

III SEMESTER B.TECH.  
(INFORMATION TECHNOLOGY/COMPUTER & COMMUNICATION ENGINEERING)  
IN-SEMESTER EXAMINATIONS, DECEMBER 2021  
SUBJECT: PRINCIPLES OF DATA COMMUNICATION [ICT 2156]  
SCHEME OF EVALUATION  
TOTAL MARKS: 20 M  
SET-1

1

- a. With respect to the standard HDLC frame format, give the structure of the frame format indicating the individual field size in bits and explain flag and address field.
- b. With respect to the error control mechanism, why the maximum window size is limited to  $2(k-1)$  in selective reject ARQ when compared to the window size  $(2k - 1)$  used in Go Back N ARQ.

1+0.5+0.

5

2

(A Constituent unit of MAH, Manipal)

Set 1

(a).

|       |                     |                  |             |                   |       |
|-------|---------------------|------------------|-------------|-------------------|-------|
| Flag  | Address             | Control          | Information | FCS               | Flag  |
| 8-bit | 8-bit<br>extendable | 8-bit<br>16 bits | Variable    | 16-bit<br>32 bits | 8-bit |

→ 1 Mark.

Flag field. →  $\frac{1}{2}$  mark.

Address field →  $\frac{1}{2}$  mark.

(1b).

$2^{(k-1)}$  in Selective reject ARQ.

$(2^k - 1)$  in Go back N ARQ. → 2 Marks

At receiver  
Here it identifies  
as frame 0  
from next  
window &  
it identifies  
that frame  
is lost.  
∴  $(k-1)$  window  
is considered in  
sequence  
and.

If the window size is  $(2^k - 1)$ ,  
eg. if  $k = 3 \Rightarrow$  then window size = 7.

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|

If the transmitter transmits all the frames till 6 & receiver receives frames 0 to 6 and ACK for frame 7 by sending RR7 and RR7 is lost. At the receiver, the window is shifted to 7, 0, 1, 2, 3, 4, 5. Since RR7 is lost & transmitter waits for some time & when timer times out, it resends frames from previous window.

2

2a. A microwave communication link exists between two parabolic antennas each with a diameter of 1.6 meters. If an isotropic antenna is assumed at the transmitter, it has an output of 40dBm at 2GHz. Calculate the gain of each antenna in decibels.

1+1

2(a).  $d = 1.6 \text{ m} \Rightarrow r = 0.8 \text{ m}$   
 $P_t = 40 \text{ dBm}$  at  $f = 2 \text{ GHz}$   
 $G = \frac{4\pi A_e}{\lambda^2} = \frac{4\pi \times f^2 A_e}{c^2}$   
 $A_e = 0.56\pi r^2$   
 $= 0.56 \times \pi \times 0.8^2$   
 $= 1.1259 \text{ m}^2$  | Mark.  
 $G = \frac{4\pi \times (2 \times 10^9)^2 \times 1.1259}{(3 \times 10^8)^2}$   
 $= 56.23 \times 628.85$   
 $G_{\text{dB}} = 27.935 = G_t = G_r$  | Mark.

b. What is the channel capacity for a teleprinter channel with a 300-Hz bandwidth and a signal-to-noise ratio of 3 dB, where the noise is white thermal noise?

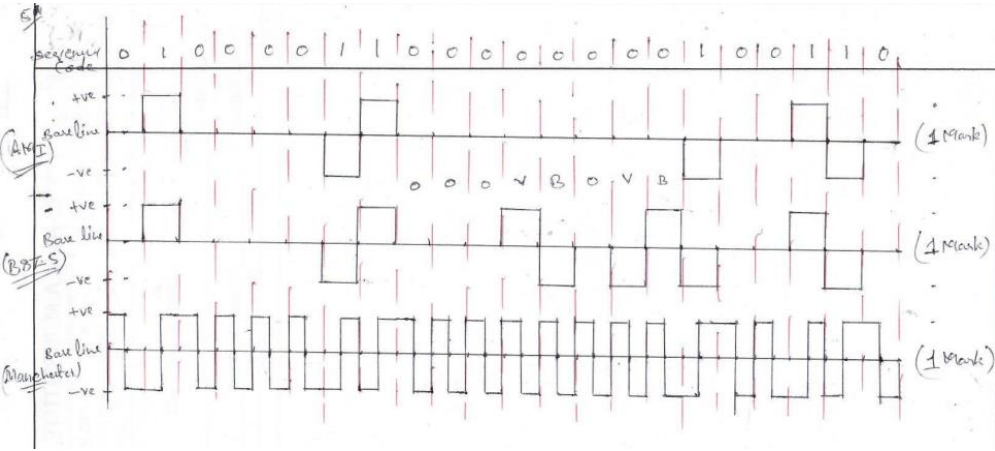
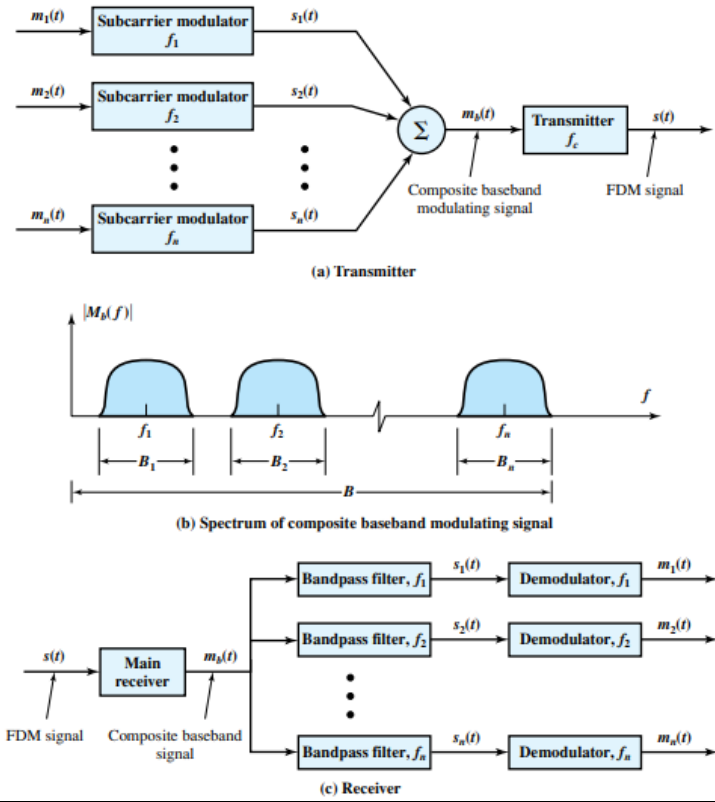
0.5+0.5

2b) Given:  $BW = 300 \text{ Hz}$  To Find: Channel Capacity (C)  
 $SNR_{\text{dB}} = 3 \text{ dB}$   
Sol<sup>n</sup>:  
 $C = B \log_2(1 + SNR)$   
 $C = 300 \log_2(1 + 10^{0.3})$   
 $C = 300 \log_2(2.025)$   
 $\Rightarrow C = 474 \text{ bps}$  [0.5M]  
 $SNR_{\text{dB}} = 10 \log_{10} SNR$   
 $\Rightarrow SNR = 10^{SNR_{\text{dB}}/10}$   
 $[0.5M]$

3

For the bit stream 0100001100000000100110, sketch the waveforms for Manchester, bipolar AMI and B8ZS. Assume that the signal level for the preceding bit for NRZI was high; the most recent preceding 1 bit (AMI) has a negative

1+1+1

|   |  |          |
|---|--|----------|
|   | <p>voltage, and the most recent preceding 0 bit (pseudo ternary) has a negative voltage.</p> <p>Each Line code Carries one mark</p>    |          |
| 4 | <p>With a neat block diagram of transmitter and receiver, explain how synchronous frequency division multiplexing (FDM) works.</p> <p>Block Diagram carries 1.5 marks and detailed Explanation carries 1.5 marks</p>  | 1.5 +1.5 |
| 5 | <p>Using modulo 2 method representation, generate the codeword for the data bit sequence 1100 1110 0111 and verify at the receiver's end using the pattern 10011.</p>  | 1.5+2.5  |

5) Given: Data bit sequence  $\rightarrow 1100\ 1110\ 0111$   
 Pattern  $\rightarrow 10011$   
 To find: Codeword using modulo 2 representation  
 (e) Verify at receiver's end.

Sol<sup>n</sup>:  $k = 12$  (Data length),  $n - k + 1 = 5$  (Pattern length),  $\Rightarrow n - k = 4$  (FCS length)

10011 | 1100 1110 0111 0000 | 11011 0001 110

1001 1  
 101 01  
 100 11  
 01 1010  
 1 0011  
 1001 0  
 1001 1  
 000 1110  
 10011  
 11010  
 10011  
 10010  
 10011  
 00010  
 00000  
 0010

[Receiver's part]  
 10011  
 10011  
 00000  
 00000  
 0000

Codeword = 1100 1110 0111 0010 [2.5M]

- 6 What will be the checksum that Alice sends Bob for the following message? Show the steps of working. Verify at the receiver's end as well. Assume  $n = 8$  and the equivalent Hexadecimal value of A = 0x41. Message: MOTIVATION

2+1

6) Given: Message = MOTIVATION  
 $n = 8$

To find: a) Checksum  
 e) Verify

Sol<sup>n</sup>: M: 0100 1101  
 O: 0100 1111  
 T: 0101 0100  
 I: 0100 1001  
 V: 0101 0110  
 A: 0100 0001  
 T: 0101 0100  
 I: 0100 1001  
 O: 0100 1111  
 N: 0100 1110

1100 00 1010  
 11  
 Sum: 0000 1101  
 Checksum: 1111 0010 [2M]

Receiver: 1100 00 1010  
 1111 0010  
 1111 1100  
 11  
 Sum: 1111 1111  
 Checksum: 0000 0000 [3M]