Question: Q3. A bit stream 10011101 is transmitted using the... | Chegg.c...

Q3. A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is $x^3 + 1$.

a. Show the actual bit string transmitted.
b. Suppose that the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end.
c. Give an example of bit errors in the bit string transmitted that will not be detected by the receiver.

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Expert Answer

(a) Given bit stream : 10011101

CRC generator polynomial : x^3+1 = 1001

K is the length of CRC generator polynomial : 4

Step1: Append 'K-1' zeroes to given bit stream.

Message : 10011101000

Step2: Compute code word for given bit stream using generator polynomial.

```
1001) 10011101000 (10001100
      1001
      ----
       0001
       0000
       ----
        0011
        0000
        ----
         0110
         0000
         ----
          1101
          1001
          ----
           1000
           1001
           ----
            0010
            0000
            ----
             0100
             0000
             ----
              100 ⟶ Remainder
```

the

Step 3: Append the remainder to bit stream which is the bit string transmitted :

Bit string transmitted : 10011101100

(c) Actual bit stream to be transmitted : 10011101100

Invert third bit from left, then we get : 10111101100.

→ To know that received message is error free & not, following steps need to be followed :

1. Calculate remainder to received message using same generator polynomial
2. If we get remainder as all zeroes, the there is no error in received message
3. else we can just say that there exists errors in received message but we can't say how many errors, what are the errors.

Eg. message (corrupted) : 10111101100

3rd bit from left is inverted.

→ So, apply CRC algorithm on message using same generator polynomial '1001'.

```
1001) 10111101100 (10101000
      1001
      ----
      0101
      0000
      ----
       1011
       1001
       ----
        0100
        0000
        ----
         1001
         1001
         ----
          0001
          0000
          ----
           0010
           0000
           ----
            0100
            0000
            ----
             100 → Remainder.
```

→ Since. remainder is not all zeroes, we can say that there exists some errors in message, but can't say what are those errors.

ⓒ lets take an example with multiple errors:

Message: 11001010100

2nd, 4th, 6th, 7th, 8th bits of original message are inverted.

① Calculate remainder.

```
1001) 11001010100 (11010000
      1001
      ----
       1011
       1001
       ----
        0100
        0000
        ----
         1001
         1001
         ----
          0000
          0000
          ----
           0001
           0000
           ----
            0010
            0000
            ----
             0100
             0000
             ----
              100 → remainder.
```

→ We totally have 5 errors, but remainder is 100, so by looking at remainder, we just can say whether the bit stream is corrupted or not but we can't say what are those corrupted bit.