EN1052 Introduction to Telecommunications
Semester 2 (2019 Batch)
Final Assessment
July 16th, 2021
Time allowed: 90 Minutes

INSTRUCTIONS TO CANDIDATES

1. This assessment contains **3 question** on **4 pages**.
2. This assessment accounts for **60**% of the module assessment. The total maximum mark attainable is **100**. The marks assigned for each part thereof are indicated in square brackets.
3. Asnswer all questions.
4. If you have any doubt as to the interpretation of the wording of a question, make your own decision, and clearly state it.
5. The answer script should be uploaded to the class Moodle webpage via the provided forum on or **before 10.30 AM** (Sri Lanka time) on the **16th of July 2021**.

Question 1

Communication systems, in a broader sense, can be classified into two categories: analog and digital communication systems.

1. What are the main differences between the analog and the digital communication systems? **[10 marks]**

2. Consider the block diagram of a basic digital communication system depicted in Figure 1. Briefly explain the functionality of each block. **[20 marks]**

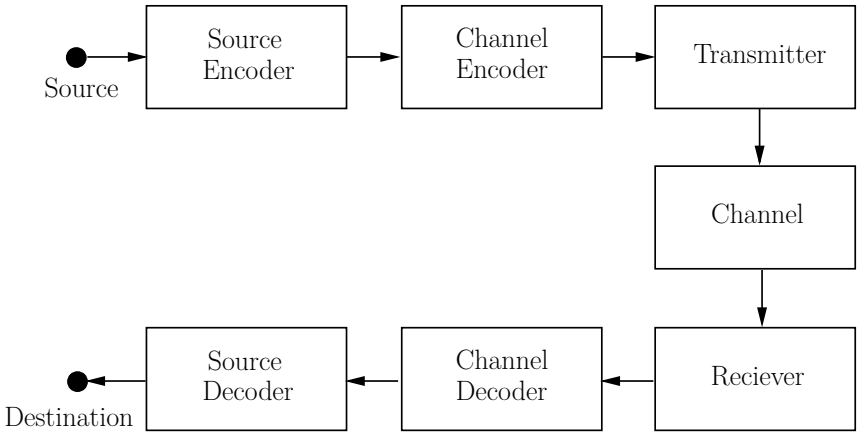


Figure 1: Basic digital communication system.

Question 2

Several signals can be combined to form one signal to be transmitted over a high-capacity medium. This process is known as multiplexing.

1. When the medium is time-shared by the signals, it is called TDM, time-division multiplexing. Explain two other multiplexing schemes. **[10 marks]**

2. Suppose four analog source signals $m_1(t)$, $m_2(t)$, $m_3(t)$, and $m_4(t)$ are to be multiplexed. The bandwidth of $m_1(t)$ is 3.6 kHz and that of other signals is 1.4 kHz each.

   (a) The signals are to be first sampled. Identify the Nyquist sampling rate of each signal. Explain why the signals should be sampled at rates no less than their respective Nyquist rates. **[10 marks]**

   (b) The samples of the signals are then to be time-multiplexed. Suggest a suitable scheme for this purpose. You are to identify the sample position along the time axis with clearly identified time epochs. **[20 marks]**

Question 3

An audio signal of bandwidth 4 kHz is sampled at a rate 25 % above the Nyquist rate and quantized. The quantization distortion is not to exceed 0.1% of the peak-to-peak voltage of the signal. The resulting quantized samples are now coded and transmitted by 4-ary pulses.

1. What is the minimum number of 4-ary pulses required to encode each sample?

   Hint: An M-ary pulse can represent $\log_2 M$ *bits, where* $M = 2^n$ *for some positive integer* n. **[20 marks]**

2. Suppose the required bandwidth to transmit an M-ary pulse used above is inversely proportional to the width of the pulse. If 16-ary pulses are used instead of 4-ary pulses, determine the bandwidth reduction factor. **[10 marks]**