Physical Optics 4048

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Motivation:

Light is the most significant interface between us and our surroundings. As such, it is used for probing vast range of systems at astronomical distances and down to the minute building blocks of life spanning all fields of science and engineering. Applied optics concerns the fundamental principles and consideration behind these abilities. The course is intended to teach these principles in context of physical optics and to show how they determine the performance of common optical instruments.

Syllabus:

Lecture	Subject	Details
1	Introduction	Historical survey of the development of the science of light.
2-4	Geometrical Optics	Rays, Fermat's principle, ray equation, imaging, and aberrations.
5	Non imaging systems	Etendue and brightness, concentration limit, Light trapping.
6	Waves	The wave equation, plain and spherical waves, dispersion, complex wavenumbers, phase and group velocities, waves in three dimensions, longitudinal vs. transverse waves.
7-9	Electromagnetics	Maxwell's Equations, electromagnetic waves, Poynting theorem, electromagnetic fields at boundaries and Fresnel's coefficients, Polarization, linear and angular momentum of light
10-11	Scalar diffraction theory	Fresnel and Fraunhofer diffraction, diffraction from periodic structures, imaging as a diffraction process.
12	Scattering theory	Scattering from small particles and Mie theory
13	TBA	

Requirements:

Basic knowledge in undergraduate level mathematics (calculus, differential-equations, and linear-algebra)

Evaluation:

Four assignments throughout the semester

Books:

S. G. Lipson, H. Lipson, and D. S. Tannhauser, *Optical Physics*, Cambridge University Press.
M. Born and E. Wolf, *Principles of Optics*, Cambridge University Press.
J. D. Jackson, *Classical Electrodynamics*, Library of Congress.

R. P. Feynman, R. B. Leighton, M. Sands, *The Feynman Lectures on Physics*, Caltech.
J. W. Goodman, *Introduction to Fourier Optics*, McGraw-Hill.
E. Collett, *Polarized Light*, Marcel Dekker.
L. Novotny, B. Hecht, *Principles of nano-optics*, Cambridge University Press.