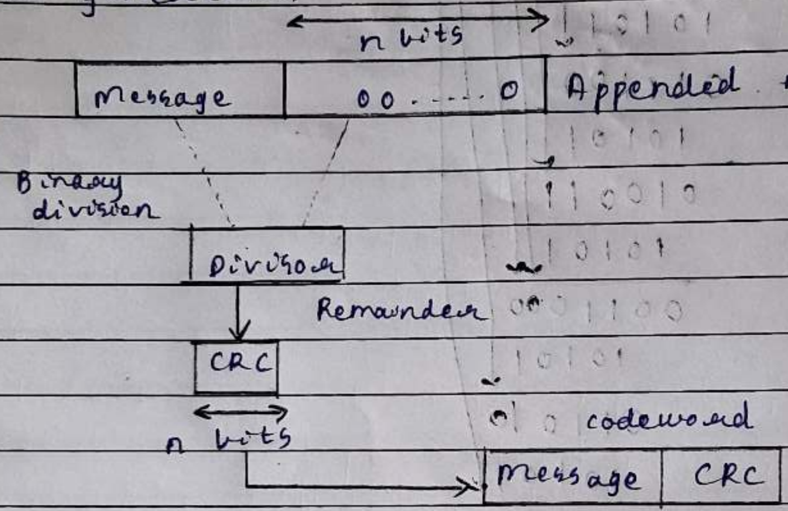
Q1. What is CRC? Explain CRC generator and checker with example.

Ans. CRC stands for Cyclic Redundancy Check, which is a mathematical algorithm that detects errors in data transmission.

1. CRC generator:-



eg: Generate CRC code for the data word 1100 10101. The divisor is 10101.

Soln: number of bits of codeword = 5

step 1: obtain the dividend

Dividend = data word + (n-1) zeroes

Dividend = 110010101 0000

Step 2: Carry out division

```
10101 ) 1100101010000
        10101
        01100 0
         10101
         011010 1
           10101
         0011100
            10101
            010011
```

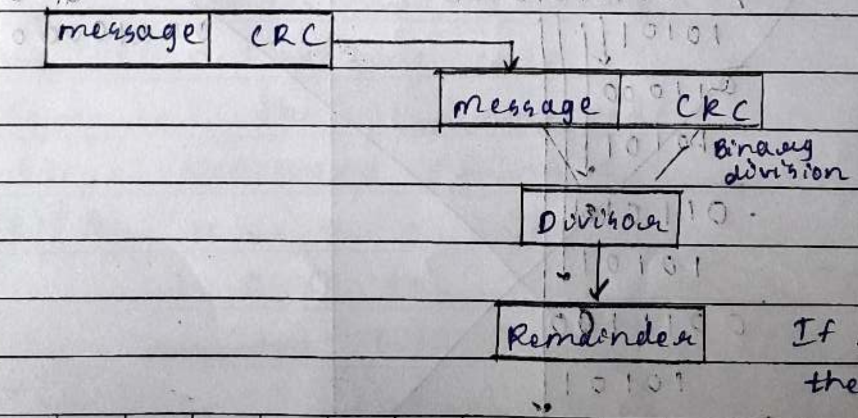
```
 10101
 10101
 00010000
```

```
10101 ) 1100 1010 10000
         101011↓
         011000
          10101↓
          011011
           10101↓
           011100
            10101↓
            010011
             10101↓↓
             0011000
                10101↓
               011010
                10101↓
               011110
                10101
                01011  ← Remainder
```

Step 3: obtain codeword

∴ codeword = $\underbrace{110010101}_{\text{data word}}\underbrace{1011}_{\cancel{\text{Cd}}\ \text{Remainder}}$

2. CRC checker



If remainder is 0 then no errors

eg: The codeword is received as 1100 1001 01011. Check whether there are errors in the received codeword, if divisor is 10101.

Soln:

Data word : 1100 1001 01011

~~Code~~ Divisor : 10101

```
10101 ) 1100100101011
        10101
        011000
         10101
         011010
          10101
          011111
           10101
           010100
            10101
            0000011011
                 10101
                 01110  ← Remainder
```

- The non-zero remainder shows there are errors in received codeword.

Q2. What is hamming code? Generate hamming code for 7/8 bit data word.

Ans. • Hamming codes are linear block codes. It is an error correcting code.

→ Compute the Hamming code for the data '1001101'.

Soln: Step1: Codeword format:

11	10	9	8	7	6	5	4	3	2	1
1	0	0	P8	1	1	0	P4	1	P2	P1

Step2: ~~Consider bits~~ Find P1, P2, P4, P8:

1. P1:

1. • consider bits 1,3,5,7,9,11

   1010 1 P1

   ∴ For ~~even~~ odd parity P1=1

2. P2:

   • consider bits 2,3,6,7,10,11

   10111 P2

   ∴ For ~~odd~~ even parity P2=0

3. ~~P4~~ P4:

   • consider bits 4,5,6,7

   110 P4

   ∴ For even parity P4=0

4. P8:

   • consider bits 8,9,10,11

   100P8

   ∴ For odd parity P8=1

→ Step 3: Write codeword:

code word = 10011 10 0 10 1

Q3. Explain checksum in detail.

Ans → Defination:-

• A checksum is a small-sized datum derived from a block of digital data for the purpose of detecting errors that may have been introduced during its transmission or storage

→ Calculation:-

• As each word is ~~adder~~ transmitted, it is added to the previously sent word and the sum is retained at the transmitter.

• Each successive word is added in this manner to the previous sum.

- At the end of the transmission the sum (called checksum) up to that time is sent.

→ eg:
what is the checksum of the following characters?
01011010, 11000101, 11011001

Soln:

```
                ~~1~~  1     1  1  1  1  1
                    0  1  0  1  1  0  1  0
discard          +  1  1  0  0  0  1  0  1
final
carry            +  1  1  0  1  1  0  0  1
                 ------------------------
                    1  1  1  1  1  0  0  0
```

∴ 11111000 is the checksum