Exercise Lesson 4

Problems from the compendium:

2.21a,b, 2.22, 2.23, 2.25, 2.29

Other problems:

4.1 Determine for each of the statements below if it is true or false.

(a) Consider an M-ary QAM system with pulse $g(t) = g_{rc}(t)$ of duration $T_s/4$.

"If the bit rate is 300 kbps and $M = 64$ then the width of the mainlobe is 800 kHz."

(b) Consider a conventional M-ary QAM system with a time raised cosine pulse of duration $T = 0.25\,\mu s$ and a symbol rate $T_s = T$.

"If the value of M is increased from $M = 16$ to $M = 64$, then both the bandwidth efficiency and the information bit rate are increased by a factor 1.5 ."

4.2 You want to design a communication system based on QPSK modulation, operating at some carrier frequency f_c with a very small bandwidth of $W = 100$ kHz (W is measured as the width of the mainlobe).

(a) At first, you choose a rectangular pulse. To be safe against multipath propagation, you make the pulse shorter than the total symbol duration, in particular, $T = T_s/2$. What is the bitrate that can be achieved?

(b) Then you find out that there is another system in the frequency band right next to your system. The carrier frequency of that system is equal to $f_c + 150$ kHz and its bandwidth is 100 kHz. The regulation agency requires that, within the frequency band of the other system, the power spectral density $R(f)$ of your signal has to be at least 45 dB below the peak of its main-lobe.

Does your system satisfy this requirement?

(c) Instead of a rectangular pulse you are allowed to use a triangular, half-cycle sinusoidal or time raised cosine pulse. Determine which of these pulse shapes would satisfy the requirement from (b). What bitrates can be achieved in these cases?