AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering
Program: B.Sc. in Computer Science and Engineering
Semester Final Examination: Spring 2020
Year: 3rd Semester: 2nd
Course Number: CSE 3211
Course Name: Data Communication

Time: 3 (Three) Hours **Full Marks: 60**

Use single answer script

Instructions:	i)	Answer script should be hand written and should be written in A4 white paper. You must submit the hard copy of this answer script to the Department when the university reopens.
	ii)	You must write the following information at the top page of each answer script: **Department:** **Program:** **Course no:** **Course Title:** **Examination:** **Semester (Session):** **Student ID:** **Signature and Date:**
	iii)	Write down Student ID, Course number and put your signature on top of every single page of the answer script.
	iv)	Write down page number at the bottom of every page of the answer script.
	v)	Upload the scan copy of your answer script in PDF format through provided **google form** at the respective course site (i.e., **google classroom)** using institutional email within the allocated time. Uploading clear and readable scan copy (uncorrupted) is your responsibility and you must cover all the pages of your answer script. However, for clear and readable scan copy of the answer script student should use only one side of a page for answering the questions.
	vi)	You must avoid **plagiarism,** maintain **academic integrity, and ethics**. You are not allowed to take any help from another individual and if taken so can result in stern disciplinary actions from the university authority.
	vii)	Marks allotted are indicated in the **right margin.**
	viii)	Necessary **charts/tables** are attached at the end of the question paper. You may use graph papers where necessary.
	ix)	Assume any reasonable data if needed.
	x)	Symbols and characters have their usual meaning.
	xi)	Before uploading, rename the PDF file as **CourseNo_StudentID.pdf** e.g., CSE3101_180104001.pdf

The answer script **(one single PDF file)** must be uploaded at designated location in the provided **Google Form link** available in the Google classroom.

There are 7 (Seven) Questions. Answer any 5(Five).

Question 1. [Marks: 12]		
a)	Why is it necessary to have layering in a network? How do two adjacent layers communicate in a layered network?	**[4]**
b)	What are the key functions of the **Data Link Layer**?	**[4]**
c)	Consider a file contains 2 million bytes. How long does it take to download this file using: I. 56-Kbps channel? II. 1-Mbps channel?	**[4]**
Question 2. [Marks: 12]		
a)	According to the ***Nyquist theorem***, the sampling rate is at least twice the highest frequency in the original signal. Now, briefly describe the technique that applies the theorem for data transmission.	**[4]**
b)	Given the dataword **1 0 1 0 0 1 1 1 1 0** and the divisor **1 0 1 1 1**, I. Show the generation of the codeword at the sender site (using binary division). II. Show the checking of the codeword at the receiver site (assume the last digit of the codeword holds an error — **if the sum of your student ID digits** is an even number; otherwise, **the second last digit of the codeword** contains an error).	**[4]**
c)	What is the result of **scrambling** the sequence **1 1 1 0 0 0 0 0 0 0 0 $ $ $** using one of the following scrambling techniques? Assume that the **last non-zero signal level has been positive.** [**$** is the **last digit** of your Student ID. If the digit is even, then it is 0, and 1 otherwise.] I. B8ZS II. HDB3 (The number of non-zero pulse is odd after the last substitution)	**[4]**
Question 3. [Marks: 12]		
a)	Why do we use QPSK instead of BPSK? Demonstrate the QPSK implementation.	**[4]**
b)	What does the ***Nyquist theorem*** have to do with communications? Calculate the baud rate for the given bit rate and type of modulation. Write your observation among those baud rates. I. 2000 bps, FSK II. 4000 bps, ASK III. 6000 bps, QPSK IV. 36000 bps, 64-QAM	**[4]**
c)	I. Can we say if a signal is periodic or non-periodic by just looking at its frequency domain plot? How?	**[2+ 2]**

	II. What causes the transmission impairment? Explain the causes of impairment briefly.	
Question 4. [Marks: 12]		
a)	What kind of error is undetectable by the checksum? Defend the reasons with the proper logic.	**[4]**
b)	Explain the **Synchronous Time-Division Multiplexing** with necessary examples.	**[4]**
c)	The T-Mobile (a mobile telecommunication company) uses two bands. The first band of 824 to 849 MHz is used for sending, and 869 to 894 MHz is used for receiving. Each user has a bandwidth of 30 KHz in each direction. The 3-KHz voice is modulated using FM, creating 30 KHz of a modulated signal. How many people can use their cellular phones simultaneously?	**[4]**
Question 5. [Marks: 12]		
a)	Why are the burst errors more affected by noise? Briefly explain the central concept of detection or correction errors.	**[4]**
b)	What is the maximum effect of a 2-ms burst of noise on data transmitted at the following rates? I. 3000 bps II. 24 Kbps III. 100 Kbps IV. 100 Mbps What is your opinion on the noise duration over the data rate in the above scenario?	**[4]**
c)	How is the simple parity check related to the two-dimensional parity check?	**[4]**
Question 6. [Marks: 12]		
a)	Seven sources with a bit rate of **$** Kbps are to be combined using multilevel TDM with no synchronizing bits. Answer the following questions about the final stage of the multiplexing: I. What is the size of a frame in bits? II. What is the frame rate? III. What is the duration of a frame? IV. What is the data rate? **[**The value of **$** depends on the **last digit** of your Student ID. If the digit is an even number, then it is 400, and 800 otherwise.]	**[4]**
b)	Why the analog hierarchy used by telephone companies? In the analog hierarchy for the following **figure 1**, find the overhead (extra bandwidth for guard band or control) in each hierarchy level. Write your observation on the overhead.	**[4]**

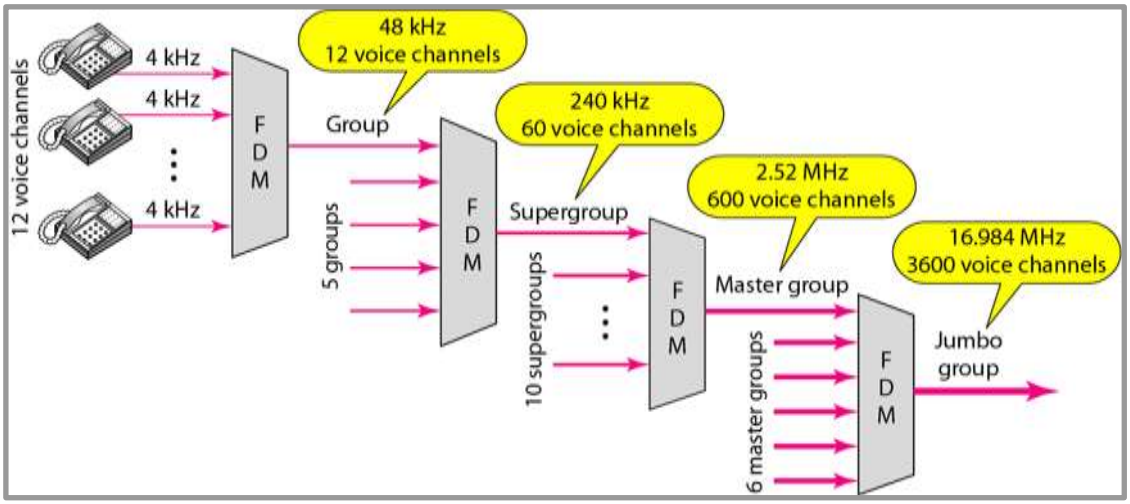

Figure: 1

c)	What multiplexing technique is used for wireless applications? Briefly explain the technique (including all of its sub-categories) associated with the wireless applications.	**[4]**

Question 7. [Marks: 12]

a)	In the Cyclic Redundancy Check, show the relationship between the following entities (here, **size** means the number of bits): I. The size of the dataword and the size of the codeword II. The size of the divisor and the remainder III. The degree of the polynomial generator and the size of the divisor IV. The degree of the polynomial generator and the size of the remainder	**[4]**
b)	Assume that an augmented dataword is **1 $ 0 1 0 0 0**. Now implement a simulator of division for the CRC encoder, and show the detailed impact after each time click. [The value of **$** is 0 if the **second last digit** of your Student ID is an even number, 1 otherwise.]	**[4]**
c)	Show that the Hamming code C(7, 4) of **Table 1** can detect one-bit error but not necessarily two-bit errors by testing the code in the following cases. The character **"V"** in the burst error means no error; the character **"E"** means an error; the value of **$** is the 0 if the **third last digit** of your Student ID is an even number, 1 otherwise. Your answer **MUST** include the **dataword, codeword, the corrupted codeword, the syndrome, and the interpretation** of each case: I. Dataword: 0 1 0 0; Burst error: E V V V V V V II. Dataword: 0 1 1 1; Burst error: V E V V V V V III. Dataword: 0 $ $ 0; Burst error: E V V V V V E IV. Dataword: $ 1 1 $; Burst error: V E V V E V E	**[4]**

Dataword	*Codeword*	*Dataword*	*Codeword*
0000	0000000	1000	1000101
0001	0001011	1001	1001110
0010	0010110	1010	1010011
0011	0011101	1011	1011000
0100	0100111	1100	1100010
0101	0101100	1101	1101001
0110	0110001	1110	1110100
0111	0111010	1111	1111111

Table: 1