Task 1

1. The baud rate of the system is 25 Mbaud. Calculate capacity, if the 32-QAM modulation is used!

2. The user has bought two radios, in which modulation can be switched between 16-QAM, 32-QAM, 64-QAM, 128-QAM. By what percentage will the capacity change, if the user will switch the modulation from 16-QAM to 32-QAM? By what percentage will the capacity change, if the user will switch the modulation from 64-QAM to 128-QAM?

3. The bandwidth of the signal is 25 MHz. The level of the signal at the receiver is 50mW. The average power of the noise 5mW. Calculate the capacity using the Shannon-Hartley theorem:

$$C = B \log_2 \left(1 + \frac{S}{N}\right)!$$

4. The bandwidth of the signal is 25 MHz. The level of the signal at the receiver is -50dBm. The average power of the noise -70dBm. Calculate the capacity using the Shannon-Hartley theorem!

5. The bandwidth of the signal is 25 MHz. The level of the signal at the receiver is -50dBm. The average power of the noise -70dBm. Calculate the capacity using the Shannon-Hartley theorem if the system uses MIMO 2×2!

6. A square pulse with amplitude S_m and duration Δt is applied to the integrating resistor R and capacitor C circuit.

   - Express the frequency response of the circuit;
   - Write spectral density of the output signal of the circuit.

   Note! The Fourier transform of such square pulse is:

$$S(\omega) = S_m \Delta t \operatorname{sinc} \frac{\omega \Delta t}{2}.$$

7. We are intending to save the human voice to the file. Prior to this, it should be discretized and quantized. Assume that the highest spectrum component that we need has a frequency of 2 kHz. Each sample has 256 quantization levels. The length of the record is 10 seconds. Calculate the size of the file!