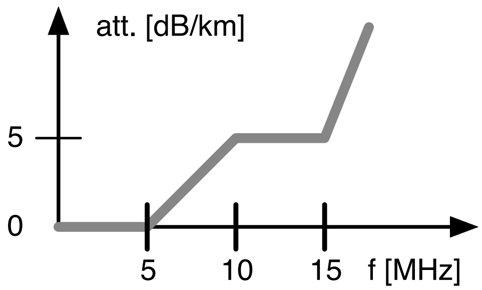
Due Tue., Nov. 11, 2014 in class by the end of class.

Only hand in the following problems: 4, 5, 9, 12, 15

1. Problem 3.44 from the Leon-Garcia/Widjaja textbook.
2. Consider the attenuation ($|A_c|^2_{dB}$) vs. frequency sketch below of some wired media. Sketch its transfer function $A(f) = |H_c|^2_{dB}$ for a channel 500-m long.



3. For the problem above. Sketch the transfer function of the equalizer needed if we want to send a signal through this channel at a rate of 30-Mbps without any distortion over 1-km.
4. Problem 3.45 from the Leon-Garcia/Widjaja textbook. Just do the problem for 1200 nm to 1400 nm. For practice in the case of 1400 to 1600 nm the answer is approximately 3 kHz per person.
5. Problem 3.50 from the Leon-Garcia/Widjaja textbook. Just do it for 0.2 nm. For 0.8 nm bit-rates up to 66 Gbps can be carried on the wavelengths (assuming that you don't have a quadrature modulation scheme and hence can only send 1 single-level pulse per Hz of bandwidth) without interfering with another wavelength.
6. Problem 3.55 from the Leon-Garcia/Widjaja textbook.
7. Problem 3.1 from the Leon-Garcia/Widjaja textbook. Just do a) and c) (for the 32-kbps modem). We don't talk about compression in detail in class (this is the "source coding/decoding" part of the digital communicator), but the general idea is extremely straightforward: Reduce the number of bits you need to send by some factor without losing any actual information (or at least without noticeably losing it) contained in the original data you wished to send. Use a compression ratio of 1:6. To test that you are doing it right the answer to b) [which requires the same approach as a)] is 8.38 seconds uncompressed and 1.4 seconds compressed.
8. Problem 3.3 from the Leon-Garcia/Widjaja textbook. Just do it for 65,536 colours. Again another thing that I expect you should be able to read-up on on your own . Calculate the number of pixels on the screen. Find out how many bits are needed to represent 65,536 different things. Multiply the two.
9. Problem 3.5 from the Leon-Garcia/Widjaja textbook. Remember in the context of voice PCM (pulse code modulations) refers to a signal sampled 8000 times per second with each sample quantized to 8 bits.
10. Problem 3.10 from the Leon-Garcia/Widjaja textbook. Just do a).
11. Problem 3.11 from the Leon-Garcia/Widjaja textbook. Expand your SNR dB expression such that the effect of n stands separate from the SNR at the input to the repeater chain. The following relations should be useful in that pursuit:

$$\begin{aligned} \log(a \cdot b) &= \log a + \log b \\ \log\left(\frac{a}{b}\right) &= \log a - \log b \end{aligned}$$

12. Problem 3.12 from the Leon-Garcia/Widjaja textbook. Just part a). You have already seen this type of question before, but in a different context, when we have been talking about BER of frames/packets through networks with errors.

13. Problem 3.13 from the Leon-Garcia/Widjaja textbook. Just the case where the signal is 10^k the noise power.

14. Problem 3.18 from the Leon-Garcia/Widjaja textbook. Just part a). If at any time you calculate that you can only send some fraction of a bit per sample, assume for simplicity that you can round the result up. Here's the solution to c) to give you some idea.

    Assuming that your A/D (i.e. the analog-to-digital converter, also referred to as A-to-D and ADC) is set such that the maximum voltage it can handle V_{max} is 4 times the average spread of the signal, σ_x (i.e. $V_{max}/\sigma_x = 4$) then the SNR of the digitized signal is (Eq. (3.11) on pg. 122 of the 2nd ed. textbook)

    $$\text{SNR [dB]} = 6m - 7.2$$

    where m is the number of bits per sample. If you want an SNR of 40-dB you need $6m = 47.2$ you need $m = 8$ bits per sample. To send 8-bits per sample at 16,000 samples per second (remember the Nyquist sampling theorem) requires 128 kbps for your modem speed.

15. Problem 3.19 from the Leon-Garcia/Widjaja textbook. Without any other info just assume $V_{max}/\sigma_x = 4$ (The maximum range of input voltages that our quantizer can handle is $\pm V_{max}$). Make sure to show your work.

16. Problem 3.21 from the Leon-Garcia/Widjaja textbook. Just part a). Note, a signal distributed uniformly between $-V$ and V has an average power of

    $$\sigma_x^2 = \frac{1}{2V}\int_{-V}^{V} x^2 dx.$$

    This is the relationship that an A/D designed for such a source is going to impose between σ_x and V. Hopefully you will find this helpful to solve the problem.

17. Problem 3.27 from the Leon-Garcia/Widjaja textbook.

18. Problem 3.28 from the Leon-Garcia/Widjaja textbook.

19. Problem 3.30 from the Leon-Garcia/Widjaja textbook.

20. Problem 3.36 from the Leon-Garcia/Widjaja textbook. Just do a.) and b.) for an 8-point constellation.

21. Problem 3.37 from the Leon-Garcia/Widjaja textbook.

22. Problem 3.38 from the Leon-Garcia/Widjaja textbook. Just do a.)

23. Problem 3.42 from the Leon-Garcia/Widjaja textbook.

24. Problem 3.59 from the Leon-Garcia/Widjaja textbook.