Semester Exam: Data Communication

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CSE/PC/B/T/224

B.E. COMPUTER SCIENCE & ENGINEERING 2nd YEAR 2nd SEMESTER EXAM
2021
DATA COMMUNICATION

Time: 3 hours Full Marks: 70

Group A [CO1, CO2, CO3, and CO4] All the Question are Compulsory

4. 2 points

Q1.

Suppose, an analog signal has $(200000)_8$ different signal elements. Now, the difference between the data rate (in bps) and the number of signal elements sent in 1s is $(3A98)_{16}$ in hex. Find the baud rate. Please provide the detailed calculations.

Mark only one oval.

- 16000
- 1000
- 500
- None of the above

5. 2 points

Q2.

For Manchester coding scheme to send data at 10 Mbps. What is average signal rate and minimum bandwidth? Please provide the detailed calculations.

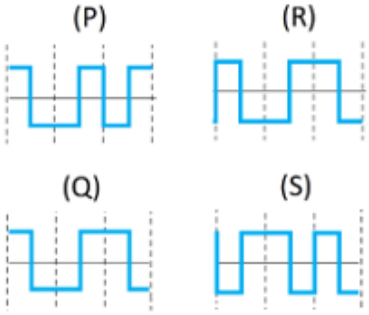
Mark only one oval.

- 500 kbaud, 1000 kHz
- 500 kbaud, 500 kHz
- 1000 kbaud, 1000 kHz
- None of the above

6. 2 points

Q3.

In the following figure, P and Q denote Manchester scheme while R and S denote differential Manchester scheme. Choose the correct matching. Please provide the detailed explanation.



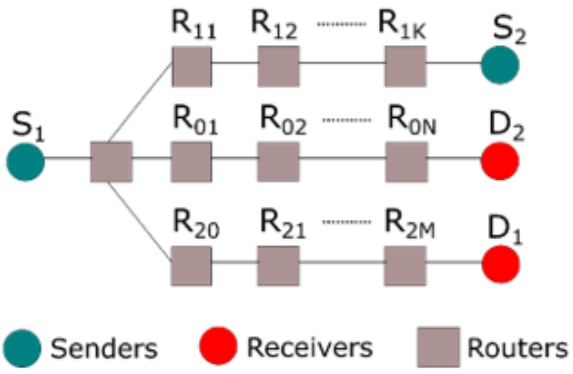
Mark only one oval.

- P=100, Q=101, R=011, S=010
- P=011, Q=010, R=100, S=101
- P=011, Q=010, R=011, S=010
- None of the above

7. 2 points

Q4.

A network is shown in the figure below. X1 and X2 denote the number of times a packet must pass through the network and data link layers during a packet transfer from S_1 to D_2. Similarly, Y1 and Y2 denote the number of times a packet must pass through the network and data link layers during a packet transfer from S_2 to D_1. Choose the correct option. Please provide the detailed calculations.



(a) X2+Y2=2(X1+Y1)-2 and X1-3=N

(b) X2+Y2=2(X1+Y1)-4 and $N=\frac{(X2-4)}{2}$

(c) X2+Y2=2(X1+Y1)-2 and M=Y1-K-4

(d) X2+Y2=2(X1+Y1)-4 and $K=\frac{(Y2-4)}{2}-M$

Mark only one oval.

- Option (a)
- Option (b)
- Option (c)
- Option (d)

8. 2 points

Q5.

Suppose, bandwidth of the channel is 1-MHz. The signal-to-noise ratio for this channel is 127. Find appropriate bit rate and signal level. Please provide the detailed calculations.

Mark only one oval.

- 6 Mbps, 4
- 7 Mbps, 4
- 8 Mbps, 6
- None of the above

9. 2 points

Q6.

SNR in the decibel unit is provided as $\frac{20 \ln N}{\ln 10}$. Find the relationship between the peak voltage value of the noise and the peak voltage value of the signal respectively. Please provide the detailed calculations.

Mark only one oval.

- The peak voltage value of the noise is (1/N) times the peak voltage value of a signal.
- The peak voltage value of the noise is N times the peak voltage value of a signal.
- The peak voltage value of the noise is (2/N) times the peak voltage value of a signal.
- None of the above

10. 2 points

Q7.

Suppose, data rate is 6000 bps and type of modulation is QPSK. Find the baud rate. Please provide the detailed calculations.

Mark only one oval.

- 3000 baud
- 2000 baud
- 4000 baud
- None of the above

11. 2 points

Q8.

Suppose, the available bandwidth is 44500 Hz. Assume that a voice channel has a 4 kHz bandwidth. Find the maximum number of voice channels that can be multiplexed using FDM, if guard bands of 500 Hz is considered? Please provide the detailed calculations.

Mark only one oval.

- 9
- 11
- 10
- None of the above

12. 2 points

Q9.

Suppose, N1 and N2 are the data rate in bps for two channels C1 and C2 respectively. C1 and C2 are to be multiplexed using pulse stuffing Time-division multiplexing (with no synchronization bits). Let, w, x, y, z represent frame size, frame rate, frame duration, and data rate respectively. Choose the correct option when N1=190 kbps and N2=180 kbps. Please provide the detailed calculations.

Mark only one oval.

- w=2 bits, x=190000 frames/sec, y=5.6 micro second, z=370 kbps.
- w=2 bits, x=180000 frames/sec, y=5.6 micro second, z=370 kbps.
- w=2 bits, x=190000 frames/sec, y=5.3 micro second, z=380 kbps.
- None of the above

13. 2 points

Q10.

Suppose, we have a line L1 with bandwidth 8 kHz. When noise is 10mV, the signal is 20V. Find the highest data rate that could be achieved by L1. Please provide the detailed calculations.

Mark only one oval.

- 43877 bps
- 43866 bps
- 43888 bps
- None of the above

14. 2 points

Q11.

Find the 8-bit data stream for each case depicted in the following figures. Please provide the explanations.

Mark only one oval.

- (i) 10011001 (ii) 11000100 (iii) 01110001
- (i) 01100110 (ii) 00111011 (iii) 10001110
- (i) 10011001 (ii) 11000100 (iii) 10001110
- None of the above

15. 2 points

Q12.

Let us consider a system needs to send data at Q Mbps. Find the minimum bandwidth requirement of the following combination of coding scheme: 4B/5B and NRZ-I. Please provide the detailed calculations.

Mark only one oval.

- 625Q MHz
- 625Q KHz
- 5Q/4 MHz
- None of the above

16. 2 points

Q13.

Suppose we have 12 quantization levels, find the SNR of the signal. Please explain the calculation in detail.

Mark only one oval.

- 19.82 dB
- 25.84 dB
- 23.34 dB
- None of the above

17. 2 points

Q14.

Suppose, the Nyquist sampling rate is 600,000 samples per second. If the minimum frequency of the band-pass signal is 100 KHz, find the bandwidth of the signal. Provide proper explanation.

Mark only one oval.

- 300 KHz
- 200 KHz
- 100 KHz
- None of the above

18. 3 points

Q15.

Suppose, N bps line is available to transfer data. P and Q denote the number of characters that could be transmitted in every second in asynchronous and synchronous transfer respectively. Let, for each character, x bits need to be sent. Also, assume that the in the case of asynchronous transfer, we need y start bits and z stop bits in order to synchronise. Choose the correct option. Please provide the detailed calculations.

Mark only one oval.

- P/x=(Q-P)/(N+y+z)
- P/x=(Q-P)/(y+z)
- Q/x=(P-Q)/(y+z)
- None of the above

Group B [CO5 and CO6] All Questions are Compulsory

19. 3 points

Q16.

Suppose, 11AB**C**0100**110** is a hamming codeword in binary form, where A, B, and **C** denote unknown bits. Find the value of A, B, and **C**. Note, the check bits are shown in blue. Please provide the detailed calculations.

Mark only one oval.

- 1 0 1
- 0 0 0
- 1 1 0
- None of the above

20. 2 points

Q17.

The maximum size of the receive window in Selective Repeat protocol is 16. The sender sends a series of frames to the same destination. The sequence numbers start from 0. Here, the sender sends a total of 100 frames. If the sender uses Go Back N instead of Selective Repeat, then what will be the sequence number after sending 100 frames. Please provide the detailed calculations.

Mark only one oval.

- 1
- 4
- 3
- None of the above

21. 2 points

Q18.

Suppose each frame carries 1000 bits of data, distance between sender and receiver is 5000km, the propagation speed is 2×10^8 m. How long does it take to send 1 million bits of data if the system uses (i) Stop-N-Wait (ii) Go-Back-N (with window size 7)? Ignore transmission, waiting and processing delays. Also assume no data or control frame is damaged or lost. Please provide the detailed calculations.

Mark only one oval.

- 50 sec, 7.1 sec
- 60 sec, 8.2 sec
- 25 sec, 3.56 sec
- None of the above

22. 2 points

Q19.

Suppose a system uses following sequence numbers: 0, 1, 2, 3, 4, 5, …., 29, 30, 31, 0, 1, 2, ….

If S, R, and n denote sender window size, receiver window size, and the number of hexadecimal digits used to represent the sequence number, respectively. Then state True/False for the following statements. Also provide explanation.

Statement 1: For Go-Back-N, S-n-R = $(1D)_{16}$
Statement 2: Selective Repeat, 2S+n-R = $(22)_8$

Mark only one oval.

- Statement 1---> T, Statement 2---> T
- Statement 1---> T, Statement 2---> F
- Statement 1---> F, Statement 2---> T
- Statement 1---> F, Statement 2---> F

23. 2 points

Q20.

Suppose, we have a code scheme with following codewords:

00000, 01111, 11a10, 011b0, 1110g, 01c10, d1011, 0100e, 1f000, 00i10, 101j1, 001k1, 101m0, 0n011, 10p10, 1000r.

Where, a, b, g, c, d, e, f, i, j, k, m, n, p, r are unknown bits. Suppose, this code is a linear block code with the minimum number of 1s in any nonzero valid codeword can be 2. How many errors are guaranteed to be detected? Please provide the detailed calculations.

Mark only one oval.

- 0
- 1
- 2
- None of the above

24. 2 points

Q21.

A code scheme has the following code words (in binary):

U= 11110000

V= 01p10101

W= 00000000

X= 0q001111

Y= 10101010

Where, U+V= $(145)_{16}$ and V+X= $(144)_8$. Note that p and q are unknown bits. How many bit errors are guaranteed to be corrected? Please provide the detailed calculations.

Mark only one oval.

- 0
- 1
- 2
- None of the above

25. 3 points

Q22.

Suppose CRC generator is 1101. Match the data word polynomial with their code word. Please provide the detailed calculations.

Data word	Code word
(i) x^6+x^3+x	(1) $x^9+x^6+x^5+x^4+x^2+x$
(ii) $x^6+x^3+x^2+x$	(2) $x^9+x^6+x^4+x^2+1$
(iii) $x^8+x^7+x^6$	(3) $x^{11}+x^{10}+x^9+x^2+1$
	(4) $x^9+x^6+x^5+x^4+x^2+1$
	(5) $x^{11}+x^{10}+x^9+x^2+x$
	(6) $x^9+x^6+x^4+x^2+x$

Mark only one oval.

- i-2, ii-1, iii-3
- i-6, ii-4, iii-5
- i-2, ii-4, iii-3
- None of the above

26. 2 points

Q23.

Suppose, we have two data words 100100 and 1101 0110 11 with corresponding generators 1101 and 10011. Choose the correct matching. Please provide the detailed calculations.

Data word (augmented)	Code word
(i) x^5+x^2	(1) x^5+x^2+1
(ii) $x^9+x^8+x^6+x^4+x^3+x+1$	(2) $x^9+x^8+x^6+x^4+x^3+x^3+x^2+x+1$
(iii) x^8+x^5	(3) x^8+x^5+1
(iv) x^7+x^4	(4) x^7+x^4+1
(v) $x^{13}+x^{12}+x^{10}+x^8+x^7+x^5+x^4$	(5) $x^{13}+x^{12}+x^{10}+x^8+x^7+x^5+x^4+x^3+x^2+x$

Mark only one oval.

- i-3, ii-2
- i-3, v-5
- iii-3, v-5
- None of the above

27. 2 points

Q24.

Data units 1111, 1110, 0001, and 1000 are sent by the sender and two-dimensional parity check technique is used. Suppose, the data units received could be any one of the following sets:

(i) 1111, 1110, 1001, 1001

(ii) 1111, 1110, 1000, 0001

(iii) 1100, 0010, 0001, 1000

In which of the above case, no error will be detected. Please provide the detailed explanation.

Mark only one oval.

- (i) and (iii)
- (ii) only
- (i) and (ii)
- None of the above

28. 3 points

Q25:

Two statements are provided below. Based on the correctness of the sentences, choose the correct option. Additionally, support your selected option with proper explanation and examples.

Statement 1: Usually, CRC has better error-checking capability compared to checksum.

Statement 2: Consider a 16-bit checksum. If several 16-bit words are incremented during transmission in such a way that the total change is a multiple of 65535, the receiver will unable to detect the error.

Mark only one oval.

- Statement 1 ---> True, Statement 2 ---> False
- Statement 1 ---> False, Statement 2 ---> True
- Statement 1 ---> True, Statement 2 ---> True
- Statement 1 ---> False, Statement 2 ---> False

29. 3 points

Q26.

Let us consider a CRC generator polynomial is: $x(x^{n-1}+1)+(x^{n-6}+1)$. Choose the correct option by computing the probabilities for the detection of burst error in the following two cases. (a) burst error of size $n+1$ (b) burst error of size 2n+1. For both of the above two cases, assume $n=8$. Please explain the calculation in detail.

Mark only one oval.

- 0.004, 0.008
- 0.0003, 0.0007
- 0.002, .004
- None of the above

30. 3 points

Q27.

Suppose, a system needs to send 4 frames using stop-and -wait protocol. The round-trip delay and time-out time is 4 ms and T ms respectively. Suppose the first frame is lost once. Choose the correct option, if 22 ms is required to complete the process of transferring all 4 frames from sender to receiver. Explain your answer with the help of appropriate flow diagram.

Mark only one oval.

- ⌈ T / round-trip delay ⌉=1, T <=7
- ⌈ T / round-trip delay ⌉=2, T >= 7
- ⌈ T/ round-trip delay ⌉=2, T <= 7
- None of the above

31. 3 points

Q28.

Suppose, a system needs to send 4 frames using stop-and-wait protocol. The round-trip delay and time-out time is 6 ms and 4 ms respectively. How much time is required to complete the process of transferring all 4 frames from sender to receiver if there is no frame loss/damage. Also draw and explain with the help of suitable flow diagram.

Mark only one oval.

- 22 ms
- 26 ms
- 20 ms
- None of the above

32. 4 points

Q29.

Suppose, stop and wait protocol is used by the system. The round-trip delay and time-out time is R ms and T ms respectively. Suppose, it is observed that the sender needs to send each frame thrice even though there is no frame loss/damage. What could be the possible relationship between R and T. Justify your answer.

Mark only one oval.

- R≥3T
- R<2T
- R<2 lnT
- R>2T

33. 3 points

Q30.

Suppose a student is asked to write some pseudocode for bit-stuffing. The frame has the following format: <start flag, data, end flag>. Also, it is provided that the start flag = 01111110 and end flag = 0111110 respectively. Let us assume that the student comes up with the following solution (i.e., pseudo code) for the sender side. For which value of **X**, **Y**, and **Z** the bit-stuffing will work perfectly? Please provide explanation.

```
InsertFrame (8-bit flag);   // Insert beginning flag
counter = 0;
while (more bits in data buffer)
{
    ExtractBuffer (bit);
    InsertFrame( bi t ) ;
    if (bit = =X)      counter = counter + 1;
    else               counter = 0;

    if (counter = =Y)
    {
        InsertFrame (bit Z);   // Bit stuff
        counter = 0;
    }}

InsertFrame (8-bit flag);   // Insert ending flag
```

Mark only one oval.

- ◯ 1,6,1
- ◯ 0,5,0
- ◯ 1,5,0
- ◯ None of the above.

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