

## Assignment 2

Due Friday, October 11. Show your work. Hand in your assignment at the lecture or during office hours. Assignments submitted after the solutions are made available will be given a mark of zero.

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### Question 1

A twisted pair cable with one pair has been run between two buildings. The noise voltage between the two pairs is measured to be 20 mVrms. The noise voltage between one pair and ground is 100 mVrms.

You have a choice of using common-mode signalling using one wire or differential signaling using the pair. Assuming that the load impedance and cable loss is the same in both cases and that both approaches are required to achieve the same SNR, which transmission scheme requires the least transmit power? What is the ratio of the powers required (in dB)?

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### Question 2

You are considering using house wiring to distribute data throughout your house. Your house wiring uses 14-gauge conductors. Using calipers you measure the diameter of each insulated wire to be 3.5 mm and you believe the insulation is made of polyethylene. What value do you expect for the characteristic impedance of the house wiring?

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### Question 3

High-power transmitters sometimes use co-ax cables filled with dry nitrogen. What phase difference would you expect between the two ends of one of these cables if the cable is 200m long and the frequency is 600 kHz?

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### Question 4

A fiber-optic cable is specified as “9/125”. What might the two numbers mean? Would this be single-mode or multi-mode cable?

Assuming the fibers were packed tightly against one another, approximately how many 125  $\mu\text{m}$  optical fibers could fit in the space taken up by one 14-gauge wire? *Hint: use the ratio of the cross-sectional areas to get an approximate answer.*

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### Question 5

Omnidirectional antennas do not concentrate power in any particular direction and thus have a gain of 1 (0 dB).

Consider an air traffic control radio system with the transmitter at the airport and the receiver on an aircraft. Both use omnidirectional antennas. Assuming a transmit power of 100 W and a frequency of 115 MHz, how much power would be received by the aircraft if it was at an altitude of 10 km and a distance (along the ground) of 50 km from the airport? Give your answer in dBm. *Hint: assume the earth is flat.*