DIPARTIMENTO DI SCIENZE DI BASE
E APPLICATE PER L' INGEGNERIA

SAPIENZA
UNIVERSITÀ DI ROMA

ACADEMIC YEAR 2020-2021

Program of *OPTICS*

Prof. Eugenio FAZIO

Electromagnetic waves and light

Maxwell equations and EM wave equation. Spherical and plane waves. Frequencies and wavelengths 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.

Reflection and refraction

Fermat "minimal action" principle and Snell Law. Fresnel coefficients. Critical angle and total reflection regime. Evanescent waves and Goos-Hänchen phase shift. Geometrical interpretation of optical fibres and waveguides.

Geometrical Optics

Short wavelength approximation. Reflection and mirrors. Refraction and dioptric surfaces. Thin lenses. Thick lenses and principal planes. Centred optical systems. Pupils/stops/f-number/numerical aperture. Vignetting and *cosine-to-the-fourth-power* law. Principal optical aberrations. Chromatic aberration and Achromatic doublet. Fundamental refractive systems. Ray-tracing and ABCD matrices.

Interference and interferometers

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. Fabry-Perot resonator. Optical fibres as transverse resonators. Multilayer interferent systems. Design of mirrors, band-pass filters. Michelson and MachZehnder interferometers.

Diffraction

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. Nano-optics.

Anisotropic optics

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. The Pockels electro-optic effect. Electro-optic modulators. Photorefractivity and self-assembling optical structures. Spatial solitons. Smart systems, Machine Learning and Photonic Artificial Intelligence.

GENERAL INFORMATION

- **e-mail**: eugenio.fazio@uniroma1.it
- **Reception for 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 and on GOOGLE CLASSROOM: course code **mvso625** (register with the institutional e-mail address: surmane.matricola@studenti.uniroma1.it)

– **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

CLASS SCHEDULE	
WEDNESDAY	**TIME 15:00 - 17:00**
THURSDAY	**TIME 10:00 - 13:00**
FACE-TO-FACE	face-to-face lectures and exercises will take place in classroom 17 – San Pietro in Vincoli
ONLINE	To follow lectures and tutorials online, use the zoom link of room 17 – San Pietro in Vincoli https://uniroma1.zoom.us/j/2956082429 which can also be found on the main page of the ICI Faculty: https://www.ing.uniroma1.it/node/8977

EXAMS

SUMMER SECTION	JUNE 14, 2021	BOOKING DEADLINE ON INFOSTUD: JUNE 10, 2021
	JULY 12, 2021	BOOKING DEADLINE ON INFOSTUD: JULY 8, 2021
FALL SECTION	SEPTEMBER 08, 2021	BOOKING DEADLINE ON INFOSTUD: SEPTEMBER 05, 2021

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