Midterm 1 Concepts

Ray Optics: Postulates of Ray Optics, Fermat’s Principle, reflection, refraction, Snell’s Law, diverging, converging, and collimated light, and basic imaging, as well as the failure of Ray Optics.

Waves and Wave Optics: The wave equation, and wavefunctions. Transverse and longitudinal waves. How to describe a harmonic wave in terms of frequency, period, amplitude, phase, wavevector or wavenumber, wavelength, and wave velocity. The superposition principle, wave pulses, wave interference including double-slit interference and single slit diffraction, standing waves. Students should be familiar with the electromagnetic spectrum, and the difference between monochromatic and broadband light sources. Students should understand the significance of the Michelson-Morley experiment, the concept of the Aether, and Maxwell’s Equations. Students should understand that EM waves are self-propagating, and do not require a medium, but carry energy in their electric and magnetic fields.

Photon Optics: Students should understand the failure of EM/Wave optics and in what situations photon optics is required to describe the behavior of light. Students should understand the photoelectric effect, and the concept of a “quanta” of light and it’s relation to the frequency of light. Students should understand the significance of probability distributions, wave-particle duality, and the double-slit interference experiment at low (1 photon at a time) light levels.

Labs:

Students should be familiar with the material contained in the lab manuals for Spectroscopy, Holography, and Nanotechnology. Students should be able to explain basic concepts from the introduction portion of the lab manuals, as well as aspects of the actual experiments. They should be able to answer basic questions about the equipment used in the lab. They should be able to draw the experimental set ups from each lab, and explain the experiments performed and the results expected from each experiment, and what those results signify.