

Cpr E 489 Spring 2020

Homework #1

Due Date: 1/30/2020 (Thu) by 11:00 AM

Type your answers and submit on Canvas

1. (60 points)

- a. A 22 KHz baseband channel is used by a digital transmission system. Suppose ideal pulses are sent at the Nyquist rate, and the pulses can take 1024 levels. There is no noise in the system. What is the bit rate of this system? Justify your answer.
- b. Suppose that multi-level square pulses are used in a digital transmission system, and the maximum pulse amplitude is  $\pm 1.1V$ . Suppose that the amplitude of the additive noise is uniformly distributed between  $(-0.1V, +0.2V)$ . What is the maximum number of levels of pulses this transmission system can use before the noise may start introducing errors? Justify your answer.
- c. Consider a noisy AWGN (Additive White Gaussian Noise) communication channel with a bandwidth of 12 KHz. Is it possible to transmit reliably over this channel at a bit rate of 150 Kbps with an SNR (Signal to Noise Ratio) of 35 dB? Justify your answer.

2. (40 points)

For bit stream 00000011, sketch the waveforms for B6ZS (Bipolar with 6 Zeros Substitution), NRZ-Inverted, 1B2B, and 2B1Q line coding schemes that we learned in the class. (Assume that the waveform in the bit interval prior to 00000011 ends at a positive voltage level.)