UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

COURSE OF STUDY THREE-YEAR BACHELOR PROGRAMME IN MATHEMATICS

ACADEMIC YEAR 2023-2024

ACADEMIC SUBJECT PHYSICS 2

General information	
Programme year	Second
Term	Second semester (February 26, 2024 – May 31, 2024)
European Credit Transfer and Accumulation System credits (ECTS)	9
SSD	FIS/01
Language	Italian
Mode of attendance	Not mandatory

Lecturers		
Name and surname	Tommaso Maggipinto (instructor of record)	Marco Ignazio Pappagallo
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Department and office	Department of Physics, second floor, office 234	Department of Physics, first floor, office 135
Virtual meeting room	Microsoft TEAMS, codice **i1a4g8g**	Microsoft TEAMS, codice **i1a4g8g**
Web page		
Office hours	By appointment by email; in presence or remotely.	By appointment by email.

Work schedule	Total	Lectures	Hands-on learning (recitations/laboratories)	Self-study
Hours	225	48	24	153
ECTS credits	9	6	3	

Learning objectives	
	The teaching aims to acquire basic knowledge of classical electromagnetism.

Course prerequisites	
	Differential and integral calculus. Study of function. Mechanics of the material point.

Syllabus	
Course contents	**Electrical force and electrostatic field.** Electrical charges. Insulators and conductors. Electrical structure of matter. Measurement of electrical charges. Coulomb's law. Electrostatic field. Electrostatic field produced by continuous charge distributions (spherical, linear, plane distribution). Electrostatic field force lines. Motion of a charge in an electrostatic field. Rutherford experience. Determination of the elementary charge. Millikan experience.

	Electrical work. Electrostatic potential. Work of electrical power. Voltage, potential. Calculation of electrostatic potential. Electrostatic potential energy. The field as a gradient of the potential. Equipotential surfaces. Curl of a vector field. Stokes theorem and application to the electrostatic field. The electric dipole. Potential of a system of charges in the dipole approximation. Force on an electric dipole. **Gauss law.** Flux of the electric field and Gauss theorem. Applications of the Gauss theorem (spherical, linear, plane charge distribution). Electrostatic field around a surface layer of charge. Divergence of a vector field. Gauss law in differential form. Maxwell equations for electrostatics. Poisson and Laplace equations. **Conductors. Electrostatic energy.** Conductors in equilibrium. Capacity of an insulated conductor. Hollow conductor. Electrostatic screen. Conductor systems. Capacitors. Capacitor connection. Electrostatic field energy. Potential energy of a charged system. Forces between the armatures of a capacitor. Electrostatic pressure. **Dielectric.** The dielectric constant. Polarization of dielectrics. Electric field produced by a polarized dielectric. Electric field within a polarized dielectric. General equations of electrostatics in the presence of dielectrics. The vector dielectric induction. Dependence of polarization on the electric field. Isotropic and anisotropic medium. Discontinuity of fields on the surface of separation between two dielectrics. Electric field within a cavity in a dielectric. Electrostatic energy in dielectrics. Introduction to polarization mechanisms in isotropic dielectrics. **Electric current.** Electrical conduction. Electric current. Conservation law of charge and steady-state current regime. Classical model of electrical conduction. Ohm law. Electrical resistance. Joule effect. Resistors in series and parallel. Electromotive force and generalized Ohm law. Charge and discharge of a capacitor through a resistor. Kirchhoff laws for circuit. Analysis of multiple mesh circuits in direct current. **Magnetic force. Magnetic field.** Experimental evidence on magnetic interaction. Magnetic field force lines. Gauss law for magnetic field. Magnetic force on charges in motion. Magnetic force on current carrying conductor. Mechanical moments on plane circuits. Ampere equivalence principle. Hall effect. **Magnetic field sources. Ampere law.** Magnetic field produced by a current. Calculations of magnetic fields produced by particular circuits. Law of Biot-Savart. Electrodynamic actions between circuits carrying current. Ampere law. Properties of the magnetostatic field in vacuum. Relativity of electric and magnetic fields. **Electric and magnetic fields variable in time.** Faraday's law of electromagnetic induction. Physical origin of induced electromotive force. Displacement current. Ampere-Maxwell law. Maxwell

	equations.
Reference books	Mazzoldi, Nigro, Voci - FISICA, Elettromagnetismo e Onde, Edises Edizioni C. Mencuccini – V. Silvestrini – FISICA, Elettromagnetismo e Ottica, CEA
Additional course materials	
Repository	Educational material uploaded to Microsoft TEAMS platform.

Expected learning outcomes	
Knowledge and understanding	Acquisition of the theoretical and experimental foundations of classical electromagnetism. Consolidation of a logical-scientific thinking.
Applying knowledge and understanding	Ability to apply knowledge of Physics to the understanding, analysis and resolution of problems and phenomena both physical and, in general, scientific and technological.
Soft skills	*Making judgements*: Ability to organize knowledge and interpret data and experience in order to address scientific and technological problems and situations in a rational and effective way.
	Communication skills: Strengthening of the basics of language and physical formalism, necessary both for the consultation and understanding of texts and for the exposure, analysis and resolution of scientific-technological problems.
	Learning skills: Ability to deepen in subsequent studies both topics of Physics and, in general, scientific and technological.

Teaching methods	
	Conducting lectures in which all the topics of the course are explained and their knowledge is consolidated, also promoting the active participation of students. Conducting exercises in which the ability is developed and consolidated students to solve problems of electromagnetism with a rational and scientific approach. Support materials will be made available through the Microsoft TEAMS platform.

Assessment	
Assessment methods	The examination consists of a written test and a subsequent oral test. The written test includes exercises related to the main topics of the program. It lasts about two hours. The results are communicated directly by the teacher or, appropriately anonymized, published on Microsoft TEAMS platform. If the written test is passed, the oral test is accessed. The oral exam includes an interview on the main theoretical topics of the program.
Evaluation criteria	• *Knowledge and understanding*: the level of knowledge and understanding of the laws and physical phenomena taught is assessed. • *Applying knowledge and understanding*: the ability to apply the physical laws learned to interpret phenomena and solve problems within the course program is evaluated. • *Making judgement*: the autonomy in analysing the phenomena and the physical laws presented in the course is evaluated.

	• *Communication skills*: the mastery of the use of the language of Physics and the overall quality of the exposure are evaluated. • *Learning skills*: the ability to organize knowledge, to reason critically and to study independently are evaluated
Grading policy	The exam consists of a written test and a subsequent oral test. The written test consists of problems of electromagnetism whose assessments are summed so that the maximum final grade of the written is 30/30. The written test is considered passed if the final score is at least 18/30. The ability to understand the tracks, to reason, to use the learned knowledge and to correctly set the resolutions is evaluated. Obtaining the exact numerical results is appreciated but not decisive for the evaluation. After passing the written test students are admitted to the oral test. The oral exam consists of an exam in which the comprehension, knowledge and ability to discuss the topics of the course program are evaluated. Particularly significant are the mastery of arguments and the ability for autonomous reasoning. The final grade is based on a reasoned assessment of the performance in the two tests; is awarded in thirtieth and the exam is considered passed if the final grade is at least 18/30. In case of excellent written test and oral exam particularly brilliant for clarity and completeness, can be attributed praise.

Further information	
	Attendance of lessons is strongly recommended.