Department of Computer Science & Engineering
University of Asia Pacific (UAP)

Final Examination **Fall 2021** **3rd Year 1st Semester**

Course Code: CSE 303 **Course Title: Data Communication** **Credits: 3**

Full Marks: 150 **Duration: 3 Hours**

Instructions:

There are **Six (6)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.

Non-programmable calculators are allowed.

1. The 8B6T encoding scheme takes 8 bits of binary data and encodes them using 6 ternary signal elements. Recall that each Ternary signal element can take on one of three values (positive, negative, and zero voltage). Table 1 is attached with this question (check the last page of this question paper) and is a portion of the 8B6T code table. The complete table maps all possible 8-bit patterns to a unique code group of 6 ternary symbols. Suppose a hexadecimal value 370000 or in binary 00110111000000000000000 is sent from sender to receiver using NRZ-L, Manchester, and 8B6T. Now answer the following: [5*5 = 25]

   i. Draw the digital signal diagram for NRZ-L, Manchester, and 8B6T.

   ii. When considering the synchronization of the receiver, why is the NRZ-L signal a problem?

   iii. How does the Manchester signal solve the synchronization problem?

   iv. What cost does the Manchester signal incur in achieving this synchronization?

   v. The 8B6T signal also solves the synchronization problem. How?

   (Assumptions: for NRZ-L: bit 1 = -V, bit 0 = +V; for Manchester encoding: bit1 = -V to +V, bit 0 = +V to -V)

OR

Polar NRZ-L and Polar NRZ-I are two line coding schemes with few similarities and differences. Compare them based on the following points. Also, give short examples for each; you may use 011101 as your bit stream to draw the digital signal diagram. [6*3 +7= 25]

i. Baseline wandering

ii. Synchronization
iii. Change of polarity
iv. DC component

(Assumptions: For NRZ-L: bit 1 = -V, bit 0 = +V;
For NRZ-I: last voltage level was positive, bit 1= change, bit 0= no change)

2. a. You have to send a bit stream 0001111111110101001100000000 to your friend using 4B/5B block coding. Now solve the following: [8+6 +6 = 20]
   i. Apply the block coding scheme to identify the encoded sequence of bits that you will send to your friend.
   ii. Discuss how it solves the synchronization problem of NRZ-I
   iii. Illustrate the disadvantages that it may have over NRZ-I

   (Please see Table 2 for 4B/5B encoding table on the last page)

   b. In digital transmission, the receiver clock is 0.1 percent faster than the sender's clock. How many extra bits per second does the receiver receive if the data rate is 1 kbps? How many if the data rate is 1 Mbps? [5]

OR

   a. Considerations for choosing a good signal element are referred to as line encoding. Explain the important points that one needs to consider while choosing a good line encoding scheme. [15]

   b. The bipolar-AMI waveform representing the binary sequence"0100101011" is transmitted over a noisy channel. The received waveform is shown in Figure 1. It contains a single error. Locate the position of the error and explain your answer. You also need to draw the correct diagram. (Assume that the last non-zero pulse was negative) [10]

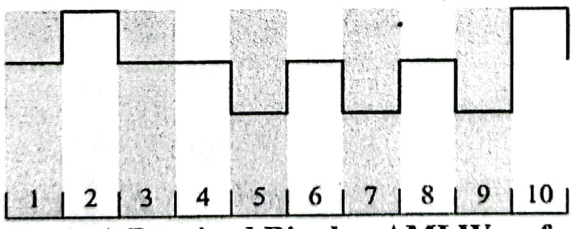

Figure 1: A Received Bipolar-AMI Waveform.

3. a. A receiver received a 7-bit Hamming code word 1011011. Assuming the even parity state, determine whether the received code word is correct or wrong. If it is wrong, locate the bit having the error and write the correct code word. [15]

   b. A bit stream 100000001 is received by the receiver side. The sender sent the bit stream using the standard CRC method. The generator polynomial was $x^3 + x^2 + 1$. Apply the CRC method to identify whether there is an error or not. You need to show the full calculation for the receiver side only. [10]

4. a. Unlike many other wireless standards, 802.11 runs on "free" portions of the radio [3*5

spectrum. Based on this concept, discuss the following: = 15]

i. Band allocations of 802.11 standard
ii. Popular naming for 802.11 standard
iii. Licensing policy and pricing
iv. Conflict of devices using the same free spectrum
v. List any two variations of 802.11 standards along with the features

b. List four key Differences Between Guided and Unguided Media. [10]

5. a. The data link layer is responsible for moving frames from one hop (node) to the next; on the other hand, the network layer is responsible for delivering individual packets from the source host to the destination host. From your point of view, discuss these two phenomena with proper figures. [15]

b. Compare the difference between circuit switching and packet switching. [10]

Topic	Circuit Switching	Packet Switching
Phases of switching		
Path information		
Data Processing		
Delay between data units		
Reliability		
Data transmission responsibility		
Congestion		
Recording of packet		
Physical path		
Wastages of resources		

6. a. Assume that a voice channel occupies a bandwidth of 8 kHz. We need to combine three voice channels into a link with a bandwidth of 24 kHz, from 20 to 44 kHz. Show the configuration, using the frequency domain, Assume the are no guard bands. [15]

b. Briefly discuss the concept of Bandwidth, Throughput, and Latency with proper examples. [10]

Data	Code	Data	Code	Data	Code	Data	Code
00	-+00-+	20	-++-00	40	-00+0+	60	0++0-0
01	0-+-+0	21	+00+--	41	0-00++	61	+0+-00
02	0-+0-+	22	-+0-++	42	0-0+0+	62	+0+0-0
03	0-++0-	23	+-0-++	43	0-0++0	63	+0+00-
04	-+0+0-	24	+-0+00	44	-00++0	64	0++00-
05	+0--+0	25	-+0+00	45	00-0++	65	++0-00
06	+0-0-+	26	+00-00	46	00-+0+	66	++00-0
07	+0-+0-	27	-+++--	47	00-++0	67	++000-
08	-+00+-	28	0++-0-	48	00+000	68	0++-+-
09	0-++-0	29	+0+0--	49	++-000	69	+0++--
0A	0-+0+-	2A	+0+-0-	4A	+-+000	6A	+0+-+-
0B	0-+-0+	2B	+0+--0	4B	-++000	6B	+0+--+
0C	-+0-0+	2C	0++--0	4C	0+-000	6C	0++--+
0D	+0-+-0	2D	++00--	4D	+0-000	6D	++0+--
0E	+0-0+-	2E	++0-0-	4E	0-+000	6E	++0-+-
0F	+0--0+	2F	++0---0	4F	-0+000	6F	++0--+
10	0--+0+	30	+-00-+	50	+--+0+	70	000++-
11	-0-0++	31	0+--+0	51	-+-0++	71	000+-+
12	-0-+0+	32	0+-0-+	52	-+-+0+	72	000-++
13	-0-++0	33	0+-+0-	53	-+-++0	73	000+00
14	0--++0	34	+-0+0-	54	+--++0	74	000+0-
15	--00++	35	-0+-+0	55	--+0++	75	000+-0
16	--0+0+	36	-0+0-+	56	--++0+	76	000-0+
17	--0++0	37	-0++0-	57	--++0	77	000-+0
18	-+0-+0	38	+-00+-	58	-+-0++	78	+++--0

Table 1: A Portion of the 8B6T Code Table

Data Sequence	Encoded Sequence	Data Sequence	Encoded Sequence
0000	11110	1000	10010
0001	01001	1001	10011
0010	10100	1010	10110
0011	10101	1011	10111
0100	01010	1100	11010
0101	01011	1101	11011
0110	01110	1110	11100
0111	01111	1111	11101

Table 2: 4B/5B encoding table