Data Communication and Net-Centric Computing

Study Period 3, 2021

Assignment 1

Due: end of Week 5, 11:59 pm on Sunday 3rd Oct, 2021

Total: 100 marks

Q1

Discuss the differences between a modem and a router **(6 marks)** and how they enable Wi-Fi Internet in a household **(8 marks)**. Include a detailed diagram to show a Wi-Fi network in a household having both a modem and a router with clear annotations about the types of signals (analog, digital) coming into and out of each device to illustrate your answer. **(10 marks)**
To draw diagrams, please use softwares such as LucidChart. However, hand drawn or scanned diagrams are also accepted but they must be clear. Marks will be deducted for poor presentation.

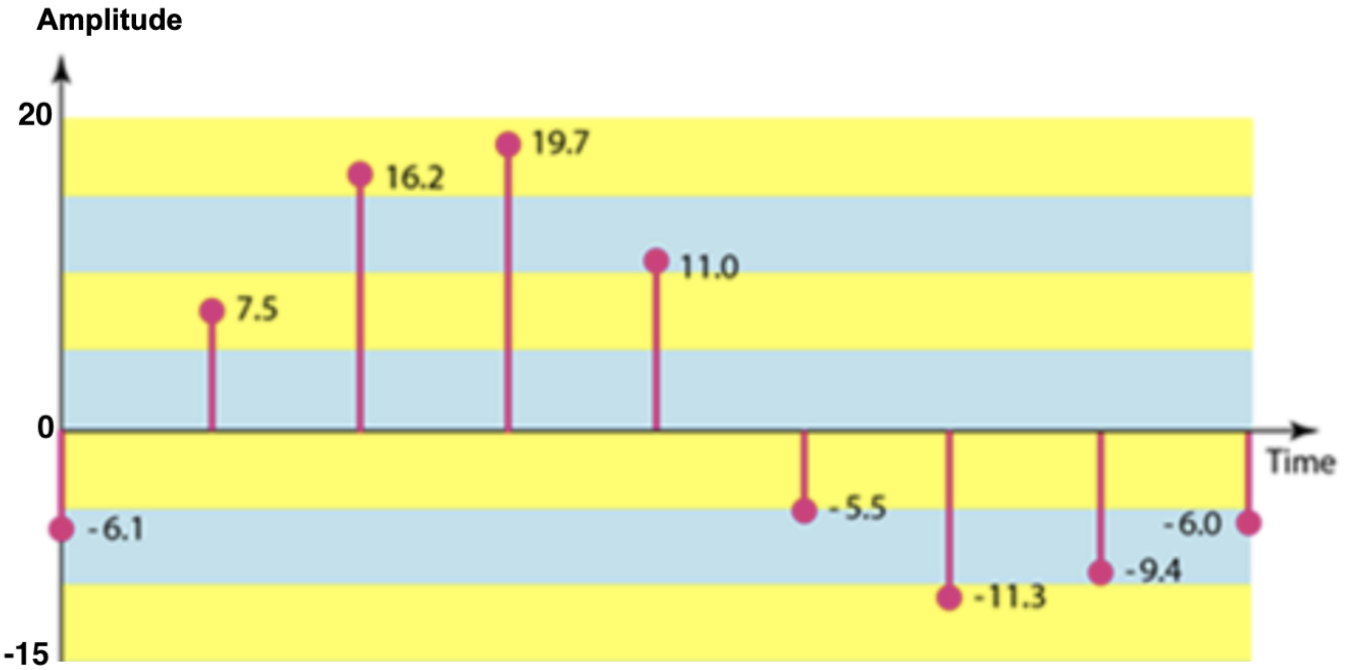
Q2

a) Refer to: https://www.youtube.com/watch?v=uakGke5TN9Q
Discuss the differences between the neighboring channels shown in the video and how the channels are related. **(4 marks)**

b) A baseband signal with a bandwidth of 17.5 kHz is sampled 38,000 times each second. Is the sampling rate sufficient to reproduce the original signal? If each sample is represented using 64 bits, what is the data rate of the system in bits per second (bps)? Show your working.
(4 marks)

Q3

Sampling the amplitudes of an analog signal is shown in the following figure:



a) If the scale-up rule applies, give the output of PCM using 5 bits for all the points shown in the diagram, Show the values as decimal numbers and convert those values to 5-bit binary numbers. Explain all details in your answers. Assume that all samples have values in the range from -15 to 20.
(10 marks)

b) What is the error incurred during the PCM process and how can the error be reduced? Use your answer in 3a above as examples to demonstrate the error.
(8 marks)

c) Discuss whether increasing bit depth to 7 bits would reduce the error incurred during the PCM process. Give at least 4 examples using the samples shown in the diagram above to demonstrate your answer. Assume that all samples have values in the range from -15 to 20.
(10 marks)

d) Discuss how the quality of Analog/Digital (A/D) conversion can be guaranteed. What is the cost of guaranteeing high quality A/D conversion?
(8 marks)

Q4

Draw diagrams of the encoding of the data stream **1011000101** using the following encoding schemes:
a) Bipolar-AMI **(4 marks)**
b) Manchester **(4 marks)**
You should use either Excel or Word (or other softwares) to draw diagrams. Hand drawn or scanned diagrams are also accepted but they must be clear. Marks will be deducted for poor presentation.

Q5

Given the data bit sequence `100111011` and the divisor bit pattern `P = 11001`

a) Calculate the CRC check bits using the base 2 method. What is the codeword? Show all calculation steps.
(6 marks)

b) Assume that the receiver receives the codeword: `1011110101101`
Apply CRC base 2 method on the receiver side to determine if any error exists. Show all calculation steps.
(6 marks)

c) Assume that the receiver receives the codeword: `1001010110101`
Apply the CRC shifted polynomial method on the receiver side to determine if error exists. Show all calculation steps.
(12 marks)

THE END