

## Exercises for Experimental Physics 3 – IPSP

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### Exercise Sheet 5 (WS 2010/11)

Date of Issue to Students: Nov. 11<sup>th</sup> 2010

**Date of Submission: Nov. 18<sup>th</sup> 2010**

**Submission Place:** Marked mailbox next to room 302 (Linnestr. 5)

**Submission Time:** 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper. Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

#### Exercises:

1. Suppose a radiating electric dipole lies along the  $z$  axis. Let  $I_1$  be the intensity of the radiation at a distance of 10 m and at angle of  $90^\circ$ . Find the intensity (in terms of  $I_1$ ) at (a) a distance of 30 m and an angle of  $90^\circ$ , (b) a distance of 10 m and an angle of  $45^\circ$ . (5 Points)
2. You and your engineering crew are in charge of setting up a wireless telephone network for a village in a mountainous region. The transmitting antenna of one station is an electric dipole antenna located atop a mountain 2.00 km above sea level. There is a nearby mountain that is 4.00 km from the antenna and is also 2.00 km above sea level. At that location, one member of the crew measures the intensity of the signal to be  $4.00 \cdot 10^{-12} \frac{W}{m^2}$ . What should be the intensity of the signal at the village that is located at sea level and 1.50 km from the transmitter? (5 Points)
3. A laser pulse has an energy of 20.0 J and a beam radius of 2.00 mm. The pulse duration is 10.0 ns and the energy density is uniformly distributed within the pulse. (a) What is the spatial length of the pulse? (b) What is the energy density within the pulse? (c) Find the rms values of the electric and magnetic fields in the pulse. (5 Points)
4. Regulations require that licensed radio stations have limits on their broadcast power so as to avoid interference with signals from distant stations. You are in charge of checking compliance with the law. At a distance of 30.0 km from a radio station that broadcasts from a single vertical electric dipole antenna at a frequency of 800 kHz, the intensity of the electromagnetic wave is  $2.00 \cdot 10^{-13} \frac{W}{m^2}$ . What is the total power radiated by the station?