Mid 2 (Set B)

1. (a) [Marks 5]

(i) $(x^3+x^2+x+1)+(x^4+x^2+x+1)$

Here,

$P_1 = x^3+x^2+x+1$

$P_2 = x^4+x^2+x+1$

Binary form of P_1 is $= 01111$

Binary " " P_2 is $= 10111$

$\oplus$

addition of thoses polynomial $= 11000$

$\therefore$ Polynomial addition (XOR operation) is $= 11000$. Ans
$=(x^4+x^3) \rightarrow$

(ii) $(x^3+x^2+x+1)/(x^2+1)$

Here,

$P_1 = x^3+x^2+x+1$, Binary form is $= 1111$

$P_2 = x^2+1$, " " is $= 101$

$$
\begin{array}{r|l}
 & 11 \rightarrow \text{Quotient} \\
101 & 1111 \\
 & 101 \\
\hline
 & 0101 \\
 & \;\;101 \\
\hline
 & \;\;000 \\
 & \;\;000 \rightarrow \text{Reminder}
\end{array}
$$

So, answer is $x+1$.

another Methode,

$$
\begin{array}{r|l}
 & x+1 \longrightarrow \text{answer.} \\
x^2+1 & x^3+x^2+x+1 \\
 & x^3+\quad+x \\ \hline
 & x^2+1 \\
 & x^2+1 \\ \hline
 & 0 \longrightarrow \text{Remaider}
\end{array}
$$

(b) Given,

CRC-16 $(x^{16}+x^{12}+x^5+1)$.

Now ~~conter~~ conveting this polynomial equivalent to it's binary form

$= x^{16}+0.x^{15}+0.x^{14}+0.x^{13}+x^{12}+0.x^{11}+0.x^{10}+0.x^9+0.x^8+0.x^7+0.x^6+0x^5+0.x^4+0.x^3+0.x^2+0.x+1$

$\therefore =$ 10001000000100001 (Ans)

(2)

Given,

Dataword = 5 bits

code word = 8 bits.

Os need to make dividend = 000 (3 bits)

Size of reminder is = 3 bits

Size of divisor is = 5-1 = 4 bits.

3. Given,

dataword = 101001111

divisor = 10111

Now, redundent bit = divisor − 1 = 5 − 1 = 4 bits of 0.

add 4 bits of 0 with dataword and ~~pef~~ perform division,

Sender ⇒

```
        100110111
10111 | 1010011110000
        10111
        000111
        000000
         001111
          00000
          11111
          10111
          010001
           10111
           001100
            00000
            011000
             10111
             011110
              10111
              010010
               10111
               0 0101  → Reminder
```

$\boxed{\text{Codeword} = \text{data} + \text{reminder}}$

∴ Codeword = 1010011110101

Receiver ⇒

add reminder with dataword and perform division again.

```
        100110111
10111 | 1010011110101
        10111
        000111
         00000
         001111
          00000
          011111
           10111
           010001
            10111
            001100
             00000
             011001
              10111
              011100
               10111
               010111
                10111
       Reminder → 00000
```

As reminder is 0 at the receiver site so, there is no error in codeword and accept it.

If the reminder will not zero then the data will not accept and error detected.

4. In noisy channel, Go-back-N and stop-and-wait ARQ faces some problems that are given below,

① Go-Back-N ARQ:

1. If a frame is lost, the sender goes back and resend that frame.

2. But, when the sender ~~sends the~~ resend the lost frame, it also resend all subsequent frame, even ~~the~~ if they were received correctly.

3. These cause waste of Bandwidth and ~~et~~ extra delay.

(ii) Stop-and-Wait ARQ:

1. Wait for acknowledgment after each frame.

2. Very inefficient for long-distance link.

3. Huge waiting time during long-distance and high-speed links transmission.

To overcome those problem, there is a solution named Selective Repeat ARQ. The way it solve those problem given below:

1. Selective Repeat ARQ retransmits only the specific frames that ~~was~~ were lost.

2. It uses a buffer at both sender and receiver to store out-of-order frame.

3. This improves efficiency in noisy channel and better utilization of bandwidth.

Working Procedure:

Sender:

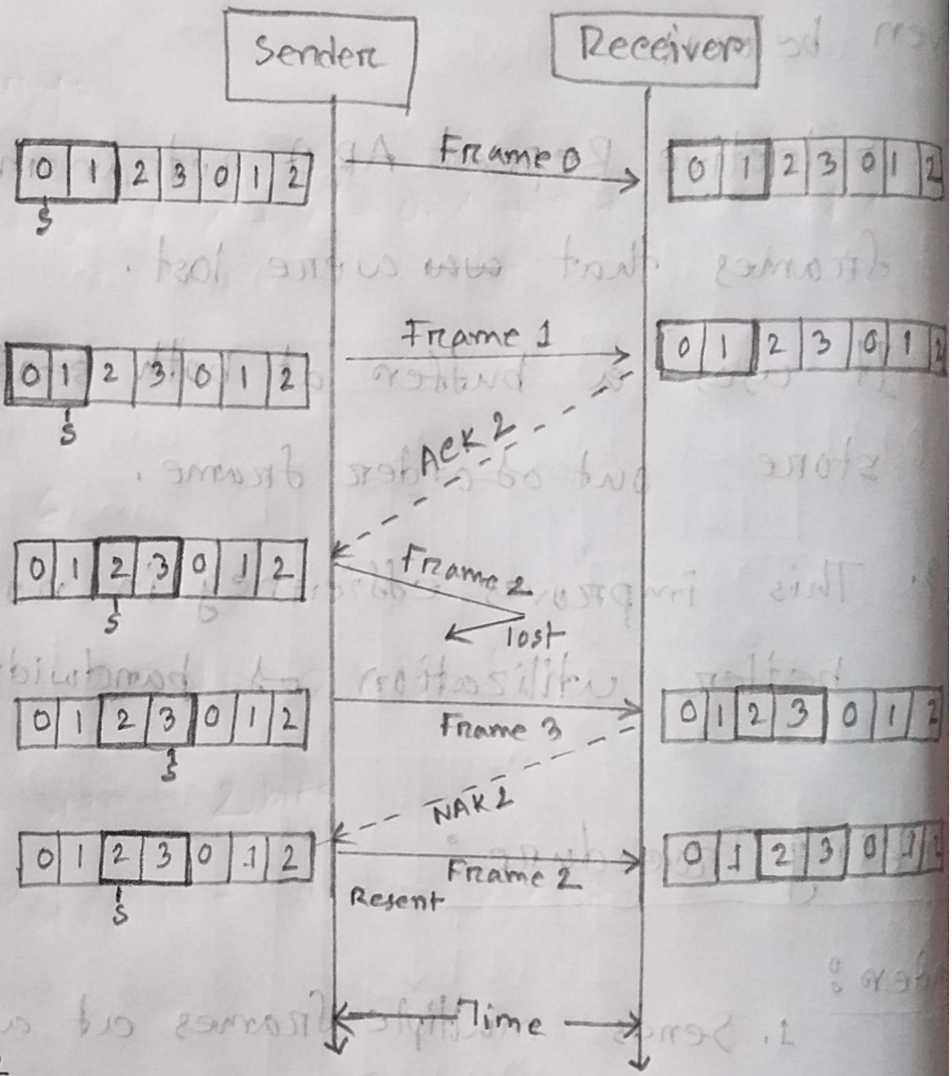
1. Sends multiple frames at a time
2. Maintain a window of frames that it can used
3. If it receives no ACK within timeout, it retransmit only the missing frame.

Receiver:

1. Accepts out-of-order frames and store them in buffer
2. Sends ACK for each correctly receive frame.

Here is an diagram and ~~expt~~ example given below:

Example:



— Diagram —

step 1:

Sender sends frame 0

step 2:

Sender sends frame 1

Receiver sends ACK for ~~fro~~ frame 2

step 3:

Sender sends frame 2 but it lost

step 4:

Sender sends frame 3

~~step 5~~ Receiver sends NAK for resent frame 2

step 5: sender ~~ser~~ resent frame 2.

Mid 2 (Set A)

1) (a)

(i) ~~$p_1 = x^5+x^3+x$~~ $\cdot(x^5+x^3+x+1)+(x^4+x^2+x+1)$

$P_1 = x^5+x^3+x+1$, Binary $= 101011$

$P_2 = x^4+x^2+x+1$, Binary $= 010111$

$\oplus$

$$\begin{array}{r} 101011 \\ \oplus\ 010111 \\ \hline 111100 \end{array}$$

$\therefore$ Answer is $= 111100 = x^5+x^4+x^3+x^2$

(ii) $(x^4+x^2+x+1)/(x^3+1)$

$$\begin{array}{r|l} & x \quad \leftarrow \text{Quotient} \\ \hline x^3+1 & x^4+x^2+x+1 \\ & x^4 \qquad\quad +x \\ \hline & x^2+1 \quad \leftarrow \text{Reminder.} \end{array}$$

$\therefore$ Answer ~~sis~~ is x and reminder is x^2+1

Another Method:

$$\begin{array}{r|l} & 1 \quad \leftarrow \text{Quotiten} \\ \hline 1001 & 10111 \\ & 1001 \\ \hline & 00101 \quad \leftarrow \text{Reminder} \end{array}$$

$\therefore$ Answer is x and ~~rir~~ reminder is x^2+1

(b)

CRC-10 ($x^{10}+x^9+x^5+x^4+x^2+1$)

convetit into binary =

$x^{10}+x^9+0.x^8+0.x^7+0.x^6+x^5+x^4+0.x^3+x^2+0\,x^1+x^0$

$\Rightarrow$ 11000110101

2.

data word = 6

code word = 8

to make dividend. add = 2 bits of 0

Remindert size = 2 bits

divisor size is = 6-1 = 5 bits.

3.

3. Given, dataword = 111001011

divisor = 11101

redundent bits = 5-1 = 4 bits of 0.

Sender:

```
        100010101
11101 | 1110010110000
        11101
        000011
         00000
         000110
          00000
          001101
           00000
           011011
            11101
            001100
             00000
             11000
              11101
              001010
               00000
               10100
                11101
                01001  -> Reminder.
```

Receiver:

```
        100010101
11101 | 1110010111001
        11101
        000011
         00000
         000110
          00000
          001101
           00000
           011011
            11101
            001101
             00000
             011010
              11101
              001110
               00000
               011101
                11101
                00000  <- Reminder
```

Codeword = 1110010111001.

As the reminder is 0 at the receiver side, so there is no error and data is correctly received.

If the reminder will not 0 then there will be an error and data couldn't accept by receiver.