Taras Shevchenko National University of Kyiv

Physics Department

Course description

Electricity & Magnetism

Level:	**Language:**	**Duration:**	**Occurrence:**
Bachelor	Ukrainian	1 semester	3rd semester
Credits:	**Total Hours:**	**Contact Hours:**	**Self-study Hours:**
6	180	90	90

Description of Course Work and Examinations

Module-rating system, results are evaluated on a 100-point scale. The course contains 2 midterms 10 pts/90 min each, an oral colloquium 10 pts/90 min, an exam on higher complexity problems 10 pts/120 min and a final exam 60 pts/90 min.

Prerequisites

None

Syllabus

Electric Field: properties of electric charges, electric field and potential, Coulomb's law, superposition principle, energy density of electric field, SI and Gaussian units, Gauss law in differential and integral forms, electric field in conductors (inside and on the surface), electrostatic shielding, Laplace and Poisson equations, capacitance, types of capacitors (plane, cylindrical, spherical), electric field in dielectrics, vectors of electric displacement and polarization, dielectric permittivity and susceptibility, Gauss law in dielectrics, polarization mechanisms in polar and non-polar dielectrics, boundary conditions for $\vec{E}$ and $\vec{D}$, electrostatic data storage, principles of copying and laser printing.

Electric Current: constant current, current carriers, current in conductors, Drude's model, Ohm's law and ohmic media, Joule-Lenz law, Kirchhoff's laws, current in semiconductors and dielectrics, temperature dependence of resistivity of conductors and semiconductors, p- and n-semiconductors, influence of impurities in semiconductors, band theory, Fermi-Dirac distribution, electric current in gases, thermionic emission (Richardson's law), thermoelectric effects (Seebeck, Peltier, Thomson), semiconductor diode and devices based on it (rectifier, photodiode, LED, OLED, solar cell), semiconductor transistor, vacuum electronics (diode, transistor, photomultiplier, X-ray generator), nanoelectronics and molecular electronics.

Magnetic Field: magnetic field of a constant current, Ampere's law, Lorenz force, force of interaction of 2 infinitely long parallel currents, definition of ampere in SI, magnetic field of a closed loop, magnetic dipole, Earth magnetic field, explanation of auroras, Gauss law for magnetism, Ampere's circuital law, Faraday's law of induction, displacement current, magnetic flux, inductance, energy density of magnetic field, magnetic field in media, $\vec{H}$ and $\vec{B}$ fields, magnetization vector, magnetic permittivity and susceptibility, boundary conditions for $\vec{H}$ and $\vec{B}$, dia- para- and ferromagneticity, Curie point, magnetic data storage.

Electromagnetic Radiation: Maxwell's equations in vacuum, derivation of the wave equation, refraction index, wave characteristics (phase and group velocities, frequency, polarization, wave vector, transversity), energy flux of an electromagnetic wave, Poynting vector, momentum and pressure of EM radiation, refraction on the interface of 2 different media, processes that lead to electromagnetic emission.

Literature

1. D.V. Sivukhin. *General course on physics*, Vol. 3: *Elecricity*. 2009 Moscow, 656 p, ISBN 978-5-9221-0673-3.

Instructors

Professor Valery M. Yashchuk/Associate Professor Artem V. Chumachenko.