



**American International University- Bangladesh (AIUB)**  
**Faculty of Engineering**

**Course Name:** Data Communication  
**Semester:** Fall 2023  
**Total Marks:** 30

**Course Code:** COE 3201  
**Term:** Final  
**Submission Date:** 23-11-2023  
**Assignment:** 02/OBE

**Course Outcome Mapping with Questions**

Item	COs	POIs	K	P	A	Marks	Obtained Marks
Q1	CO4	P.f.2.C6	K7	P1, P3, P7		30	
Total:						30	

**Student Information:**

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<b>Section:</b> H	<b>Department:</b> CSE

**Marking Rubrics (to be filled by Faculty):**

	Excellent [15]	Proficient [12]	Good [10]	Acceptable [7]	Unacceptable [5]	No Response [0]	Secured Marks
Problem	Detailed unique response explaining the concept properly and answer is correct with all works clearly shown.	Response with no apparent errors and the answer is correct, but explanation is not adequate/unique.	Response shows understanding of the problem, but the final answer may not be correct	Partial problem is solved; response indicates part of the problem was not understood clearly.	Unable to clarify the understanding of the problem and method of the problem solving was not correct	No Response/(Copied/identical submissions will be graded as 0 for all parties concerned)	
1							
2							
Comment						Total marks (30)	

Use your ID (ID = AB-CDEFG-H)

(For example: If B=1, C=2 and E=1, BCE= 121)

1. A voice channel occupies a bandwidth of **BCE** kHz. Three voice channels are multiplexed together using FDM (Frequency Division Multiplexing).

(a) Propose the minimum required Bandwidth for the setup mentioned above.

(b) Design the configuration of multiplexing and demultiplexing process as an illustration using the above voice channels, bandwidth and the guard bands with proper labeling (choose carrier frequency range of your preference according to the Bandwidth).

ID: 21-45127-2  
B C E

1. A voice channel occupies a bandwidth of BCE  $\rightarrow 141$  kHz. Three voice channels are multiplexed together using FDM.

(a) The minimum required bandwidth for Frequency Division Multiplexing (FDM) can be calculated by adding the individual bandwidths of the voice channels and adding guard bands to prevent interference between adjacent channels.

$\therefore$  Minimum bandwidth in FDM is,  $MB = CB + GB$

here,  $MB$  = Minimum bandwidth

$CB$  = Channel bandwidth

$GB$  = Guard bandwidth

Given that each voice channel occupies 141 kHz and there are three channels, let's assume a guard band of 10 kHz on each

voice channel for illustration.

$$\begin{aligned}\text{Therefore, } MB &= 3 \times 141 \text{ kHz} + 2 \times 10 \text{ kHz} \\ &= 443 \text{ kHz}\end{aligned}$$

So, the minimum bandwidth for FDM is 443 kHz.

(b) Design configuration of multiplexing and demultiplexing process,

In FDM, each voice channel is allocated a specific frequency range within the total bandwidth. Let's say we choose the carrier frequency range 0 to 443 kHz.

The three voice channels are allocated non-overlapping frequency ranges within this band width.

Voice channel 1: 0 kHz - 141 kHz

Voice channel 2: 151 kHz - 292 kHz

Voice channel 3: ~~202~~<sup>302</sup> kHz - 443 kHz

Here, I have left 9 kHz guard bands on



both sides of each channels to avoid interference.

Illustration of FDM Configuration:

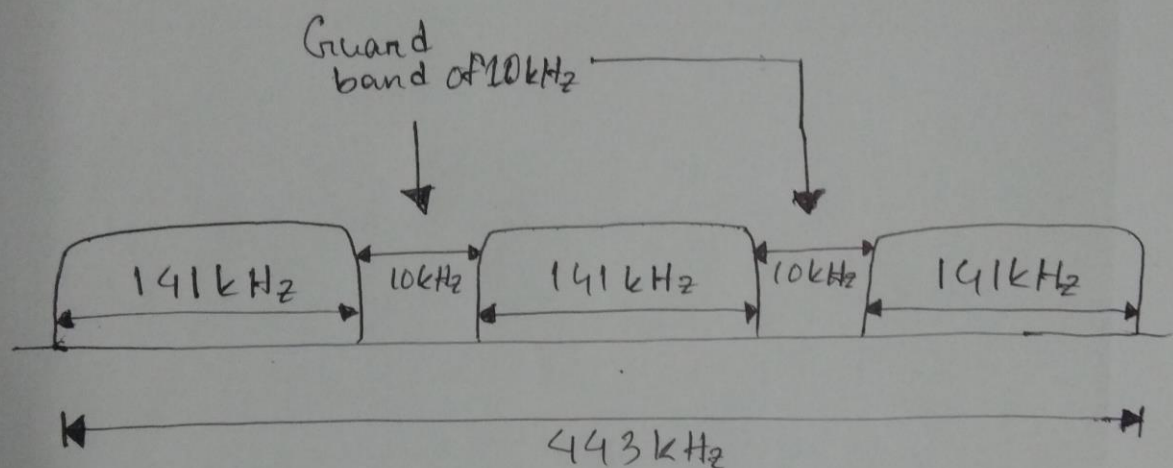


Figure 4: Basic illustration of FDM

In the multiplexing process, the individual signals from each channel are combined to form a composite signal, and in the demultiplexing process, these signals are separated back into their original channels.