2020 EBU5302 Week Three Problems

1. A multilevel digital communication system is to operate at a data rate of 1500kb/s. If a 4-bit words are encoded into each level for transmission over the channel. What is the minimum required bandwidth for each channel?

2. A multilevel digital communication system sends of 16 possible levels over the channel every 0.8ms?
   1) what is the number of bits corresponding to each level?
   2) What is the baud rate?
   3) What is the bit rare?

3. A binary waveform of 9600 bits/s is converted into an 8-level waveform that is passing through a channel with a raised cosine roll-off Nyquist filter. The channel has a conditional (equalised) phase response out to 2.4KHz:
   1) What is the baud rate?
   2) What is the roll-off factor (without introducing ISI.)?

4. An analog signal is to be converted into a PCM signal that is a binary polar NRZ line code. The signal is transmitted over a channel that is absolutely band limited to 4kHz. Assume that the PCM quantizer has 16 steps, and the overall equivalent system transfer function is of the raised cosine roll-off type with r=0.5. (Note: the binary signalling is used)
   1) Find the maximum PCM bit rate that can be supported by this system without introducing ISI.
   2) Find the bandwidth that can be permitted for the analog signal.

5. Consider a random data pattern consisting of binary 1's and 0's where the probability of obtaining either a binary 1 or binary 0 is 50%. Calculate the PSD for the unipolar NRZ signalling as a function of T_b (the time needed to send 1 bit of data).