# **Question Paper**

Exam Date & Time: 19-Dec-2022 (09:30 AM - 12:30 PM)



## MANIPAL ACADEMY OF HIGHER EDUCATION

#### THIRD SEMESTER B.TECH. (INFORMATION TECHNOLOGY) EXAMINATIONS - DECEMBER 2022 SUBJECT : ICT 2156 - PRINCIPLES OF DATA COMMUNICATION

#### Marks: 50

### Duration: 180 mins.

#### Answer all the questions.

1A)	<ul> <li>Assume that the selective repeat data link protocol uses 3-bit sequence number. When the lower and the upper edges of the sender's sliding window are 6 and 1, respectively. With respect to the given scenario draw the vertical time sequence diagram and answer the following:</li> <li>a) What will be the lower and upper edges of the receiver's sliding window if RR6 is delivered successfully?</li> <li>b) What if the RR 6 is lost during the transmission and the transmitter times out?</li> <li>c) What if the RR6 is delivered successfully, and the Data frame 6 is lost during the transmission?</li> <li>d) What if the receiver buffer is full and it cannot accommodate further frames?</li> </ul>	(5)
1B)	<ul><li>Suppose a transmitter produces 100 W of power.</li><li>a) Express the transmit power in units of dBm and dBW.</li><li>b) If the transmitter's power is applied to a unity gain antenna with an 800-MHz carrier frequency, what is the received power in dBm at a free space distance of 50m?</li><li>c) Repeat (b) for a distance of 10 km.</li></ul>	(3)
1C)	Assume that the TV picture is to be transmitted over a channel with 4.5-MHz bandwidth and a 35- dB signal-to-noise ratio. Find the capacity of the channel (bps)	(2)
2A)	A CRC is constructed to generate a 4-bit FCS for a 10-bit message. The generator polynomial is $X^4+X^3+X^2+1$ . Encode the data bit sequence 1001101110 using the generator polynomial and give the code word by using modulo 2 arithmetic and verify at receiver's end.	(5)
2B)	A system uses the Stop-and-Wait ARQ Protocol. If each frame carries 1000 bits of data, estimate the time it take to send 2 million bits of data if the distance between the sender and receiver is 6000 Km and the propagation speed is $2 \times 10^8$ m. Ignore transmission, waiting, and processing delays. We assume no data or control frame is lost or damaged.	(3)
2C)	Consider a channel with a 2-MHz capacity and an SNR of 18 dB. a) What is the upper limit to the data rate that the channel can carry? b) How many signal levels are needed to achieve this channel capacity?	(2)
3A)	Sketch the wave form for the bits "1011001" using Manchester, Differential Manchester and NZR-I encoded techniques and identify the relationship between Baud rate and bit rate for these techniques.	(5)
3B)	A want to send data to B wherein he uses the hamming code technique for error detection and correction. Assume that data word is 1 <b>101010</b> , Compute the code word sent from A to B and illustrate the steps used by receiver B to accept the code word sent from the sender A.	(3)
3C)	A station needs to send a message consisting of 9 frames to station B using sliding window (window size=3) and Go Back N error control strategy. All packets are ready for transmission. If every 5th frame A sends gets lost (but no ACK s from B ever get lost), then what is the number of packets that A will transmit for sending the message to B.	(2)
4A)	Compute the minimum number of bits required for the sequence number field to achieve 100%	(5)

utilization for the following scenario. Consider a 128 x 103 bits/sec satellite communication link with one way propagation delay of 150 msec. Selective Retransmission (repeat) protocol is used on this link to send data with a frame size of 1 KB. Neglect the transmission time of acknowledgement.

- 4B) A group of N stations share 100 Kbps slotted ALOHA channel. Each station output a 500 bits frame (3) on an average of 5000 ms even if previous one has not been sent. Compute the required value of N.
- 4C) Compute the appropriate bit rate and signal level for a channel with a 1 Mhz bandwidth and has the (2) SNR value as 63db.
- 5A) Suppose nodes A and B are attached to opposite ends of the cable with propagation delay of 12.5 (5) ms. Both nodes attempt to transmit at t=0. Frames collide and after first collision, A draws k=0 and B draws k=1 in the exponential back off protocol. Ignore the jam signal. At what time (in seconds), is A's packet completely delivered at B if bandwidth of the link is 10 Mbps and packet size is 1000 bits?
- 5B) For the bit stream 011000000000000100110, sketch the waveforms for Manchester, bipolar AMI (3) 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 voltage, and the most recent preceding 0 bit (pseudo ternary) has a negative voltage.
- 5C) Represent the following signals using a time domain representation. Also, identify values of 3 (2) important characteristics of drawn signal.
   i) s(t)=8sin(4πt+π/4)

ii)  $s(t)=2sin(2\pi t + \pi/2)$ 

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