Exercise 4

Task 1. A wireless channel has the following power-delay profile:

Power [dB]	-3	0	-2	-6	-8	-10
Delay [μs]	0	0.2	0.5	1.6	2.3	5

a) Determine the root-mean-square delay spread and estimate the coherence bandwidth of this channel.

b) If a mobile user of this channel travels at a speed of 50 km/h, determine the channel Doppler spread and coherence time, assuming a carrier of 2.1 GHz.

Task 2. Radio system specifications usually define that a receiver should be able to handle a certain amount of Doppler spread in the received signal. Consider a mobile communication system which is operating at frequencies of both 900 MHz and 1800 MHz. Assuming that only the user terminal is mobile:

a) What is the maximum Doppler spread the system must handle, if it should be capable of communicating when the mobile is moving at 200 km/h?

b) If the system is able to operate using the 900 MHz band when the mobile moves at 200 km/h, what is the maximum speed supported in the other band 1800 MHz, assuming the same Doppler spread?

Task 3. A digital transmission system uses quadrature amplitude modulation with 16 different symbols (16-QAM) and Gray coding. All possible complex symbol I_n have the same probability P = 1/16.

a) Draw the constellation diagram and label the symbols with their corresponding binary data.

b) Calculate the average power of the transmitted signal.

c) Calculate the minimum Euclidean distance between symbols that differ by one bit, two bits, three bits, or four bits respectively.