AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department: Computer Science and Engineering
Program: B.Sc. in Computer Science and Engineering
Semester Final Examination: Fall 2020
Year: 3rd   Semester: 2nd
Course Number: CSE 3211
**Course Name: Data Communication**

Time: 2 (Two) Hours   **Full Marks: 50**

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
	xii)	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 6 (Six) Questions. Answer any 4 (Four).

Question 1. [Marks: 12.5]		
a)	How do two adjacent layers communicate in a layered network? Explain your answer with necessary examples.	**[4]**
b)	How do the layers of the Internet model correlate to the layers of the OSI model?	**[4]**
c)	What is the difference between a port address, a logical address, and a physical address?	**[4.5]**

Question 2. [Marks: 12.5]		
a)	Can we say if a signal is periodic or nonperiodic by just looking at its frequency domain plot? How?	**[2.5]**
b)	How does the **Nyquist theorem** and the **Shannon capacity** differ from each other in data communication? If the peak voltage value of a signal is 20 times the peak voltage value of the noise, what is the **SNR**? What is the **SNR$_{dB}$**?	**[2.5 + 2.5]**
c)	Draw the graph of the **Differential Manchester** scheme using each of the following data streams, assuming that the last signal level has been **negative**. I. 0 0 0 0 0 0 0 0 II. 1 1 1 1 1 1 1 1 III. 0 1 0 1 0 1 0 1 IV. 0 0 1 1 0 0 1 1	**[5]**

Question 3. [Marks: 12.5]		
a)	Which of the three analog-to-analog conversion techniques (AM, FM, or PM) is the most susceptible to noise? Defend your answer.	**[2.5]**
b)	What is the bit rate for each of the following signals? I. A signal in which 1 bit lasts 0.001 second II. A signal in which 1 bit lasts 2 millisecond III. A signal in which 10 bits last 20 microsecond	**[5]**
c)	For the following cases which one is/ are **baseband** or **broadband** transmission(s). Proper explanation is needed. I. send a voice signal from a microphone to a recorder. II. send a digital signal from one station on a LAN to another station. III. modulate several voice signals and send them through the air.	**[5]**

Question 4. [Marks: 12.5]		
a)	Distinguish between the **synchronous TDM** and the **statistical TDM**.	**[2.5]**
b)	Why the analog hierarchy is 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.	**[5]**
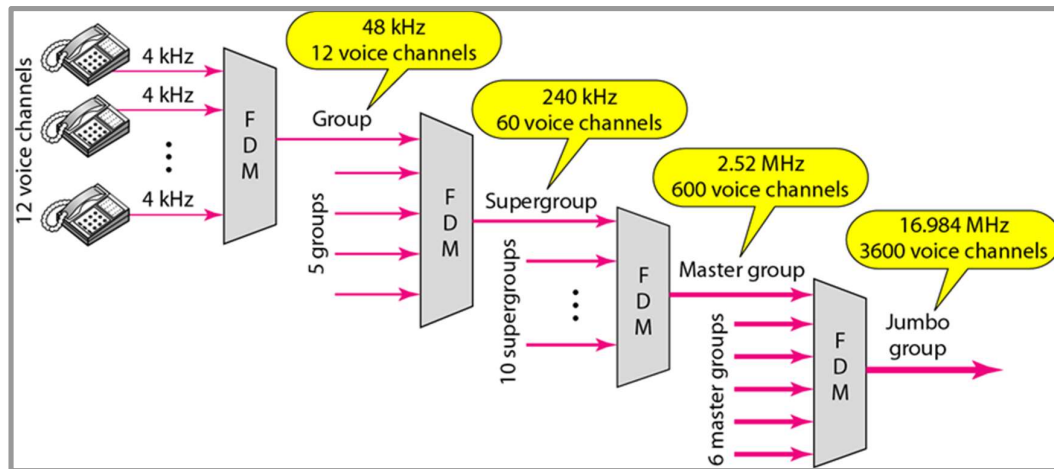
Figure: 1

c)	$ sources, six with a bit rate of 200 kbps and remaining with a bit rate of 400 kbps are to be combined using multiple slot 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 10, and 20 otherwise.]
		[5]

Question 5. [Marks: 12.5]

a)	Distinguish between forward error correction and error correction by retransmission.	**[2.5]**
b)	What kind of error(s) is/ are undetectable by the checksum? Briefly explain your answer.	**[5]**

c)	Assuming even parity, find the parity bit for each of the following data units.
	   I. 1001011
	   II. 0001100
	   III. 1000000
	   IV. 1110111
	 [Proper explanation is needed to defend your answer]
		[5]

Question 6. [Marks: 12.5]

a)	Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.	**[2.5]**
b)	Create a Hamming code for C(7, 4) which 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	**[10]**

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: V V V V V V E
 IV. Dataword: $ 1 1 $; Burst error: V V V V E V E