Eeva Nyberg
eeva@keskus.hut.fi

Those exercises marked as home exercises must be returned latest wed 4.10, 12 o'clock into the box in G-wing marked S-38.118
Exercises 1 - 3 are demonstrated (in Finnish) during exercise class by the assistant. Exercises 4 - 6 are home exercises. Each home exercise is worth 0-2/points. You may receive help in solving the home exercises during exercise class after the assistant has explained exercises 1 - 3.

1. Exercise to be presented by the assistant

   a) How many dBm is 2 mW?

   b) How many W is -5 dB?

   c) If the incoming signal P_{in} is 100 mW and the outgoing signal P_{out} is 1 W, what is the dB difference of the two signals?

   d) In a 40 km long cable there is an 15 dB amplifier halfway. The attenuation of the cable is 0.5 dB/km. If the outgoing signal is 125 mW, what is the power of the incoming signal?

   e) The signal-to-noise ratio is also measured in decibels. If $S/N = 60$ dB, and the power of the signal is 15 W, what is the power of the noise?

2. Exercise to be presented by the assistant

   a) What is the capcity of a channel used for transmitting speach, if the bandwidth is 3400 Hz and the signal-to-noise ratio (S/N) is 30 dB?

   b) What is the maximum signal-to-noise ratio of a phone connection in order for a 28,8 kbit/s -modem to be used at maximum capacity?

3. Exercise to be presented by the assistant (an old exam question)

   Kalle is working as a summer trainee at X-laboratories. There he finds two devices, with the label 'Constant Power Reference Supply'. In the other device he finds an additional label with +3dBm and in the other -3dBm. Kalle connects these two devices together and in series with a power-meter. What reading does the meter give (in W)? Assume that there are no phase differences.

4. Home exercise (max 2 points)

   a) A 150 mW signal is fed into a 75 km cable. The outgoing signal is 105 mW. Calculate the attenuation of the cable dB/km.

b) Using the same cable as in a), an outgoing signal of 140 mW should be measured when the incoming signal is 150 mW. How many 0.32 dB amplifiers are needed if the attenuation of the cable is equal to the attenuation of part a)?

5. and 6. Home exercise (max 4 points)

a) In the text book "Understanding Telecommunications 1" the following sentence appears on page 196:

"When the attenuation on the line makes it necessary to use amplifiers, the signal-to-noise-ratio (S/N) will decrease, because the incoming noise is amplified just as much as the signal." What is meant by the sentence? Is the reason given for the S/N decrease correct? Hint 1 : How is the noise generated? Hint 2: Look at question b).

b)

i. If a signal has a S/N equal to 30 dB on a cable with no attenuation, what is the signal-to-noise-ratio after a 25 dB amplification?

ii. If the incoming signal is 100 mW and the noise generated by the cable is always 10mW, what is the S/N? What if a 50 km cable has an attenuation of 0.5 dB/km, what is the S/N of the outgoing signal then? a) without amplification and b) with a 20 dB amplification? Assume, that the noise generated by the cable is constant and the amplifier is at the end of the cable.