Assignment 3

Due Wednesday, April 4. Submit your assignment using the appropriate dropbox on the course web site. Assignments submitted after the solutions are made available will be given a mark of zero. Show your work.

Question 1

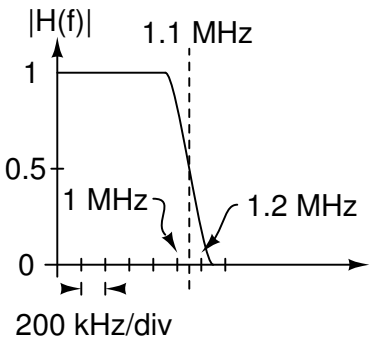
An optical communication system transmits data at a rate of 1 Mb/s using two different wavelengths of light. In heavy rain the receiver sometimes mistakes one wavelength for the other. This happens about once every hundred bits.

This error rate is too high for the system to be useful so you would like to add FEC to correct almost all errors. What is the best throughput you could expect after adding FEC? Give your answer in Mb/s.

Hint: Assume the channel is a BSC.

Question 2

(a) What is the excess bandwidth parameter (α) for a channel with the following frequency response:



(b) What symbol rate can be transmitted over this channel without ISI?

Question 3

The rules used by PPP for framing are actually a bit more complex than was explained in class. In particular, the character following the PPP escape character is XOR'ed with 0x20. This is described in RFC 1662:

https://tools.ietf.org/html/rfc1662#page-8

Using these rules, what sequence of characters would be transmitted using PPP encapsulation of the sequence of bytes:

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0x00, 0x27, 0x7e, 0x7e, 0x7d, 0x11
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Question 4

(a) How many errors can be corrected by a (7,4) block code with minimum distance of 3?

(b) A channel introduces errors randomly. The probability of a bit being received in error is $p = 10^{-3}$. What is the probability of receiving one of these 7-bit codewords that contains exactly one error?

Hints: There are 7 ways that exactly one bit could be in error. To find the probability of each of these words, use the fact that the probability of a bit being in error is p and the probability of a bit being correct is $1 - p$.

For example, the probability that only the first bit is in error and the other 6 are correct is $p(1-p)^6$.