S-72.3281 Advanced Transmission Methods P
EXAM 10.12.2013, 16:00-19:00
OPEN BOOK

1. The multipath intensity profile of a radio channel is given by the following table:

Delay (μs)	Fractional power
0	0.8
4	0.2

The power spectral density of channel noise is $N_0 = -20 dBm / Hz$.

Consider passing through this channel 2 radio signals: the first signal has the bandwidth 10 kHZ, and the second radio signal is characterized by the 20-MHz bandwidth.

(a) What is the frequency response of the ZF (zero forcing) equalizer in each case?
(b) What is the frequency response of the MMSE (minimum mean-square error) equalizer in each case?
(c) Let the 20-MHZ signal is transmitted over the channel. Write formulas for the evaluation of noise power in the bandwidth of the transmitted signal:

- without equalization?
- with the equalizer (a)?
- with the equalizer (b)?

Please explain your answer.

2. Let the truncated channel inversion method be applied in Rayleigh fading channel with the average SNR= 30 dB.

(a) What is the received SNR corresponding to the outage probability of 0.1?

(b) What is the maximum size of the M-QAM constellation that can be transmitted under this policy if the bit-error probability in non-outage $P_b \approx 10^{-3}$.

3. Consider an AWGN channel with bandwidth 30 MHz, received power 10 dBm, and noise PSD N_0 = -2 × 60dBm/Hz. How does the capacity change if the received power is doubled? How does the capacity change if the channel bandwidth is 10MHz?

4. Consider the OFDM signal specified by IEEE 802.11 a: the symbol time is $T_s = 4\mu s$; the number of active (carrying out information) subcarriers is $N = 48$.

Write formulas for the optimal subcarrier resource allocation providing minimizing the BER under constraints on the data rate and transmit power.

Propose at least one sub-optimal solution to the problem (write a formula for the resource allocation) for the case where:

1) the target data rate is 24Mb/s;
2) the target data rate is 48Mb/s.