

ECE404: Geometric and Physical Optics

(course outline)

Spring 2021

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Week 1: History of optics; Waves and rays; Optical path; Snell's law

Week 2: Paraxial approximation; Ray vector; Optical component matrices; Thin lens equation; Lens maker's formula; Resonator stability

Week 3: Graphical ray tracing, image formation, and magnification in an optical system

Week 4: Optical Instruments I -- Camera (Pinhole imaging; Aperture effects; Depth of field; Perspective distortions; Resolution; Basic aberrations)

Week 5: Human eye as camera (retina, lens, acuity, laser damage); Optical Instruments II: Compound Microscope and Telescopes

Week 6: Review Maxwell's equations; Wave equation in vacuum; Monochromatic waves and scalar Helmholtz equation

Week 7: Interference; Optical Instruments III -- Interferometers (Mach-Zehnder; Michelson, Sagnac, and Fabry-Perot)

Week 8: Paraxial wave equation and Gaussian beams

Week 9: q-parameter of a Gaussian beam and ABCD matrices; Optical waves at a dielectric surface

Week 10: Fresnel relations; Brewster angle; Total internal reflection; Wave equation in a conducting medium

Week 11: Fourier optics (Fresnel and Fraunhofer approximation, diffraction grating, thin lens as a Fourier transform computer)

Week 12: Polarization (polarization ellipse, Jones vectors, and Jones matrices)