Homework #5 (due Sept. 30)

Each problem is 10 points

Problem A1: The polishing quality of optical surfaces is often characterized in fraction of a wavelength; for example, a $\lambda/8$ irregularity means that a manufacturer would guarantee that the deviation between the actual shape and its intended shape of an optical surface is less than $\lambda/8$. If the frequency of a laser used for the tests is $7\cdot10^{15}$ *Hz*, what is the average surface irregularity in *nm*? What color radiation is that?

Problem A2: What should be the phase difference between two identical light sources so that the total intensity is equal to the intensity of an individual source?

Problem A3: A light wave of wavelength 500nm falls perpendicularly on the screen with two very closely positioned holes. A thin piece of glass is placed behind one of them, so that one of the output beams travels through it, and the other travels only through the air. What is the minimum thickness of the glass required for the beams to interfere destructively? Calculate two more possible thicknesses that also result in the destructive interference. Take the refractive indices of air and glass to be 1.0 and 1.5 respectively, and neglect the spacing between the holes (i.e. assume that the two interfering beams propagate along the same direction).

Problem A4: In Young's experiment the slit spacing is 0.02mm and monochromatic light of wavelength 633nm is used. What is the fringe spacing if the image focusing lens has focal length 1.5m.

Bonus problem. In class we considered interference of two waves of equal amplitude. We show that, depending on their relative phase, the total intensity changes from zero to four times the intensity of an individual source.

Suppose now that we have two sources with different amplitudes:

$E=A\cos(kz-\omega t) + B\cos(kz-\omega t+\phi)$

Will we be able to observe any interference? If yes, what are the maximum and minimum values of total intensity?