

Assignment 4

ECE1150 - Introduction to Computer Networks

University of Pittsburgh

(40 points)

Show all steps in answering the following questions. Make sure to put units of measurements (if applicable) in your answers.

1. (27 points) A signal $S(t) = 2\cos(48\pi t)$ is sent using a digital communication system.
 - (a) (5 points) The signal is first sampled. What is the minimum sampling rate required to avoid aliasing?
 - (b) (4 points) If the signal is then quantized from -2 to 2 using uniform quantizer of 8 quantization levels. Find the quantization levels.
 - (c) (2 points) Using the quantizer in (b), what is the maximum quantization error for any given sample?
 - (d) (6 points) With the same quantizer, how many bits are needed to represent each quantization level? Clearly write one possible way to encode all quantization levels. (i.e., assign each level to a code)
 - (e) (5 points) A sample from (a) is equal to 1.1. Based on your answers above, what is the code that represent this sample.
 - (f) (5 points) Assume Manchester encoding, roughly sketch the output signal corresponding to the sample in (e).
2. (13 points) Assume modulated symbols transmitted over a communication channel. A communication link supports a maximum rate of 5 Gsymbols/sec. Assume that 8 channels (channel 1 to channel 8) are multiplexed over that link using TDM.
 - (a) (5 points) What is the maximum symbol rate of channel 1 (average over time)?
 - (b) (4 points) If channel 1 uses QPSK modulation, what is the bit rate sent over that channel?
 - (c) (4 points) If channel 2 uses 64-QAM. What is the bit rate over that channel? In the same way,