Stampare su carta intestata del CdS

General information		
Academic subject	**FUNDAMENTALS OF PHYSICS II** Module **A:** electrostatics and magnetostatics Module **B:** electromagnetic waves	
Degree course	Scienze e tecnologie dei materiali	
Academic Year	2°	
European Credit Transfer and Accumulation System (ECTS)		11
Language	Italian	
Academic calendar (starting and ending date)	Module **A**: September 2021 – December 2021 Module **B**: March 2022 – June 2022	
Attendance	NO	

Professor/ Lecturer	
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Virtual headquarters	
Tutoring (time and day)	Available on request

Syllabus	
Learning Objectives	Provide the basic knowledge on classical electromagnetism and optics
Course prerequisites	Elementary algebraic calculus – Trigonometry – Graphic representations – Notions of differential and integral calculus. Notions of vector calculus - Knowledge of material point mechanics and rigid bodies - Basic knowledge of wave phenomena
Contents	Module **A**: General information on electrical and magnetic phenomena. Electric charge. Conductors and insulators. Coulomb's law. Continuous charge distributions. Preservation of charge. Definition of electric field. Electric field generated by point charges. Electric field generated by continuous charge distributions. Lines of force. Point charge in an electric field. Dipole in an electric field. Electric field flow. Gauss's law. Applications of Gauss's law. Conductors and Gauss's law. Experimental evidence of the laws of Gauss and Coulomb. Electrical potential energy. Electric potential. Calculation of the potential given the electric field. Potential due to point charges. Electric potential due to continuous charge distributions. Calculation of the field given the potential. Equipotential surfaces. Potential of a charged conductor. Types of substances. Electrical properties of matter. Conductors in electric fields under static conditions. Conductors in electric fields under dynamic conditions. Ohmic resistors. Ohm's law from the microscopic point of view. Insulators in electric fields. Polarization of matter. The electric displacement. Calculation of electrical susceptibility. Capacitors and electrical capacity. Capacity calculation. Capacitors in series and parallel. Energy storage in an electric field. Capacitors with a dielectric. Electric current. Electromotive force. Circuit analysis. Electric fields in circuits. Resistors in series and parallel. Energy transfers in electrical circuits. RC circuits. Magnetic interactions and magnetic poles. Magnetic force on a moving charge. Loads in motion on circular trajectories. Hall effect. Quantum Hall effect. Magnetic force on a wire traveled by current. Twisting moment on a coil traveled by current. Magnetic field generated by a charge in motion. Magnetic field generated by currents. Parallel currents.

	Magnetic field generated by a solenoid. Ampere's law. Magnetic dipoles. Force agents on dipoles in uneven field. Atomic and nuclear magnetism. Magnetization and magnetic properties of matter. The magnetizing field. Calculation of magnetic susceptibility. Magnetic materials. Gauss's law for magnetism. In-depth study on the electrical and magnetic properties of materials: Maxwell displacement vectors and magnetizing field vector. Module **B**: Faraday experience. Faraday's law of induction. Law of Lenz. Electromotive force resulting from motion. Wind turbines and electric motors. Induced electric fields. Inductance. Calculation of inductance. RL circuits. Energy storage in the magnetic field. Qualitative and quantitative treatment of electromagnetic oscillations. Damped and forced oscillations. Alternating currents. Single-mesh RLC circuit. Power in alternating current circuits. Fundamental equations of electromagnetism. Induced magnetic fields and displacement currents. Maxwell's equations in integral and differential form. Generations of an electromagnetic wave. Wave propagation and Maxwell's equations. Energy transport and Poynting vector. Radiation pressure. Electromagnetic spectrum. Visible radiation. Speed of light. Electric fields in matter, electromagnetic waves in dielectrics, electromagnetic waves in conductors, reflection, and refraction of plane waves. Total reflection. The Fresnel coefficients for reflection and transmission. Pockels effect. Doppler effect for light. Interference due to two sources. Interference from double slit. Coherence. Intensity in double-slit interference. Interference from thin foils. Michelson interferometer. Diffraction and wave nature of light. Diffraction from single slit. Intensity in single-slit diffraction. Diffraction through a circular hole. Double slit: combination of interference and diffraction. Multiple slits. Diffraction gratings. Dispersion and resolving power. X-ray diffraction. Polarization of electromagnetic waves. Polarizing foils. Polarization for reflection. Birefringence. Circular polarization. Polarization by diffusion. Kerr effect.
Books and bibliography	- R. Resnick, D. Halliday, K.S. Krane " FISICA 2" quinta edizione (2003) Casa Editrice Ambrosiana ; - S. Focardi, I. Massa, A. Uguzzoni, "FISICA GENERALE: onde e ottica", seconda edizione, Casa Editrice Ambrosiana; - Alonso, Finn "Elementi di Fisica per l'università", vol. II "Campi ed onde", seconda edizione, Masson Italia Editore - Feynmann, Leighton, Sands, "La Fisica di Feynmann", Vol. 2, Zanichelli, 2017
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
275	56	60	159
ECTS			
11	7	4	
Teaching strategy	Lectures with traditional blackboard, video projector or overhead projector, numerical exercises.		
Expected learning outcomes			

Knowledge and understanding on:	Knowledge of the basic aspects related to the study of electromagnetism, electromagnetic waves, and optics.
Applying knowledge and understanding on:	ability to independently recognize the main characteristics of an electromagnetic phenomenon and describe it through relationships between physical quantities.

Soft skills	• *Making informed judgments and choices*
	  ○ ability to evaluate the conceptual appropriateness of models and relationships between physical quantities.
	• *Communicating knowledge and understanding*
	  ○ skills in the exhibition in Italian of laws, models and relationships between quantities and related demonstrations;
	  ○ ability to express and expose their knowledge with appropriate scientific language.
	• *Capacities to continue learning*
	  ○ ability to deepen specific topics of electromagnetism and optics independently starting from the knowledge and methods acquired during the course

Assessment and feedback	
Methods of assessment	At the end of Module A (January-February): partial written test only for Module A; Partial Oral Test only for Module A. At the end of Module B (from June): partial written test only for Module B or total written test for Module A + Module B; Partial Oral Exam solo per il Modulo B o oral colloquium for Modulo A + Modulo B.

Evaluation criteria	• *Knowledge and understanding*
	  ○ a qualitative but precise knowledge of the principles underlying electrostatics and magnetostatics, of the principles of geometric optics and physical optics, and of electromagnetic and optical phenomena is sufficient;
	  ○ the formal knowledge of the general laws governing electromagnetic phenomena, maxwell's equations, and the laws of geometric optics and physical optics, and the ability to use them appropriately in solving proposed problems, is positively evaluated.
	• *Applying knowledge and understanding*
	  ○ the ability to independently recognize the main characteristics of an electromagnetic phenomenon and describe it through relationships between physical quantities is positively evaluated.
	• *Autonomy of judgment*
	  ○ the ability to evaluate the correctness of the relationships between electromagnetic and optical physical quantities is sufficient;
	  ○ the ability to evaluate the conceptual correctness of models and relationships between electromagnetic and optical physical quantities is positively evaluated.
	• *Communicating knowledge and understanding*
	  ○ the ability to expose in Italian the basic principles concerning electromagnetic phenomena, geometric optics and physical optics is sufficient;
	• *Communication skills*
	  ○ the ability to expose in Italian the fundamental laws of electromagnetism and optics, and the interpretation of natural

	phenomena through these laws, is positively evaluated. • *Capacities to continue learning* ○ the ability to deepen specific topics of electromagnetism and optics in an autonomous way is positively evaluated.
Criteria for assessment and attribution of the final mark	In the written test, the clarity of the work and the correctness of the procedure used for solving problems will be positively evaluated. In the oral exam the ability to expose in a clear and complete way the various concepts and the level of understanding of the same will be positively evaluated. The written tests affect the final evaluation for 40%, the oral ones for 60%.
Additional information	