



# American International University-Bangladesh (AIUB)

## Faculty of Engineering

### COE 3101: Data Communication

### Final Term Theory Assignment Question Paper

#### Instructions:

- This assignment must be submitted online as a **PDF** file on **VUES** under the component named '**FT Theory ASSIGNMENT**'.
- The file name must be '**FT Theory ASSIGNMENT ID.pdf**', where **ID** is your ID. For example, the file name can be **FT Theory ASSIGNMENT 19-34567-2.pdf**.
- On cover page of this assignment, **NAME**, **ID**, and **SECTION** must be mentioned clearly.
- **ID** related calculations must be presented clearly.
- You can prepare the assignment by hand or on computer.
- Total grade is **10**.
- **Plagiarism will be penalized.**
- **Deadline: 28/11/2021 (Sunday) 10:00 PM.**

#### Question (10 marks):

Assume your ID is **AB-CDEFG-H**. You are given **4** (four) digital signals named **ds1**, **ds2**, **ds3**, and **ds4**. All four digital signals have **2** (two) data elements in each signal element.

Data rate values of these four digital signals are **(D+1)** kbps, **(E+1)** kbps, **(F+1)** kbps, and **(G+1)** kbps, respectively. These four digital signals need to be transmitted together (multiplexing) over a communication link of **350** kHz bandwidth ranging from **250** kHz to **600** kHz using frequency division multiplexing (**FDM**).

To do that you must convert the digital signals into analog signals using frequency shift keying (**FSK**), first. For **FSK**, use **d = 1**, and **(H+2)** kHz guard bands. Assume, after applying **FSK**, **ds1**, **ds2**, **ds3** and **ds4** are converted into **ms1**, **ms2**, **ms3**, and **ms4**, respectively. So, **ms1**, **ms2**, **ms3**, and **ms4** are analog in nature.

Now you can combine the modulated signals (**ms1**, **ms2**, **ms3**, and **ms4**) using **FDM** into one composite signal **xt** (where, **xt = ms1+ms2+ms3+ms4**) and transmit it through the given communication link. For **FDM**, use **(H+7)** kHz guard bands. [Note: **ms1**, **ms2**, **ms3**, and **ms4** cannot overlap in frequency domain and their frequency range must be supported by the given communication link]

- a) What can be appropriate central (or nominal) carrier frequency values to convert **ds1**, **ds2**, **ds3**, and **ds4** into **ms1**, **ms2**, **ms3**, and **ms4** respectively using **FSK**? (2)

- b) What are the different carrier frequency values to convert **ds4** into **ms4** using **FSK**? (2)
- c) What are the bandwidth values of **ms1**, **ms2**, **ms3**, and **ms4** after **FSK**? (2)
- d) What is the required bandwidth to transmit **xt** over the given communication link using **FDM**? (1)
- e) In receiver side, how can **ms1**, **ms2**, **ms3**, and **ms4** be separated from the received composite signal **xt** (assuming received signal is same as transmitted signal)? Explain. (3)

**Tips:** This is a set of problems. You need to do all the conversions first and ensure that they are congruent with each other so that the combination of those four digital signals can be transmitted over the communication link successfully. Always take guard bands correctly into consideration in the calculation. Then you can start answering questions from (a) to (e). There can be multiple correct answers.