General information		
Academic subject	**GENERAL PHYSICS II mod B**	
Degree course	(L-30) Physics	
Academic Year	2023-24	
European Credit Transfer and Accumulation System (ECTS)		7
Language	Italian	
Academic calendar (starting and ending date)	March-June (II semester) – II year	
Attendance	no	

Professor/ Lecturer	
Name and Surname	Roberto Bellotti, Milena D'Angelo, Antonio Palazzo
E-mail	roberto.bellotti@uniba.it, milena.dangelo@uniba.it, palazzo@ba.infn.it
Telephone	080 544 3217
Department and address	Interuniversity Department of Physics
Virtual headquarters (Microsoft Teams code)	Teams Class: 0hrd50
Tutoring (time and day)	By appointment, to be fixed via email or phone call to the course professors

Syllabus	
Learning Objectives	The course aims at providing a basic knowledge of electromagnetic waves and optics.
Course prerequisites	Understanding of a text, notions of geometry, algebra and elementary trigonometry. Differential and integral calculus of functions with one variable. Differential equations of the first and second order. Scalar and vector quantities. Newton's laws and motion equations. Energy and power.
Contents	**1) Electromagnetic waves** (chap. 12 except 12.7; in addition demonstration of polarization ellipse equation explained in class). Plane e.m. waves. Plane harmonic waves. Propagation of a plane e.m. wave in a non-dispersive transparent dielectric. Refractive index. Derivation of the general wave equation from Maxwell's equations. Spherical e.m. waves. Polarization of e.m. waves (with demonstration of polarization ellipse equation). Energy of a plane e.m. wave. Poynting vector. Conservation of electromagnetic energy. Poynting's theorem. Momentum of an e.m. wave. Radiation pressure. EM radiation produced by an oscillating electric dipole. Notes on the radiation of an accelerated charge. Larmor's formula. Wave packets. Group velocity. Spectrum of e.m. waves Reasoned resolution of various problems. **2) Reflection and refraction of waves** (cap. 13 till par. 13.6) Huygen-Fresnel principle. Laws of reflection and refraction, Snell's law, critical angle and total reflection, dispersion. Intensity of e.m. waves reflected and refracted: Fresnel formulas, reflection coefficients in the p plane and in the s plane (any incidence, normal incidence), Stokes relations, reflected intensity in the general case (rectilinear, elliptical, circular, and unpolarized wave polarization), angle of Brewster and reflection polarization, degree of polarization. Propagation of an e.m. plane wave in an anisotropic medium, birefringence. Applications of birefringence: dichroic crystals, polarizers and analyzers, Malus' law, delay plates (quarter wave and half wave plates). Reasoned resolution of various problems. **3) Interference** (cap. 15, till par. 15.4) Sum of waves, interference phenomena, concept of coherence. Phasor method and symbolic method. Interference produced by two sources of spherical waves: constructive and destructive interference, maximum and minimum of interference; interference from incoherent sources. Interference of two light waves, Young's experiment, interference fringes, pitch; interference between polarized waves; optical path; observation of interference fringes in the focal plane of a lens. Interference produced by N sources of coherent waves: resultant intensity, main maxima and minima, angular width of the main maxima. Light interference on thin plates, thin wedge, Newton's rings. Reasoned resolution of various problems.

	4) Diffraction (cap. 16, till par. 16.5 + par. 16.10) Notes on the diffraction phenomena of Fraunhofer and Fresnel. Fraunhofer diffraction: - Rectilinear slit diffraction: intensity distribution, minima, width of the central maximum (angular and spatial), intensity of the secondary maxima. - Diffraction from a circular hole: first minimum of diffraction, angular width of the central maximum. Notes on diffraction from an opaque disc. - Notes on the resolution limit of lenses. - Diffraction grating: intensity distribution, principal maxima, angular width of the maxima, intensity of the principal maxima. X-ray diffraction. Reasoned resolution of various problems. **5) Geometric Optics** (cap. 14, till par. 14.5 – except for thick lenses) Laws of reflection and refraction. Definitions and conventions: real and virtual object, real and virtual image, conjugate points, paraxial rays, mirrors, dioptres, optical axis; sign conventions. Mirrors: concave and convex mirror; spherical mirror equation; focus, focal distance and focal plane of a spherical mirror; ray tracing; real and virtual images; transverse magnification. Flat mirror. Diopters: concave and convex diopter; spherical diopter equation; focus, focal distance and focal plane of a spherical diopter; ray tracing; real and virtual images; transverse magnification. Flat diopter. Lenses: simple lens, thin simple lens, thin lens equation; focus, focal distance and focal plane of a thin lens; lens manufacturers equation; ray tracing; converging and diverging lenses; transverse magnification. Centered diopter systems: system of two thin lenses. Fermat's "Principle". Reasoned resolution of various problems. **6) Magnetic properties of matter** (cap. 9 fino a par. 9.5) Experimental observations. Magnetization of matter. Magnetic permeability, magnetic susceptibility. Amperian currents and magnetization. General equations of magnetostatics. The H field. Ferromagnetic substances. Hysteresis loop.
Books and bibliography	*P. Mazzoldi - N. Nigro - C.Voci - (Vol. 2) Elettromagnetismo e Onde, Terza edizione*
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
70	40	30	105
ECTS			
7	5	2	

Teaching strategy	Lectures and dialogues, exercises, expressing from the chair.

Expected learning outcomes	
Knowledge and understanding on:	The objective of this teaching is to provide students with the basic knowledge of electromagnetic waves and the related interference and diffraction phenomena, and the basics of geometric optics. Understanding of how the laws of Physics are verified by famous examples and experiments.
Applying knowledge and understanding on:	Ability to set up and solve problems related to electromagnetic waves and optics, physics and geometry. Ability to identify essential elements of a phenomenon, in terms of order of magnitude and level of approximation required..
Soft skills	**Judgment autonomy** Development of the critical sense necessary to discern the significant aspects from the marginal ones, to evaluate the correctness of the assumptions and

	approximations adopted. Development of analytical skills aimed at identifying inconsistencies and possible sources of error, including dimensional checks. Ability to recognize the variety and beauty of the discoveries of phenomena concerning electromagnetic waves and optics. Ability to evaluate logical structure in the presentation (formal or informal, written or oral) of physics topics. This ability to self-assessment is required in the various tests that the student must pass. **Communication skills** Acquisition of competence in communication in Italian, and of the rigor necessary for the topics covered.

Assessment and feedback	
Methods of assessment	
Evaluation criteria	The final evaluation mark is decided by the Commission on the basis of the outcome of written and oral exams. The written test is passed if: • Both exemptions are passed (generally the first exemption is carried out during the courses break of the second semester, and the other immediately after the end of the course), or • The written test is passed in one of the foreseen examination sessions. The written test is considered passed when the student has achieved at least a sufficient evaluation mark. If the written test is passed, the oral test can be given in any session scheduled during the same exam session (summer or winter). If the oral test is not passed, then the written test again should be given again.
Criteria for assessment and attribution of the final mark	The written exam constitutes an access test to the oral exam and is intended to verify the student's ability to solve problems related to the topics covered during the course. In the oral test, the ability to illustrate the topics to other people, connect different parts of the program, use the scientific language introduced in the course and the mathematical formalism appropriately to the level of the course are evaluated.
Additional information	