

**ADDITIONAL EDUCATIONAL PROGRAM (MINOR)  
«MULTIFUNCTIONAL MATERIALS RESEARCHER»**

**For whom it is intended:** The program (Minor) «Multifunctional materials Researcher» is intended for students of all Major educational programs.

**Relevance:** due to the rapid development of technologies that impose new requirements on various products, in relation to materials that are the basis of any material form, and from the point of view of studying new compositions, they must have special properties that ensure a high-quality human life at a new high level.

**Justification:** A multifunctional materials researcher forms professional competencies to perform work on the study of the technological process in accordance with the regulations, the use of technical means to measure the main parameters of the technological process, the properties of raw materials and finished products. The formation of mandatory professional qualities of a graduate is combined with the development of universal skills for building a personal educational trajectory.

**Purpose:** The purpose of this work is to study the interaction of art and science in the process of creating materials with new properties obtained from various manipulations for further shaping of three-dimensional structures.

**Program Description:**

1. The program (Minor) consists of 3 disciplines, each discipline has 5 credits, in total the student must master 15 credits.

2. The program (Minor) «Multifunctional materials Researcher» does not require pre-requisites.

3. The number of credits for obtaining a bachelor's degree remains unchanged at least 240 credits.

**Program content:**

Name of the discipline	Description of the discipline	Teaching outcomes
Condensed matter physics	A field of physics that studies the macroscopic and microscopic properties of matter. In particular, this applies to "condensed" phases, which appear whenever the number of constituent components in the system is extremely large and the interactions between the components are strong. The most familiar examples of condensed phases are solids and liquids, which arise from interactions between atoms. Condensed matter physics seeks to understand and predict the behavior of these phases using physical laws. In particular, they include the laws of quantum mechanics, electromagnetism and statistical mechanics.	LO 1 - formation of in-depth knowledge in certain sections of condensed matter physics; LO 2 - to teach the effective use of fundamental knowledge in the field of condensed matter physics for solving practical problems; LO 3 - he is able to use the methods and variational methods of the theory of oscillations of quantum mechanics for the analysis of processes in a condensed state;
Fundamentals of nanotechnology	The field of fundamental and applied science and technology dealing with a set of theoretical justification, practical methods of research, analysis and synthesis, as well as methods of production and application of products with a given atomic structure by controlled manipulation of individual atoms and molecules.	LO 1 - Knows the basic principles of nanotechnology application; LO 2 - Knows the capabilities of nanostructures and nanomaterials, hardware design of physical research methods; LO 3 - Forms skills of professional use of research equipment and devices, generalization, analysis of interpretation of research results.
Fundamentals of quantum chemical calculations	Discussing the electronic structure of molecules, it is impossible not to say a few words about quantum chemical calculations. More recently, such work could only be performed by specialists in large computing centers. Currently, quantum chemical calculations have become available to chemists of all specialties who do not have special in-depth theoretical training, and the presence of well-developed and fairly easy-to-use software systems and increased computer capabilities allow the use of personal computers and standard techniques.	LO 1 - Information about the structure and energy of compounds, about the nature of the bonds in them can be explained by the results of experiments; LO 2 - He is able to make independent decisions and take responsibility for them, carry out qualitative and quantitative analysis and synthesis of the results obtained.