

**ANNOTATION**  
**of the course program**  
**“Functional nanomaterials”**

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1. **The name of the education program involving the course:** 28.04.01 Nanotechnology and microsystem technology (Master program “Material Science of Nanosystems”)
2. **The name of the education program involving the course:** 28.04.01 Nanotechnology and microsystem technology (Master program “Material science of nanosystems”)
3. **The total workload:** 1 credit point (36 hours).
4. **The place of the course in the structure of the educational program.** The course “Functional nanomaterials” is offered in the 1st semester. To study this course, the background knowledge of the basic sections of physics is required to be mastered. This course is required for the following internships, included in the training plan within the educational program.
5. **The objective of the course «Functional nanomaterials»:** acquiring the knowledge on the peculiarities of the functional nanomaterials, particularly, on the problems, the areas, the tendencies and the promises of the nanotechnology development, adjacent fields of science and technology; getting skills of the scientific merit estimation and application promises of research findings in nanotechnology sphere.
6. **Requirements for the results of mastering the course.** The course is focused on forming the following *general professional (GPC)* and *professional (PC) competences*:
  - the ability to acquire knowledge and use new knowledge and skills in a practice in some subject area (*GCC-4*);
  - to formulate the research goals and objectives in nanotechnology and microsystem technology sphere, to select reasonably theoretical and experimental techniques and solution tools of formulated tasks (*PC-I*);
7. **The course content:**

Module 1. Dielectric materials.

Subject 1. The basic concepts. The types of polarization in dielectrics: elastic, thermal; piezo- and pyropolarization.

Subject 2. Dielectric losses. Dispersion of a dielectric permittivity.

Subject 3. Electron, ion, and polar conduction of dielectrics.

Subject 4. Ferroelectrics. Spontaneous polarization and domains. Repolarization process. Ferroceramics. Applications.

Module 2. Magnetic materials.

Subject 1. Magnetic field in magnetic materials. Dia-, para- and ferromagnetics, ferrites.

Subject 2. Ferromagnetism. Electrons exchange coupling. Domains in ferromagnetics.

Subject 3. Ferroics. What they have in common? Multiferroics.

Subject 4. New areas of applications of magnetics. Magnetoresistivity. Spintronics.
8. **The basic educational technologies.** Within the course «Functional nanomaterials» classes are provided in the format of lectures and laboratory work. The active and interactive forms of conducting classes are not provided.
9. **Forms of control:** the current control involves the estimation of the participation during the practical trainings, the midterm assessment implies the colloquium summarizing the results of each unit; the end-of-course assessment involves examination.