UNIVERSITÀ degli STUDI di CATANIA

DEPARTMENT OF ELECTRICAL, ELECTRONIC AND COMPUTER ENGINEERING
Bachelor's Degree in Electronic Engineering
Academic Year 2017/2018 - 2° Year

PHYSICS II

FIS/03 - 9 CFU - 1° Semester

Teaching Staff

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DETAILED COURSE CONTENT

- **Electrostatic Field**: Electrical charges: phenomenology and Coulomb's law. The principle of superposition. Electrostatic field generated by a set of discrete charges. Force lines. Gauss' law. Electrostatic field produced by continuous distributions of charges. Motion of charges in an electrostatic field.
- **Electrostatic potential:** Work of the electric force and the electrostatic potential. Electrostatic potential energy, equipotential surfaces. Tension. Electric dipole. Maxwell's equations for the electrostatic field.
- **Conductors and electrical capacity**: Conductors under equilibrium conditions. Capacity of an insulated conductor. Electrostatic screen. Capacitors in series and parallel connections. Energy stored in a capacitor.
- **Dielectrics:** Phenomenology of dielectrics and polarization vector. Qualitative description of the mechanisms of electronic and orientation polarization. Maxwell's equations in dielectrics. Continuity properties of the electric fields. Energy of the electric field in the presence of dielectrics. Microscopic model of the electronic polarizability.
- **Direct electric current**: Electrical conduction. Electric current. Principle of conservation of charge and continuity equation. Drude model for the conduction and Ohm's law (Joule effect). Resistors in series and in parallel. RC circuits.
- **Magnetic field:** Magnetic force: phenomenology. Force lines and Gauss's law for the magnetic field. Lorentz law. Force on current-carrying conductors: elementary laws of Laplace. Ampere's principle of equivalence. Magnetic field produced by currents. Ampere's law. Electrodynamic actions between circuits. Maxwell's equations magnetostatic field.
- **Magnetic media:** Phenomenology of magnetic substances and magnetization vector. Maxwell's equations in magnetic media. Continuity properties of the magnetic fields. Energy of the magnetic

field in material media. Microscopic model of Larmor diamagnetism. Langevin paramagnetism. Qualitative discussion of ferromagnetism: hysteresis and magnetic shields.

- **Electric and magnetic fields that vary over time:** Electromagnetic induction, Faraday's Law Lenz. Induced electromotive force. Induction phenomena. Displacement current and Maxwell Ampere's law. Magnetic energy.
- **Maxwell's equations and electromagnetic waves in a vacuum** Maxwell equations in vacuum in integral and differential forms. Introduction to electromagnetic waves. D'Alembert equation. Symbolic notation. Plane waves. Harmonic waves. Polarization of electromagnetic waves. Energy density of electromagnetic waves, and the Poynting vector intensity.
- **Maxwell's equations in matter and electromagnetic waves in media**: electromagnetic waves in linear materials. Refractive index and propagation speed. Relationship between refractive index, dielectric function and absorption coefficient. Dispersion in dielectrics. Elettormagnetic wave propagation and absorption in metals.

TEXTBOOK INFORMATION

P. Mazzoldi, M. Nigro, C. Voci, Fisica volume II Seconda edizione, EdiSES 2000.

Fisica 2, D. Halliday, R. Resnick, K. S. Krane, Zanichelli

Edward M. Purcell, La Fisica di Berkley 2, Elettricità e Magnetismo, Zanichelli.
