



Program of OPTICS

Prof. E. Fazio A.A. 2019-2020

Electromagnetic waves and light

Maxwell equations and EM waves. Types and spectrum of EM waves. Microscopical interpretation of the refractive index. Active and reactive terms and the complex refractive index. Sellmeyer equation for the refractive index dispersion. Abbe number and Abbe space for the glasses. Poynting vector and light energy. Lightning quantities. Fermat "minimal action" principle and Snell Law. Fresnel coefficients. Critical angle and total reflection regime. Evanescent waves and Goos-Hänchen phase shift.

Geometrical Optics

Short wavelength approximation. Reflection and mirrors. Refraction and dioptric surfaces. Thin lenses. Centred optical systems. Principal optical aberrations. Chromatic aberration and Achromatic doublet. Fundamental refractive systems and ray-tracing ABCD matrices. Thick lenses and principal planes.

Propagation, diffraction and interference

Interference of 2 wave co- and contra-propagating. Wave beating. Continuous waves and pulses. Phase and group velocities. Spatial and temporal interference. Young's experiment. Temporal or spatial interference. Fabry-Perot resonator. Plane wave development. Huygens-Fresnel principle and integral. Near field regime and Fresnel Integral. Far field and Fraunhofer integral. Diffraction from a slit. Diffraction from a stop. Diffraction from a grating. Harmonic and anharmonic gratings. Transmission through a phase mask. Transmission through a thin lens.

Anisotropic Media

Anisotropic crystals. Index Ellipsoid. Uniaxial and biaxial crystals. Dichroism. retardation plates.

Nonlinear Optics

Nonlinear response. Anharmonic oscillator. Second order effects. The nonlinear optical tensor. Optical harmonic generation. Parametric effects. Acousto-optic effect and optical modulators. The Pockels electro-optic effect. Electro-optic modulators. Photorefractivity and self-assembling optical structures. Spatial solitons and Kerr third order nonlinearity.

– e-mail: eugenio.fazio@uniroma1.it

– **Direct explanations:** for an explanation meeting on unclear points send an e-mail (write RICEVIMENTO in the object)

– **Information on the course:** <http://www.sbai.uniroma1.it/users/fazio-eugenio>

– **Books:**

F. Gori, *Elementi di Ottica*, ed. Accademica

P. Mazzoldi/M.Nigro/C. Voci, *Elementi di Fisica-Onde*, EdiSES

K.D. Moller, *Optics*, Springer

A. Yariv, *Quantum Electronics*, John Wiley & Sons

Wyszecki & Stiles, *Color Science*, Wiley Classics Library

H. Zappe, *Fundamentals of Micro-Optics*, Cambridge University Press

– **Thesis:** topics for stages are available on request. Please contact the professor for details.