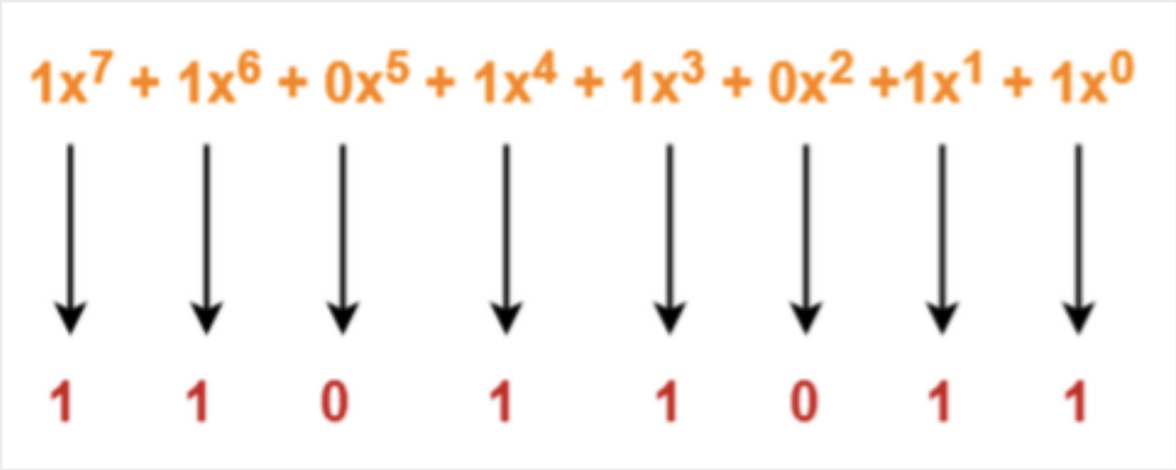
- Cyclic Redundancy Check (CRC) is an error detection method.
- It is based on binary division.

CRC Generator-

- CRC generator is an algebraic polynomial represented as a bit pattern.
- Bit pattern is obtained from the CRC generator using the following rule-

The power gives the position of the bit & the coefficient give the value of bit.

Example-
Consider the CRC generator is x7+ x6+ x4+ x3+x+ 1.
The corresponding binary pattern is obtained as-



Thus, for the given CRC generator, the corresponding binary pattern is 11011011.

Steps Involved-
Error detection using CRC technique involves the following steps-
Step-01: Calculation Of CRC At Sender Side-
At sender side,
- A string of n O's is appended to the data unit to be transmitted.
- Here, n is one less than the number of bits in CRC generator.
- Binary division is performed of the resultant string with the CRC generator.
- After division, the remainder so obtained is called a s CRC.
- It may be noted that CRC also consists of n bits.

Step-02: Appending CRC To Data Unit-
At sender side,
- The CRC is obtained after the binary division.
- The string of n O's appended to the
data unit earlier is replaced by the CRC remainder.

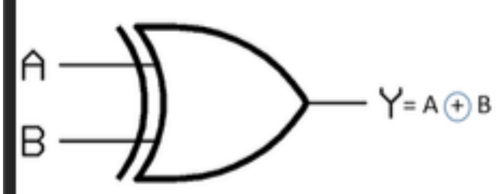
Step-04: Checking a t Receiver Side-
At receiver side,

- The transmitted code word is received.
- The received code word is divided with the same CRC generator.
- On division, the remainder so obtained is checked.

The following two cases are possible-
Case-01: Remainder = 0

If the remainder is zero,
-> Receiver assumes that no error occurred in the data during the transmission.
-> Receiver accepts the data.

Case-02: Remainder != 0
If the remainder is non-zero,
-> Receiver assumes that some error occurred in the data during the transmission.
-> Receiver rejects the data and asks the sender for retransmission.



EX-OR gate symbol

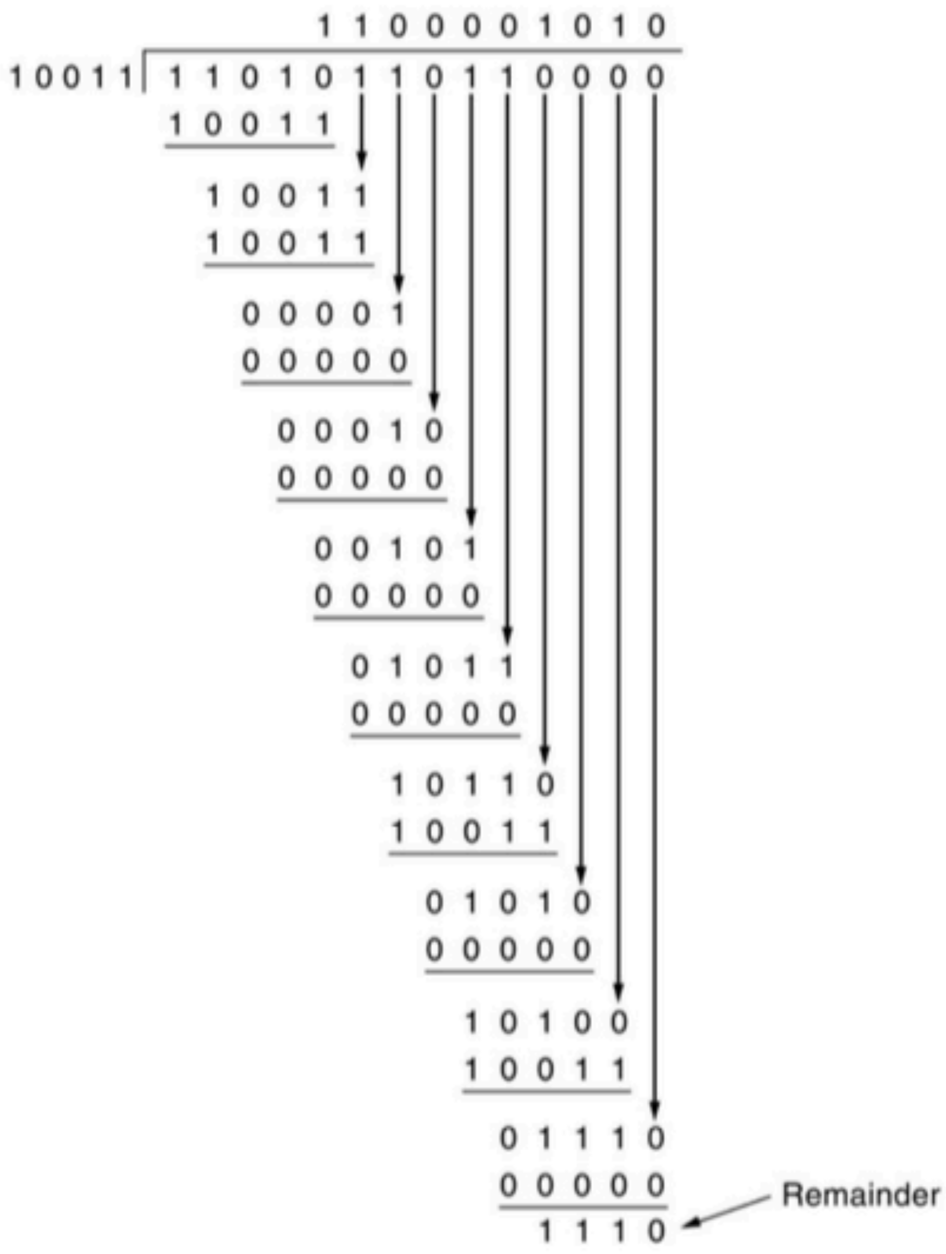
A	B	Y=A ⊕ B
0	0	0
0	1	1
1	0	1
1	1	0

EX-OR gate truth table

PRACTICE PROBLEMS BASED ON CYCLIC REDUNDANCY CHECK (CRC)

Problem-01:
A bit stream 1101011011 is transmitted
using the standard CRC method. The generator polynomial is x4+x+1. What is
the actual bit string transmitted?

Solution-
- The generator polynomial G(x) = x* + x + 1 is encoded as 10011.
- Clearly, the generator polynomial consists of 5 bits.



From here, CRC = 1110.

NOW,

- The code word to be transmitted is
obtained by replacing the last 4 zeroes of 11010110110000 with the CRC.
- Thus, the code word transmitted to the receiver = 11010110111110.

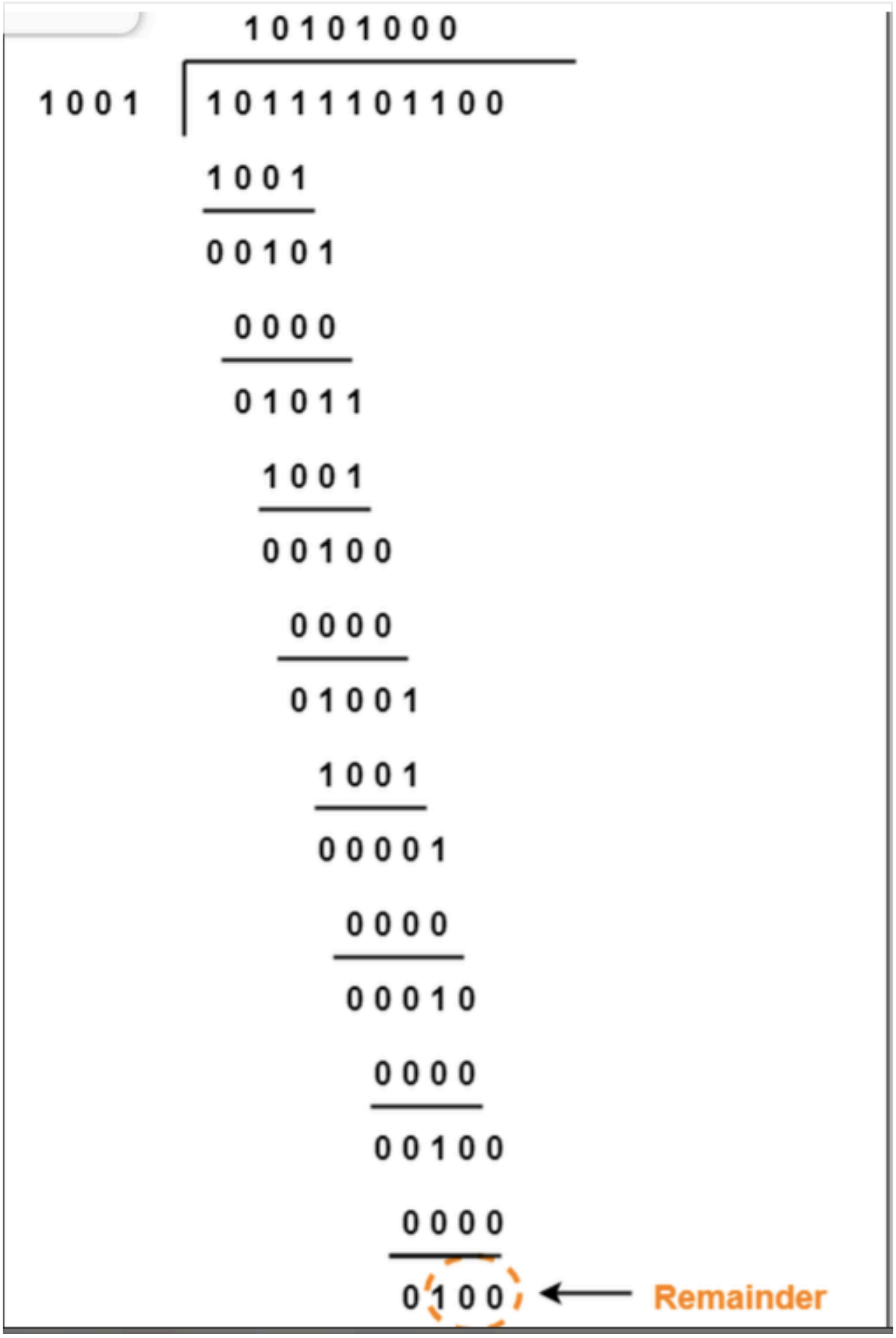
Problem-02:

A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is x°+1.
.1 What is the actual bit string transmitted?
2. Suppose the third bit from the left is inverted during transmission. How will receiver detect this error?

Solution- Part-01:

- The generator polynomial G(x) = x3 + 1 is encoded as 1001.
- Clearly, the generator polynomial consists of 4
- So, a string of 3 zeroes is appended to the bit stream to be transmitted.
- The resulting bit stream is 10011101000 bits.

Now, the binary division is performed as-



From here, CRC = 100. NoW,

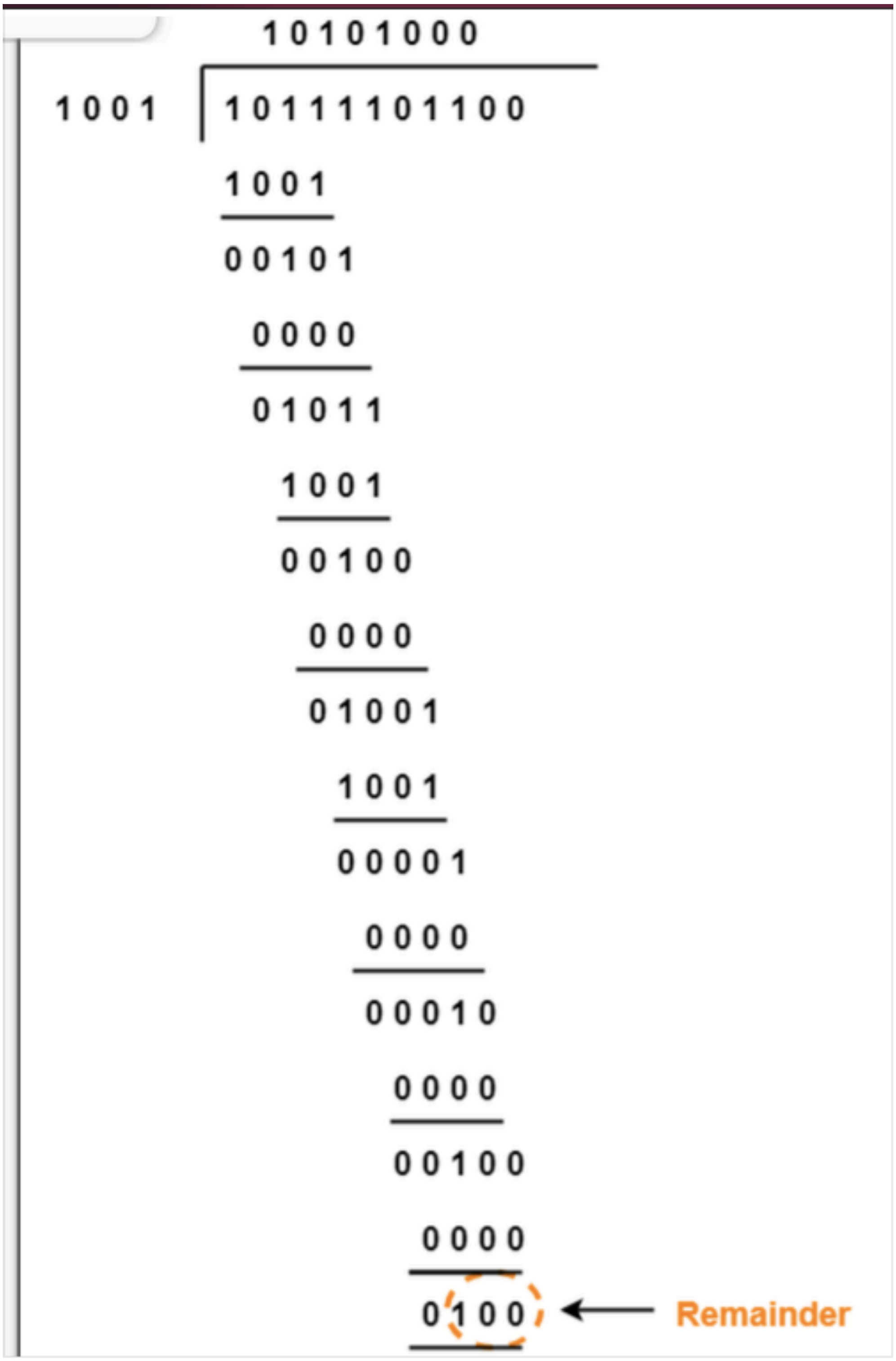
- The code word to be transmitted is obtained by replacing the last 3 zeroes of 10011101000 with the CRC.
- Thus, the code word transmitted ot the receiver = 10011101100.

Part-02:

According to the question,

• Third bit from the left gets inverted during transmission.
• So, the bit stream received by the receiver = 10111101100.

Now,
-> Receiver receives the bit stream = 10111101100.
-> Receiver performs the binary division with the same generator polynomial as -



From here,
• The remainder obtained on division is a non-zero value.

- This indicates to the receiver that an error occurred in the data during the transmission.
- Therefore, receiver rejects the data and asks the sender for retransmission.