Homework #6
OPTI 370
2/25/2015
(due date: 3/4/2015)

Problem 1:

Consider a Gaussian beam with a Rayleigh range of $z_0 = 5\text{cm}$ and beam waist located at $z = 0$. Using the formula for $R(z)$ given in class, determine the radius of curvature at positions $z = -10, -5, -0.1, 0, 0.1, 5, 10$ (units of cm). Plot $R(z)$ as function of z.

Now assume you have two mirrors with which you want to make a resonator with two concave mirrors (i.e. the same geometry as was discussed in class) that supports that Gaussian beam. Using the notation discussed in class, the two concave mirrors have negative curvatures, assumed here to be $R_1 = -10$ and $R_2 = -50/4$. At which z positions do you have to place the two mirrors? What is the mirror spacing d? You should do this simply by inspection, without any calculation.

Make a rough plot of the wave fronts in your resonator that clearly shows the curvature at the mirrors and at $z = 0$.

(10 points)

Problem 2:

Solve Exercise 3.1-1 (a) and (b) on p. 84 of the book.

(10 points)

Problem 3:

Assume you filter a part of the infrared spectrum (900-1400 nm) out of sunlight. Determine the coherence time and coherence length of the filtered light.

(10 points)

Problem 4:

Consider, as an idealized model for a very good laser, a monochromatic oscillation $U(t) = a\, e^{j2\pi\nu t}$ with a=8 (units of $W^{1/2}$/cm) and $\nu = 660 THz$. Using the definition of the degree of coherence via the time average, determine the coherence time and coherence length. Sketch the degree of coherence vs. τ.

(10 points)