UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2016/2017
BACHELOR'S DEGREE (BSC)	MECHANICAL ENGINEERING
SUBJECT	PHYSICS II
TYPE OF EDUCATIONAL ACTIVITY	A
AMBIT	50293-Fisica e chimica
CODE	07870
SCIENTIFIC SECTOR(S)	FIS/01
HEAD PROFESSOR(S)	PERSANO ADORNO DOMINIQUE Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**PERSANO ADORNO DOMINIQUE** Monday 12:00 14:00 Stanza 112 (primo piano) Dipartimento di Fisica e Chimica Viale delle Scienze, Ed. 18

DOCENTE: Prof.ssa DOMINIQUE PERSANO ADORNO

PREREQUISITES	In order to understand the content and the course learning objectives, the student should possess good knowledge of Mechanics,Thermodynamics, Chemistry, Calculus.
LEARNING OUTCOMES	Knowledge and Comprehension: the students, at the end of the course, will have learned how to build a physical model for the description of phenomena in which electric and magnetic forces are involved. In particular, the students will gain knowledge of electrostatic: charge, electric field, electrostatic potential, Coulomb's law, Gauss theorem, energy of the electrostatic field, electric dipole, capacitors and dielectrics. Moreover, the students will have understood the importance of Kirchhoff's laws for the study of electrical circuits. They will have also awareness of magnetism: magnetic field, Lorentz force, Ampere's law, Biot-Savart relation, electromagnetic induction (Faraday-Lenz law), energy of the magnetic field, diamagnetism, paramagnetism and ferromagnetism. Finally, the students will have understood the importance of Maxwell's equations as an essential tool for the description and quantification of each electrical phenomenon and / or magnetic observable in classical physics. In particular, through the study of electromagnetic waves and their equation, obtained directly from the Maxwell's equations, the students will have known the electromagnetic nature of light and radio waves. Ability to apply knowledge and comprehension: The student will be able to identify the symmetries in a physical problem, schematize the electromagnetic phenomena for their quantitative description and to describe an electromagnetic phenomenon via the Maxwell equations, identify the variables needed to build a physical model. Moreover, the students will have also the ability to apply the laws of electromagnetism to concrete situations in order to solve simple problems concerning electric and magnetic phenomena, using symmetry arguments, the superposition principle and the conservation laws, the Maxwell equations. Making judgments: The student will be able to determine if in a given problem should be used a "dynamic" approach (analysis of the system in terms of electric and magnetic forces) or, otherwise, an "energetic" approach (analysis of the system through the application of principle of energy conservation), also in real life problems. Communicative skills:The student will acquire the ability to exhibit consistently and with language properties the course contents, referring to Electromagnetism principles and laws, by making qualitative considerations on specific problems; for example, in a discussion about two coils in motion relative, the student will indicate which forces are present, the origin of these forces and their effect on each coil. Learning ability:The student will have learned the basic laws of electromagnetism; he will know how to consult books and journals and to find concrete applications of the laws and principles studied. This will allow to the student to continue his engineering studies with greater intellectual independence and increased capability in operating assessments and making decisions.
ASSESSMENT METHODS	Written and Oral examination. The written test requires the resolution of 3/4 exercises on all parties covered by the program, and aims to verify the possession of skills and abilities provided by the course; the evaluation is expressed in thirtieths. The questions, well-defined, clear and interpretable, allow to independently formulate the response, and are structured so as to ensure comparability. Their structure provides open answers that meet constraints such as to make them comparable with predetermined correction criteria. The oral test consists of an interview, in order to check student skills and disciplinary knowledge provided by the course; the evaluation is expressed in thirtieths. The candidate must answer to at least three / four oral questions/problems on all parties covered by the program. Both written and oral examinations aim to assess whether the student holds mastery and understanding of the topics, has acquired interpretative competence and independence of judgment in real cases. The sufficiency will be reached if the student knows and understands the topics, at least in general terms, and holds minimal skills of problem solving. Below this threshold, the examination will result insufficient. Evaluation methods: Excellent: 30-30 cum laude: the student shows good knowledge of the topics, excellent properties of language, good analytical skills, and is able to apply

	knowledge to solve the proposed problems. Very good: 26-29: the student owns good mastery of the subjects, language skills, and is able to apply knowledge to solve the proposed problems. Good: 24-25: the student shows good knowledge of the main topics, good language skills, but limited ability to independently apply knowledge to solve the proposed problems. Satisfactory: 21-23: the student possess basic mastery of the main topics of the course and owns satisfactory language skills. The student is not able to independently apply knowledge to solve the proposed problems. Sufficient: 18-20: the student owns basic knowledge of the main topics and minimum language skills, very little ability to independently apply the knowledge gained. Insufficient: the student does not have an acceptable knowledge of the topics of the course.
EDUCATIONAL OBJECTIVES	EDUCATIONAL OBJECTIVES OF MODULE 1 The learning objectives of module 1 are the study of the phenomena in which electric and magnetic forces are due to steady currents, the construction of an adequate physical model and the ability to apply the laws of Coulomb, Gauss and Ampere to specific cases. The correct use of the conservation principles, the electrostatics law and the Ampere's law, is a fundamental objective not only to understand the meaning of charge, electric field, magnetic field and electric current, but also to understand the role played from these quantities in the operation of the real world. Will be also introduced the concept of electrostatic potential, with the goal of providing the student an essential conceptual tool for the description of an electrostatic system in terms of energy changes. The student will face physical situations in which there are charges or steady currents, describe qualitatively what is happening in the system under consideration, choose the correct way to quantitatively analyze the dynamics of the system through the application of laws and principles and, finally, solve the equations to find the mathematical solution of the problem. EDUCATIONAL OBJECTIVES OF MODULE 2 The learning objectives of the module 2 are the study and understanding of the phenomena and laws related to electric and magnetic fields varying in time. Through the study of electromagnetic induction (Faraday-Lenz law), and the displacement currents (Maxwell's law) the student will face fields variable both in time and space, know the electromagnetic nature of the light and radio wave and learning to qualitatively describe the phenomena present in a given system. Finally, by choosing the appropriate tools to analyze quantitatively the dynamics of a system, the student will be able to solve the equations to obtain the mathematical solution of the problem. The comparison between the physical aspect of the problem, discussed qualitatively, and the description obtained mathematically, will allow to the student to have a complete understanding of the studied phenomenon.
TEACHING METHODS	Lectures, classroom exercises, laboratory experiments.
SUGGESTED BIBLIOGRAPHY	1 - D. Halliday, R. Resnick, J. Walker, Fondamenti di Fisica: Elettrologia, Magnetismo, Ottica (vol. 2), Casa Editrice Ambrosiana, 6a edizione, Milano. 2 - R. A. Serway, R. J. Beichner, Fisica per Scienze e Ingegneria (vol. 2), EdiSES, 3a edizione, Napoli. 3 - P. Mazzoldi, M. Nigro, C. Voci, Elementi di Fisica, Elettromagnetismo, EdiSES, Napoli, II edizione 4 - P. Tipler, G. Mosca, Corso di Fisica, vol.2, Zanichelli, Bologna, quarta edizione

SYLLABUS

Hrs	Frontal teaching
18	Module 1 Electric charge. Conductors and insulators. Coulomb's law. Charge conservation principle. The electric field. Electric field generated by a single charge. Electric field generated by an electric dipole. Electric field generated by a linear charge distribution and by a disc with a homogeneous charge distribution. Electric charge in an electric field. Electric dipole in an electric field: torque on the dipole and potential energy of the dipole within the field. Vector magnitudes and flux through a surface. Flux of the electric field and Gauss's law. Relationship between Gauss's law and Coulomb's law. Distribution of the charge on an isolated conductor. Gauss' law in conditions of spherical and cylindrical symmetry; electric field in insulating or conducting foils. Electric potential energy of a system of charges. The physical meaning of the electric potential. Equipotential surfaces. The zero of potential: its meaning and its importance for the calculation of the potential in different points of space. Potential due to a point charge. Potential due to a system of charges. Potential due to an electric dipole. Potential due to a continuous charge distribution. Calculation of the electric field given the potential. Calculation of the electric energy given the potential. Electric potential of a charged conductor isolated. Capacity. The capacitor. Relationship between capacity and electric charge in a capacitor. Calculation of capacity for a plane, spherical or cylindrical capacitor. Capacitors in series and in parallel. Energy stored in a capacitor. Energy stored in an electric field: density of electric energy. Dielectric characteristics. Capacitor with dielectrics. The Gauss law in the presence of a dielectric. Electric current. Density of current and drift velocity. Resistivity and electrical resistance. Conductivity. Ohm's Law: phenomenological and microscopic appearance. Power in electric circuits. Electromotive force. Calculation of the current in a circuit Resistors in series, resistors in parallel. Relationship between power, potential and electromotive force in a circuit. RC circuits: charge and discharge of a capacitor.
18	Module 2: Magnetism and definition of magnetic field: Lorentz law. Magnetic field lines. Hall Effect. Electrical charges in circular motion. Electrical charges moving on helical paths: the cyclotron. Magnetic force acting on an electrical wire. Torque on a current loop. Magnetic dipole moment. The Biot-Savart law. Force between two parallel conductors. Ampere's law. Magnetic field generated by a long straight current-carrying wire. Magnetic fields generated by a solenoid and a toroid. Magnetic dipole of a current-traversed coil. Experiments on electromagnetic induction: Faraday's law and Lenz's law. Electromagnetic induction and energy balances. Flux of the magnetic field and inductance. Auto-induction. RL circuits. Energy stored in a magnetic field. Mutual inductance. LC circuit: circuit analysis and electromechanical analogy. RLC circuit and damped oscillations. The transformer. Gauss' law for magnetism. Displacement current and Maxwell's equations. Diamagnetism, paramagnetism and ferromagnetism. Light as a wave phenomenon. Electromagnetic waves and their equation obtained starting from Maxwell's equations. Energy carried by an electromagnetic wave and Poynting vector. Radiation pressure.

Hrs	Practice
9	Exercises on Coulomb's and Gauss's law: calculation of electric field and the flux of electric field in several cases. Exercises on the conductors. Calculation of the charge distribution, the electric field and potential. Fields generated by particular charge distributions (linear, homogeneous on the flat surface, homogeneous on the spherical surface, homogeneous and non-homogeneous within spherical volume, homogeneous on the cylindrical surface). Exercises on the capacitors: calculation of the electric field and the potential difference between the plates of capacitors of different type. Exercises on dielectrics: calculation of electric field and potential difference. Exercises on the variation of the capacity of a capacitor in the presence of a dielectric. Electrostatic energy calculations in a vacuum and in a dielectric. Exercises on DC circuits. Applications of Ohm's law and Kirchhoff's laws. Calculation of power within electrical circuits. Study of the RC circuit in various conditions.
9	Exercises on Biot-Savart and Ampere's law. Calculation of the magnetic field generated by current in various conditions. Exercises on solenoids and toroids. Exercises on magnetic dipoles (coils traversed by current). Exercises on Faraday's law of magnetic induction: electric fields induced by changes in magnetic flux. Exercises on magnetic fields, coils and inductance. Exercises on RL circuits. Calculation of the energy stored in a magnetic field in various systems. Exercises on LC circuits (oscillations) and RLC (damped and forced oscillations). Calculation of power in alternating current circuits. Exercises on electromagnetic waves: calculation of electric field, magnetic field, wave amplitude, Poynting vector and the radiation pressure in various conditions. Exercises on reflection and refraction of light.