

Ans.1 (a) Data word - 1010011010
 Divisor - 10111
 Augmented Word - 10100110100000

```

      1001101011
10111 ) 10100110100000
        10111
        ---
        00011110
          10111
          ---
          010011
            10111
            ---
            00100000
              10111
              ---
              11100
                10111
                ---
                10110
                  10111
                  ---
                  00001
  
```

Generated code Word - 10100110100001

(b) No error checking.

```

      1001101011
10111 ) 10100110100001
        10111
        ---
        00011110
          10111
          ---
          010011
            10111
            ---
            00100000
              10111
              ---
              0011100
                10111
                ---
                10111
                  10111
                  ---
                  00000
  
```

X No error found

(c)

1001111101 error bit

$$\begin{array}{r} 10111 \overline{) 10100010100001} \\ \underline{10111} \\ 00011010 \\ \underline{10111} \\ 011011 \\ \underline{10111} \\ 011000 \\ \underline{10111} \\ 011110 \\ \underline{10111} \\ 10010 \\ \underline{10111} \\ 0010101 \\ \underline{10111} \\ 00010 \end{array}$$

There is an error.

Ans 2 a) Data Word - $x^8 + x^7 + x^5 + x + 1$

Divisor - $x^3 + x + 1$

Augmented D.W. $\rightarrow x^{11} + x^{10} + x^8 + x^4 + x^3$

$$\begin{array}{r}
 x^8 + x^7 + x^6 + x^5 + x^2 + x \\
 x^3 + x + 1 \overline{) x^{11} + x^{10} + x^8 + x^4 + x^3} \\
 \underline{x^{11} + x^9 + x^8} \\
 x^{10} + x^9 + x^4 + x^3 \\
 \underline{x^{10} + x^8 + x^7} \\
 x^9 + x^8 + x^7 + x^4 + x^3 \\
 \underline{x^9 + x^7 + x^6} \\
 x^8 + x^6 + x^4 + x^3 \\
 \underline{x^8 + x^6 + x^5} \\
 x^5 + x^4 + x^3 \\
 \underline{x^5 + x^3 + x^2} \\
 x^4 + x^2 \\
 \underline{x^4 + x^2 + x} \\
 x
 \end{array}$$

Code Word $\rightarrow x^{11} + x^{10} + x^8 + x^4 + x^3 + x$

$$\begin{array}{r}
 x^8 + x^7 + x^5 + x^4 + x^3 + x \\
 x^3 + x + 1 \overline{) x^{11} + x^{10} + x^8 + x^4 + x^3 + x} \\
 \underline{x^{11} + x^9 + x^8} \\
 x^{10} + x^9 + x^4 + x^3 + x \\
 \underline{x^{10} + x^8 + x^7} \\
 x^9 + x^7 + x^4 + x^3 + x \\
 \underline{x^9 + x^7 + x^6} \\
 x^8 + x^6 + x^4 + x^3 + x \\
 \underline{x^8 + x^6 + x^5} \\
 x^7 + x^5 + x^4 + x^3 + x \\
 \underline{x^7 + x^5 + x^4} \\
 x^3 + x \\
 \underline{x^3 + x^2 + x} \\
 x^4 + x^2 + x \\
 \underline{x^4 + x^2 + x} \\
 x^3
 \end{array}$$

errored Data

Remainder (error)

Ans 3

A → 01000111

FLAG → 01111110

B → 11100011

ESC → 11100000

Show → A B FLAG ESC With Bit Stuffing.

FLAG 01111110 01000111 11100011 01111110 11100000

01111110 01000111 11100011 11100000 01111110

FLAG

FLAG

Ans 4 Bit String →

0111101111101111110

What will be transmitted signal after Bit Stuffing.

01111110 0111101111101111110 110 01111110

FLAG

FLAG

Ans 5

Channel Data Rate - 4 Kbps.

tps - 20 ms

Frame Range for stop & wait for at least 50% efficiency.

$$U = \frac{T_{\text{frame}}}{T_{\text{frame}} + 2T_{\text{ps}}}$$

$$= \frac{L/R}{L/R + 2T_{\text{ps}}}$$

Where L - frame length

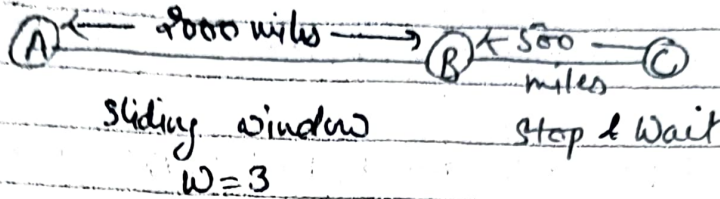
R - channel capacity (4 Kbps)

$$0.5 = \frac{L/4}{L/4 + 2 \times 20}$$

$$0.5 = \frac{L}{L+160}$$

$$L = 0.5 \times 160 / 0.5 \Rightarrow 160 \text{ bits}$$

Ans 6



from A to B →

$$\text{Propagation } T_1 = T_{\text{frame}} + 2 T_{ps}$$

$$T_1 = \frac{1000}{100 \text{ Kbps}} + 2 \times 20 \text{ ms} = 10 \text{ ms} + 40 \text{ ms}$$

$$T_1 = 50 \text{ ms.}$$

In every 50 ms, 3-frames of 1000 bit each tx from A to B.

from B to C → Buffer of node B will flood because of the previous link.

$$T_2 = T_{\text{frame}2} + 2 T_{ps2}$$

$$= L/R_2 + 2 \times 5 \text{ ms.}$$

$$T_2 = \frac{1000}{R_2} + 10 \text{ ms}$$

In T_2 time 1 frame send from B to C. To send 3-frame we require - $3T_2$ time.

$$3T_2 = 50 \text{ ms} \quad (\text{Not floody B})$$

$$50 = 3 \left(\frac{1000}{R_2} + 10 \right)$$

$$\left(\frac{50}{3} - 10 \right) = \frac{1000}{R_2} \Rightarrow \frac{20}{3} = \frac{1000}{R_2}$$

$$R_2 = \frac{1000 \times 3}{20}$$

$$\Rightarrow 50 \times 3 = 150 \text{ Kbps.}$$