



## Program of OPTICS

**Prof. E. Fazio A.A. 2017-2018**

### **Electromagnetic waves and light**

Maxwell equations and EM waves. Types and spectrum of EM waves. Poynting vector and light energy. Lightning quantities. Fermat "minimal action" principle and Snell Law. Fresnel coefficients. Absorbing, dispersive and emitting systems.

### **Geometric Optics**

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

### **Propagation, diffraction and interference**

Interference of 2 wave co- and contra-propagating. Wave beating. Continuous and pulses light beams. Phase and group velocities. Spatial and temporal interference. Young's experiment. Coherence. Temporal or spatial interference. Fabry-Perot resonator. Plane wave development. Evanescent waves. Huygens-Fresnel principle and Helmholtz-Kirchhoff formula. Near field and far field diffraction. Image resolution).

### **Guided optics**

Guided waves through total reflection, planar guides, propagation modes and phase conditions, TE modes (pol-s) and TM modes (pol-p), optical fibers, numerical aperture, chromatic dispersion and modal dispersion of fibers and their practical applications.

### **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](mailto: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/node/5747/edit>

– **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.