

Phys 411/611 - Optics for Scientists and Engineers - 3 credits

Bulletin Description:

Introduction to modern optics. Geometric optics, electromagnetic nature of light, polarization, interference, diffraction, fiber optics. Corequisite laboratory with major related optics project. Prereq: PHYS 252, Coreq: PHYS 411L. Cross-listed with ECE 411

Course Objectives:

To provide students with the fundamentals necessary to enable them to successfully apply optics in their respective disciplines through hands-on use of state-of-the-art equipment in the co-requisite laboratory course in conjunction with classroom discussions to experience and understand the most important concepts and phenomena of optics. To develop skills to solve technical problems, to present technical results, and to do technical writing.

Content Listing:

Part 1: First 12 Weeks

- Properties of waves: harmonic waves, phase and phase velocity, complex representation, 3-D differential wave equation.
- EM nature of light: electromagnetic waves, Poynting vector, irradiance, radiation pressure.
- Reflection and refraction: Fermat's principle, Fresnel equations, Brewster's angle, total internal reflection, phase change on reflection, evanescent wave.
- Dispersion: Dispersion in dielectric media, dispersion in conducting media.
- Geometric optics: Refraction at spherical surfaces, thin-lens equations, thin lens combinations, aperture and field stops, spherical mirrors.
- Polarization: Linear, circular and elliptical polarization, Malus's Law, scattering and polarization, polarization by reflection.
- Interference: Constructive and destructive interference, temporal and spatial coherence, Young's double slit experiment, amplitude splitting interferometers, multiple beam interference.
- Diffraction: Huygens-Fresnel principle, Fraunhofer diffraction, double slit, diffraction grating, Airy disk.

Part 2: Major related experiment

An experiment related to the student's academic major (engineering, chemistry, physics, etc.) using optics will be selected by groups of three to four students for the last four-week project. Students will present their results to the class during Dead Week and write a research paper on this experiment that is due in lieu of a final exam. Students will be graded in this course on their paper, their presentation and their explanation of the results and will receive a separate laboratory grade based on their experimental apparatus and approach.