Signaling

Q1.

1.1 Explain the following

(a) Analog and Digital type of signaling

In analog signaling waking and sleeping method is adopted where one person is sleeping with respect to other person and when a service is needed by a person that person has to wake the other person. In digital type of signaling it is similar to a marring system where husband and wife are both live with respect to attention. There is no question of waking and sleeping only the message transmission. In analog type of signaling waking methods are called supervisory signals (line signals) and register signals are the message that has to be transmitted.

With the development of the technology analog type of signaling are now phased out where as the digital type of signaling becoming prominent.

(b) Forward and Backward error correction

When a message is transmitted from one place to another place, message has to be appended with an error control field. This error control field will have dual function That is detect an error and correct an error. In the forward error correction filed both these functions are achieved from the error control field where as in the backward error correction only an error will be identified and the transmitter will again requested to retransmit the message. Hence this method is called the backward error correction method.

In forward error correction error control field is comparable to the main and data field and needs high bandwidth. This method is used for un-directional transmission (example radio broadcasting) and even for bi-directional transmission where the information is real time (example voice).

(c) Four layers of SS7

User part- Actual message pertaining to a service will be prepared.

Signaling network control- Message handling and message rerouting will be carried out.

Link Control- Error detection message structuring and formation of cyclic redundancy code and the management of sequence control field will be carried out.

Link- The medium and the speed of data transfer will be defined as link. Normally 64kbps trunk.

1.2 In SS7 signaling backward error correction is deployed. Explain the difference between basic method and preventive cycle retransmission of error correction. Clearly explain the sequence control field.

Backward method of error correction is deployed in a bi-directional transmission system from one station to another. Both these stations will transmit and receive information with respect to one another. Both these information whether correctly received or not will be accommodated in the sequence control field. Hence the sequence control field will have 2 major subfields that are information with regard to forward sequencing and information with regard to backward sequencing (backward sequencing means the information received from the other station).

Forward Sequence	Backward Sequence

In the basic method positive and negative acknowledgement are used, where as in the preventive cycle re-transmission only the positive acknowledgement used.

FSN	FIB		BSN	BIB
7 Bits	1Bit		7 Bits	1 Bit

1.3 In the basic method of error correction station A is sending 5 messages to station B. The details of the message transferred is given below;

(a) Message no. 1 received by station B correctly.

(b) Message no. 2 has to be retransmitted once to be correctly received by station B.

(c) Message no. 3 received by station B correctly.

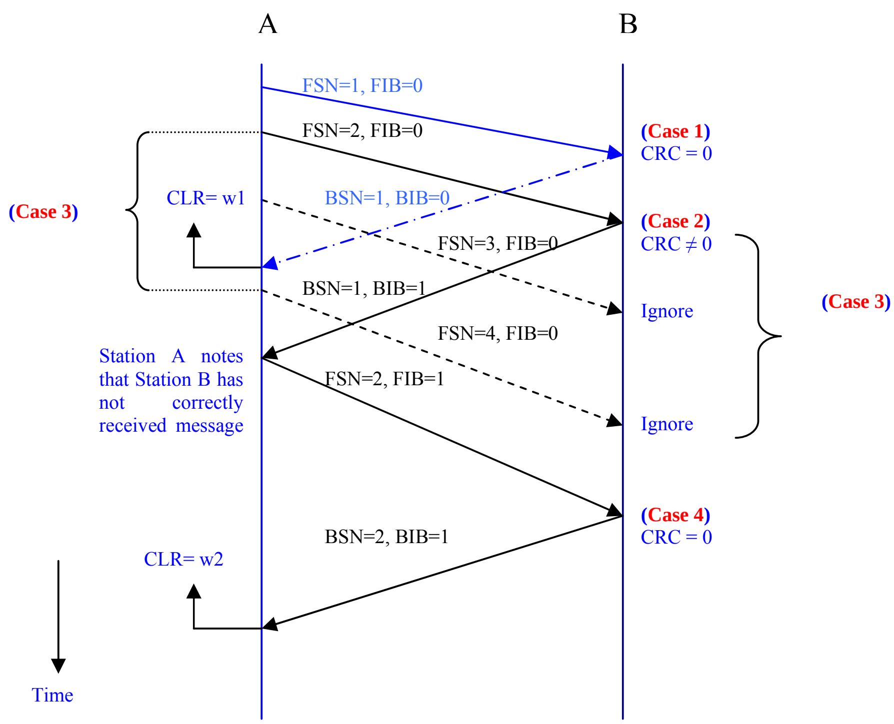
(d) Message no. 4 has to be retransmitted once to be correctly received by station B.

(e) Message no. 5 received by station B correctly.

Draw the signaling diagram that you may observe from station A to station B to show the above transaction. Clearly explain the sequence control field.

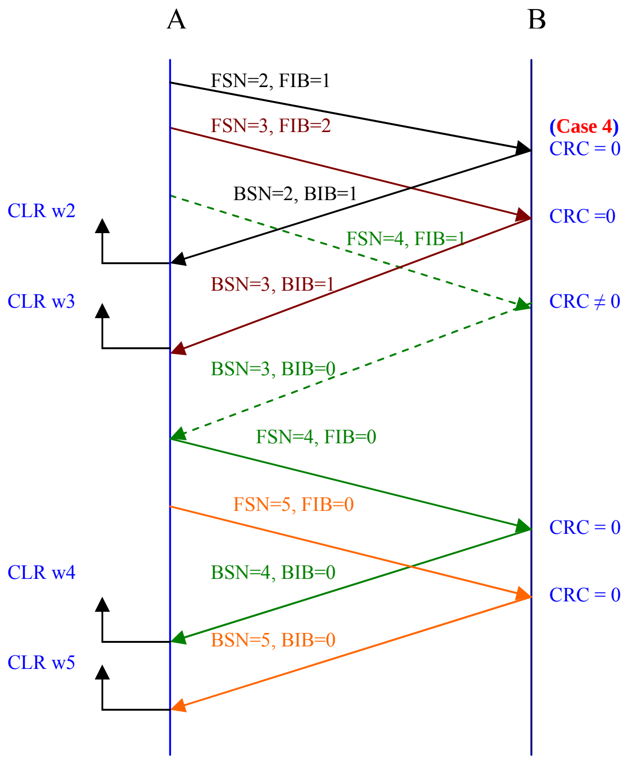
Ans: Observations

i. A→B indication for Forward Sequencing, B→ A indication for Backward Sequencing
ii. +ve acknowledgement, if CRC=0, FIB=0 and BIB=0 (Case 1)
iii. –ve acknowledgement, if CRC ≠ 0 FIB=0, BIB=1 (Case 2)
iv. Station A keeps on sending message despite the error but Station B ignores (Case 3)
v. Station B give +ve Ack only for FIB=1 (Case 4), otherwise all FIB=0 are ignored.
vi. Station A CLRs w1 and w2 at the moments shown in a diagram below



The above gives clearly the concept how the messages are been correctly transmitted from Station A to Station B and how the 2 words are cleared in the Station A.

The following shows the answer for the above (c), (d) and (e).

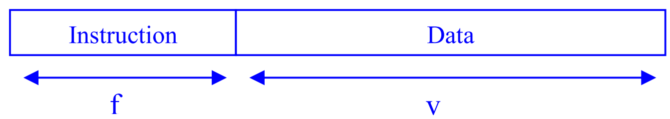


Q-2

1. Clearly explain the four layers of CCITT No. 7 Signalling.

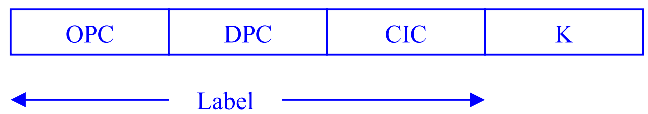
   User Part – 4th layer
   Signalling Link Control – 3rd layer
   Link Control – 2nd layer
   Link – 1st layer

Message is evolved from

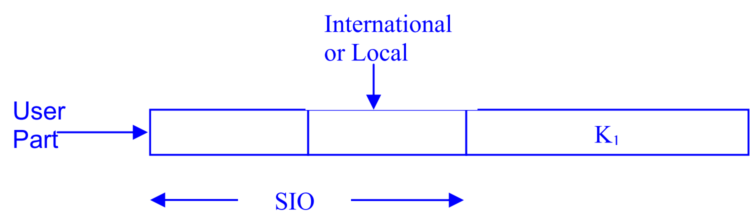


= K

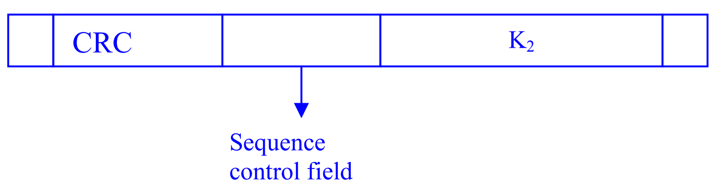
To homogeneous network K_1 =

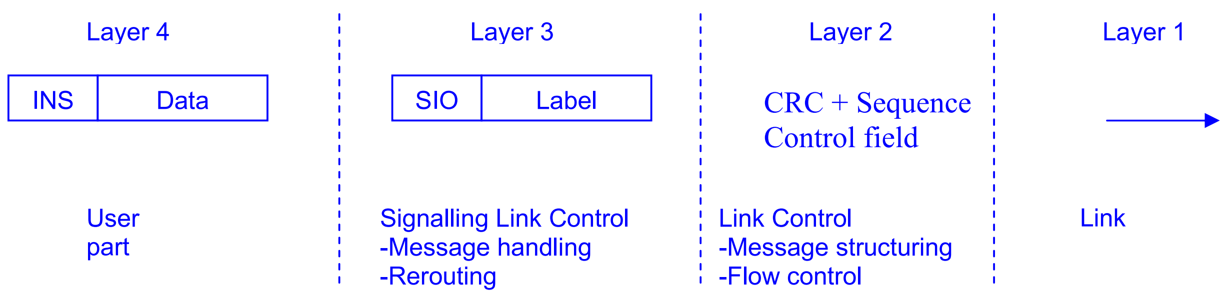


Then to Non-homogeneous network K_2 =

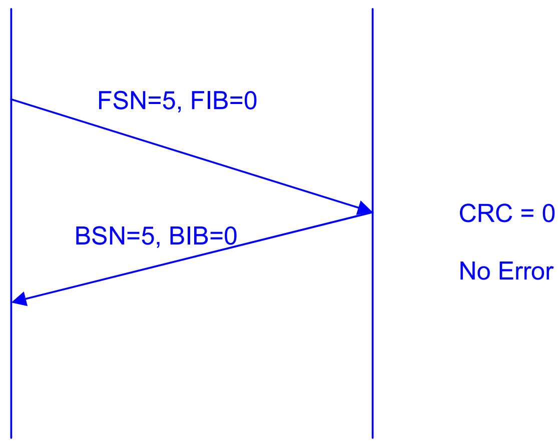


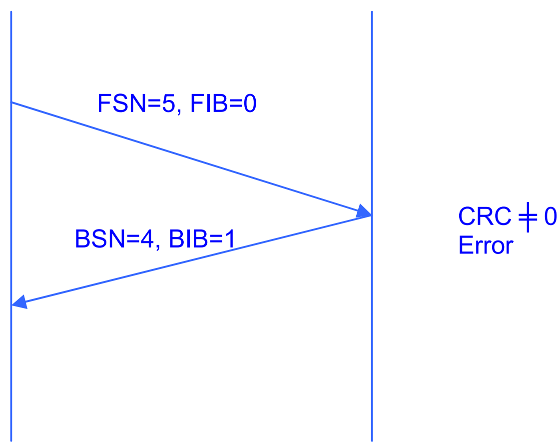
Then basic Non homogeneous message is formed by including Backward error correction to be accommodate. Hence message will be





2. Error control plays a vital role in transmitting data from one station to another station. In CCITT No. 7 signalling, for error control Cyclic Redundancy Code of 16 bits are used. Explain how CRC is applied for error control in No. 7 signalling.





3. A polynomial of $P(x) = 1+X^3+X^4$ is used to form a CRC in certain systems. If your data stream is 1001010101, deduce the CRC.
If we assume no error occurred during the transmission, show how the receiver identifies that there is no error.
Design a circuit to deduce CRC using 1 bit shift registers and Exclusive OR gates, and how to achieve CRC.

P = 11001 ; $X^4 + X^3 + 1 = P(X)$
M = 1001010101

```
                1 1 1 0 1 1 0 1 0 0
11001 | 1 0 0 1 0 1 0 1 0 1 0 0 0 0
        1 1 0 0 1
          1 0 1 1 1
          1 1 0 0 1
            1 1 1 0 0
            1 1 0 0 1
              0 1 0 1 1
              0 0 0 0 0
                1 0 1 1 0
                1 1 0 0 1
                  1 1 1 1 1
                  1 1 0 0 1
                    0 1 1 0 0
                    0 0 0 0 0
                      1 1 0 0 0
                      1 1 0 0 1
                        0 0 0 1 0
                        0 0 0 0 0
                          0 0 1 0 0
                          0 0 0 0 0
                            0 1 0 0
```

Hence transmit word. 1001010101: 0100

Received bits are again divided with the same polynomial. If there is no residual no error occurred during the transmission.

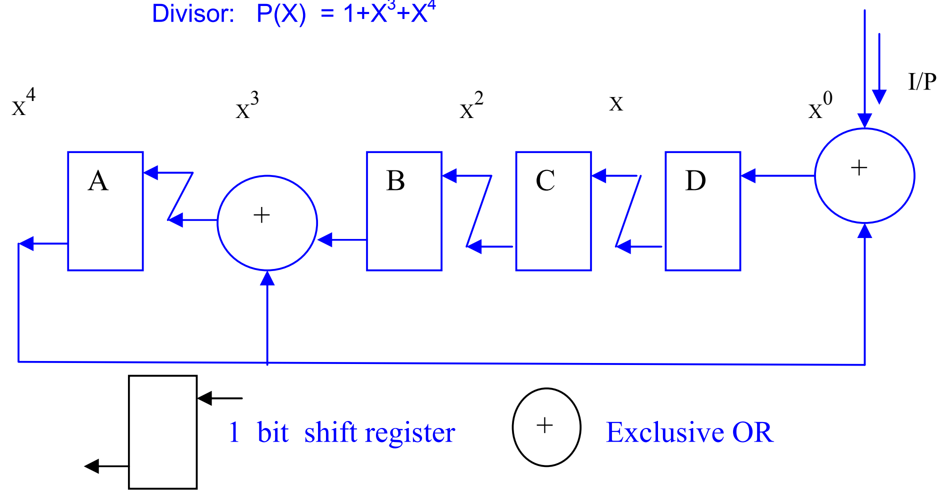
```
                1 1 1 0 1 1 0 1 0 0
11001 | 1 0 0 1 0 1 0 1 0 1 0 1 0 0
        1 1 0 0 1
          1 0 1 1 1
          1 1 0 0 1
            1 1 1 0 0
            1 1 0 0 1
              0 1 0 1 1
              0 0 0 0 0
                1 0 1 1 0
                1 1 0 0 1
                  1 1 1 1 1
                  1 1 0 0 1
                    0 1 1 0 0
                    0 0 0 0 0
                      1 1 0 0 1
                      1 1 0 0 1
                      0 0 0 0 0
```

Implementation:

CRC process can easily be implemented as a dividing circuit consisting of Exclusive OR gates and shift registers. Implementation is as follows.

M = 1001010101: $M(X) = X^9 + X^6 + X^4 + X^2 + 1$

Divisor: $P(X) = 1+X^3+X^4$



Contents of shift registers:

	A	B	C	D	I/P
STEP 0	0	0	0	0	0
1				1	1
2			1	0	0
3		1	0	0	0
4	1	0	0	1	1
5	1	0	1	1	0
6	1	1	1	0	1
7	0	1	0	1	0
8	1	0	1	1	1
9	1	1	1	1	0
10	0	1	1	0	1
11	1	1	0	0	0
12	0	0	0	1	0
13	0	0	1	0	0
14	0	1	0	0	0

INF (steps 0–10)

Four Zeros (steps 11–14)

Frame check sequence

4. Show an instant where CRC is failed to identify errors in the bit stream.

The receiver will fail to detect an error if and only if received message is divisible by P, i.e. if and only if E (error pattern with 1's in positions where errors occur) is divisible by P.

Example :

Let T = 10010101010100, P = 11001 and
Tr = T+E =10010101001101

Therefore E = 00000000011001 which is same as P.

The method of finding error

(i) Compare the received message with the transmitted message
(ii) If there are no errors make the relevant bits 0, otherwise 1.
(iii) The error message will have the same digit length as T or Tr

To find whether the received message is in error Tr has to be divided by P.

```
                    1 1 1 0 1 1 0 1 0 1
1 1 0 0 1 | 1 0 0 1 0 1 0 1 0 0 1 1 0 1
            1 1 0 0 1
            ---------
              1 0 1 1 1
              1 1 0 0 1
              ---------
                1 1 1 0 0
                1 1 0 0 1
                ---------
                  0 1 0 1 1
                  0 0 0 0 0
                  ---------
                    1 0 1 1 0
                    1 1 0 0 1
                    ---------
                      1 1 1 1 0
                      1 1 0 0 1
                      ---------
                        0 1 1 1 1
                        0 0 0 0 0
                        ---------
                          1 1 1 1 1
                          1 1 0 0 1
                          ---------
                            0 1 1 0 0
                            0 0 0 0 0
                            ---------
                              1 1 0 0 1
                              1 1 0 0 1
                              ---------
                                0 0 0 0
```

Remainder implies no error.

Hence if the error is same as the polynomial, the error will not be detected at the receiver.