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| **Abstract to the work program of the discipline (module)** |
| **FLEXIBLE MANAGEMENT OF ENGINEERING PROJECTS** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Flexible management of engineering projects" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |
| As a result of mastering the discipline, the student must master the competencies: |
| **UC-1** - Capable to carry out a critical analysis of problem situations on the basis of a systematic approach, develop a strategy of action  |
| **UC-2** - Capable to manage a project at all stages of its life cycle  |
| **UC-3** - Capable to organize and lead the work of the team, developing team strategy to achieve this goal  |
|  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - Methods of developing a flexible management concept and a project implementation plan, taking into account the possible risks of implementation and the possibilities of their elimination |
| - Modern project management methods |
| - Modern project management methods |
| - Methods of developing a flexible management concept and a project implementation plan, taking into account the possible risks of implementation and the possibilities of their elimination |
| - Methods of developing a flexible management concept and a project implementation plan, taking into account the possible risks of implementation and the possibilities of their elimination |
| - Modern project management methods |
| **Be able to:** |
| - To form a project task based on the problem posed and a way to solve it through the implementation of flexible project management |
| - To develop the concept of an engineering project within the framework of the identified problem and a project implementation plan, taking into account the possible risks of implementation and the possibilities of their elimination using a flexible methodology |
| - To form a project task based on the problem posed and a way to solve it through the implementation of flexible project management |
| - To develop the concept of an engineering project within the framework of the identified problem and a project implementation plan taking into account possible risks of implementation and the possibilities of their elimination using a flexible methodology |
| - To develop the concept of an engineering project within the framework of the identified problem and a project implementation plan taking into account possible risks of implementation and the possibilities of their elimination using a flexible methodology |
| - To form a project task based on the problem posed and a way to solve it through the implementation of flexible project management |
| **Possess:** |
| - Skills in developing the concept of an engineering project using a flexible methodology |
| - Project management skills using a flexible methodology |
| - Skills in developing the concept of an engineering project using a flexible methodology |
| - Project management skills using a flexible methodology |

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| - Skills in developing the concept of an engineering project using a flexible methodology |
| - Project management skills using a flexible methodology |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
|  |  |
| Total labor intensity: |  | 3 credits (108 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **INNOVATIVE MATERIALS AND SYSTEM INTEGRATION FOR INFORMATION TECHNOLOGIES** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
|  |  |  |
| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Innovative materials and system integration for information technologies" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **PC-3** - Capable of determining possible physical implementation options, physical and mathematical models of micro- and nanosystems and using software tools for their design and modeling  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - the most common software tools for designing and modeling electronics elements |
| - basic principles of drawing up computational models of physical systems |
| **Be able to:** |
| - determine the software tools that are most suitable for solving the task |
| - apply knowledge of physical laws for qualitative analysis of computational models |
| **Possess:** |
| - skills of using any software tool for designing and modeling electronics elements |
| - skills in compiling algorithms for computational models of physical systems |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 8 credits (288 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **QUANTUM MATERIALS AND QUANTUM OPERATION FOR INFORMATION TECHNOLOGIES** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Quantum materials and quantum operation for information technologies" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **PC-1** - Capable to apply in-depth knowledge of the structure, physical, physico-chemical properties, the purpose of nanomaterials and nanostructures, and methods of measuring their parameters  |
| **PC-3** - Capable of determining possible physical implementation options, physical and mathematical models of micro- and nanosystems and using software tools for their design and modeling  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - basic principles of drawing up computational models of physical systems |
| - what quantum mechanical effects are used in electronics |
| **Be able to:** |
| -apply knowledge of quantum mechanical effects for qualitative analysis of computational models of physical systems |
| - apply physical laws and the corresponding physical and mathematical apparatus to solve simple typical problems of quantum mechanics |
| **Possess:** |
| - skills in compiling algorithms for computational models of physical systems |
| - skills of using the laws of physics and mathematics in solving practical problems |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 4 credits (144 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **COMMUNICATION TECHNOLOGIES IN THE PROFESSIONAL DOMAINS IN A FOREIGN LANGUAGE** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Communication technologies in the professional domains in a foreign language" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **UC-4** - Capable to use modern communication technologies, including the foreign language(s) for academic and professional communication  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - terminological professional base for professional communication in a foreign language |
| - general rules of business documentation |
| **Be able to:** |
| - professional vocabulary and basic grammar for oral and written communication in a foreign language |
| - to draw up different types of business documentation |
| **Possess:** |
| - skills and etiquette of professional communication in a foreign language to participate in professional discussions |
| - the style of business correspondence in a foreign language |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
|  |  |
| Total labor intensity: |  | 3 credits (108 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **COMPUTER-BASED SIMULATIONS OF NANOSYSTEMS** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
|  |  |  |
| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Computer-based simulations of nanosystems" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **GPC-4** - Capable of developing and applying specialized software and mathematical software for conducting research and solving engineering problems  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - basic principles of data representation and the basics of the programming language of the Maxima and Comsol package; theoretical foundations of operations research; classification of operations research tasks and basic approaches to analyzing and solving problems from various classes. |
| - the main capabilities of the Maxima and Comsol Multiphysics analytical computing package in modeling, analyzing and solving operations research problems and in visualizing the source data and the resulting solutions, taking into account the requirements of regulatory documentation. |
| **Be able to:** |
| - visualize and analyze the source data and the results obtained using graphical tools and animation functions of the Maxima and Comsol package. |
| - use modern automation tools, apply theoretical knowledge in practice using the analytical capabilities of the Maxima and Comsol package, simulate and solve various tasks of operations research using the Maxima and Comsol package. |
| **Possess:** |
| - software (tools of the Maxima and Comsol package) used for modeling, analysis and solving operations research problems. |
| - Modern software tools for the preparation of design and technological documentation, conceptual apparatus and modern computational methods of operations research. |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
|  |  |
| Total labor intensity: |  | 3 credits (108 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **MATERIALS FOR BIOMEDICAL APPLICATIONS** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Materials for biomedical applications" aims to contribute to the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **PC-1** - Capable to apply in-depth knowledge of the structure, physical, physico-chemical properties, the purpose of nanomaterials and nanostructures, and methods of measuring their parameters  |
| **PC-2** - Capable to participate in the development and implementation of modern technological processes, the master of new equipment, technological equipment, the necessary modes of production of micro- and nanoelectronics  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - technological bases of processes and methods of manufacturing and processing of structural materials |
| - the main technological processes of manufacturing materials |
| - norms of technological production of materials |
| **Be able to:** |
| - choose alloys and processing modes that ensure the formation of the necessary structure and a complex of physical and mechanical properties for various operating conditions |
| - to analyze technical requirements and results of scientific research of materials |
| - analyze technological problems and identify the basic components |
| **Possess:** |
| - basic knowledge of the physico-chemical bases of production, properties and ways of using various materials |
| - skills in choosing production modes |
| - methods of searching for reliable information |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 5 credits (180 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **MATERIALS AND DEVICES FOR RENEWABLE ENERGY** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
|  |  |  |
| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Materials and devices for renewable energy" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **PC-1** - Capable to apply in-depth knowledge of the structure, physical, physico-chemical properties, the purpose of nanomaterials and nanostructures, and methods of measuring their parameters  |
| **PC-2** - Capable to participate in the development and implementation of modern technological processes, the master of new equipment, technological equipment, the necessary modes of production of micro- and nanoelectronics  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - fundamentals of calculating the efficiency of using renewable energy sources |
| - provisions of the main regulatory documents in the field of renewable energy sources |
| - the role of renewable energy sources in energy supply |
| **Be able to:** |
| - calculate the efficiency of using renewable energy sources |
| - calculate the characteristics of renewable energy sources using regulatory documents |
| - analyze the problems of renewable energy sources |
| **Possess:** |
| - skills in analyzing information about the technical parameters of power plants using renewable energy sources |
| - terminology in the field of renewable energy sources |
| - problems of the use of renewable energy sources |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 5 credits (180 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **MATERIALS AND DEVICES FOR SENSING** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
|  |  |  |
| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Materials and devices for sensing" aims to contribute to the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **PC-2** - Capable to participate in the development and implementation of modern technological processes, the master of new equipment, technological equipment, the necessary modes of production of micro- and nanoelectronics  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - basic sensor development processes |
| - modern sensor devices |
| **Be able to:** |
| - evaluate the optimal processes for developing sensor devices |
| - develop and implement modern sensor devices |
| **Possess:** |
| - skills in choosing optimal processes for developing sensor devices |
| - skills in the development and implementation of modern sensor devices |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 4 credits (144 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **CHARACTERIZATION TECHNIQUES FOR MATERIALS AND DEVICES** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
|  |  |  |
| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Characterization techniques for materials and devices" aims to contribute to the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **PC-1** - Capable to apply in-depth knowledge of the structure, physical, physico-chemical properties, the purpose of nanomaterials and nanostructures, and methods of measuring their parameters  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - basic techniques and approaches for studying the parameters of nonequilibrium charge carriers in semiconductor materials, as well as optical methods for measuring the properties of semiconductors |
| - basic techniques and approaches for studying the resistivity of semiconductor materials and structures, as well as the distribution of charge carrier concentrations in them |
| **Be able to:** |
| - apply techniques and approaches to the study of semiconductor materials using optical techniques, build the simplest physical and mathematical models describing the interactions of light and semiconductor structures |
| - apply methods and approaches for the study of semiconductor materials by galvanomagnetic and probe techniques, build the simplest physical and mathematical models describing the conductivity of semiconductor materials |
| **Possess:** |
| - skills in choosing techniques and approaches for estimating the lifetime and mobility of charge carriers in semiconductor materials and structures |
| - skills in choosing techniques and approaches for determining the conductivity of semiconductor materials and structures |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 8 credits (288 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **BUSINESS PROCESS MODELING** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
|  |  |  |
| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Business process modeling" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **UC-2** - Capable to manage a project at all stages of its life cycle  |
| **UC-3** - Capable to organize and lead the work of the team, developing team strategy to achieve this goal  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - Standard project concepts and theoretical foundations of project implementation planning |
| - Principles of organization and adjustment of teamwork |
| - Principles of teamwork organization |
| - Principles of project management based on business process modeling |
| **Be able to:** |
| - Organize and manage the work of the team |
| - Develop project concepts and project implementation plans |
| - Organize, manage and adjust the work of the team |
| - To form a project task based on business process modeling |
| **Possess:** |
| - Methods of modeling business processes, taking into account the need to organize teamwork |
| - Methods of forming project tasks based on business process modeling |
| - Methods of developing project concepts and project implementation plans |
| - Methods of modeling business processes, taking into account the need to organize teamwork |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Electives |
|  |  |
| Part: |  | Факультативы |
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| Total labor intensity: |  | 1 credits (36 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **SIMULATION USING COMSOL MULTIPHYSICS** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
|  |  |  |
| The discipline "Simulation using Comsol Multiphysics" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **PC-3** - Capable of determining possible physical implementation options, physical and mathematical models of micro- and nanosystems and using software tools for their design and modeling  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - effective methods of designing and modeling parameters and characteristics of devices, circuits and devices of micro- and nanoelectronics for various functional purposes |
| - the main features of the Comsol Multiphysics analytical computing package for solving problems related to modeling physical processes in the study of nanoelectronics elements. |
| **Be able to:** |
| - to apply in practice methods and tools of computer-aided design and modeling of micro- and nanosystems |
| - use modern automation tools, apply theoretical knowledge in practice using the analytical capabilities of the Comsol package, simulate and solve various tasks of operations research using the COMSOL package |
| **Possess:** |
| - methods and tools of specialized computer-aided design and modeling of micro- and nanosystems |
| - Modern software tools for the preparation of design and technological documentation, conceptual apparatus and modern computational methods of operations research |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 6 credits (216 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **LOW-DIMENSIONAL SYSTEMS** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| Discipline "Low-dimensional systems" aims to contribute to the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **GPC-1** - Capable to present a modern scientific picture of the world, identify the natural science essence of problems, determine ways to solve them and evaluate the effectiveness of the choice made  |
| **GPC-2** - Capable to apply modern research methods, present and argumentatively defend the results of the work performed  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - features of quantum states of charge carriers in typical low-dimensional systems |
| - basic physical models of low-dimensional systems |
| **Be able to:** |
| - evaluate the values of parameters that determine the electronic properties of nanosystems |
| - apply physical considerations to the choice of a model of a real low-dimensional system |
| **Possess:** |
| - skills in analyzing physical effects used in modern electronics |
| - skills in solving standard problems in the field of low-dimensional systems |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
|  |  |
| Total labor intensity: |  | 5 credits (180 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **OPTICAL MATERIALS AND OPTICAL OPERATION FOR INFORMATION TECHNOLOGIES** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Optical materials and optical operation for information technologies" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **PC-1** - Capable to apply in-depth knowledge of the structure, physical, physico-chemical properties, the purpose of nanomaterials and nanostructures, and methods of measuring their parameters  |
| **PC-2** - Capable to participate in the development and implementation of modern technological processes, the master of new equipment, technological equipment, the necessary modes of production of micro- and nanoelectronics  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - basic technologies for manufacturing fiber light guides |
| - structure and basic properties of optical materials |
| - basic concepts, definitions and laws of various sections of optics |
| **Be able to:** |
| - to carry out measurements of optical, photometric and electrical quantities |
| - to carry out work in the field of optical materials research |
| - evaluate the limits of applicability of the results obtained by various methods |
| **Possess:** |
| - standard methods of performing optical measurements of various quantities and characteristics |
| - methods of studying the properties of optical materials |
| - methods of experimental investigation of the properties of optical materials |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
|  |  |
| Total labor intensity: |  | 5 credits (180 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **RESEARCH AND DEVELOPMENT MANAGEMENT** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Research and development management" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **UC-2** - Capable to manage a project at all stages of its life cycle  |
| **GPC-2** - Capable to apply modern research methods, present and argumentatively defend the results of the work performed  |
|  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - ways to formulate goals, objectives, problems, risks and significance of projects, stages of the project life cycle; stages of project development and implementation; methods of project development and management. |
| - modern methods of research of materials and products of electronics and nanoelectronics and ways of presenting the results of research in this area |
| - methods of conducting a comparative analysis of research methods in a given direction in the field of electronics based on various sources |
| - modern sources of scientific information, in particular Russian and international databases of scientific journals and patent sources; methods of searching and analyzing sources that substantiate methods and approaches to solving the problem, its novelty, relevance and significance. |
| **Be able to:** |
| - to conduct a comparative analysis of research methods in a given direction in the field of electronics based on various sources; selection of an adequate research method based on the analysis of sources, as well as analysis of available resources and infrastructure |
| - to develop a project taking into account the risk analysis of its implementation, to determine the target stages, main directions and expected results of work; to organize the control of the project implementation taking into account the possible risks of implementation and the possibilities of their elimination |
| - to present and defend the results of the work performed in a reasoned manner |
| - to set a project task based on the selected sources, to justify its novelty and significance, to choose adequate methods and approaches to solving the problem, to analyze the problem, highlighting the stages of its solution. |
| **Possess:** |
| - skills of organizing and conducting research by research teams of various levels, presentation and reasoned defense of the results of the work performed |
| - ways of solving tasks through project management |
| - skills of project development and management, skills of monitoring the implementation of the work plan and achieving expected results; skills of adjusting the plan and justifying adjustments in case of deviations in the course of the project; skills of creating applications for participation in competitions, skills of registration and submission of reporting documentation on the project |
| - the skills of choosing an adequate research method in a given direction in the field of electronics based on the analysis of sources, as well as the analysis of available resources and infrastructure |

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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
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| Total labor intensity: |  | 3 credits (108 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **СOMPUTER-AIDED DESIGN SYSTEMS** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Computer-aided design systems" aims to contribute to the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **PC-3** - Capable of determining possible physical implementation options, physical and mathematical models of micro- and nanosystems and using software tools for their design and modeling  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - methods and means of automation of technical experiments and design of electronic devices and systems |
| - fundamentals of VLSI construction based on CMOS circuits and modern Computer-aided design systems and modeling of electronic component base devices |
| **Be able to:** |
| - to apply in practice methods and means of automation of technical experiments and design of electronic devices and systems |
| - to apply in practice knowledge of the principles of building integrated circuit elements, physical and mathematical models of electronic component base elements and tools of computer-aided design and modeling systems for the development of electronic component base devices |
| **Possess:** |
| - tools and methods of automation of technical experiments and design of electronic devices and systems |
| - methods of designing and modeling electronic component base devices based on modern specialized computer-aided design software packages |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Part of the curriculum formed by the participants of educational relations отношений |
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| Total labor intensity: |  | 6 credits (216 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **SOCIOLOGY** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| Discipline "Sociology" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **UC-3** - Capable to organize and lead the work of the team, developing team strategy to achieve this goal  |
| **UC-5** - Capable to analyze and take into account the diversity of cultures in the process of intercultural interaction  |
| **UC-6** - Capable to determine and implement the priorities of his own activities and ways to improve it based on self-assessment  |
|  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - definition and role of self-esteem in the development of personality, the essence, signs and specifics of educational needs |
| - various historical types of cultures |
| - problems and specifics of various types of resources, basic concepts of sociological knowledge. |
| - mechanisms of intercultural interaction in society at the present stage, principles of correlation of global and national cultural processes |
| - the basics of organizing and adjusting the work of the team taking into account collegial decisions; the main characteristics of the team; features of a multicultural team |
| - principles and technologies for developing a teamwork strategy to achieve the goal, processes of internal team dynamics, technologies and methods of cooperation in teamwork; methods of selecting team members. |
| **Be able to:** |
| - apply the theoretical foundations of developing a teamwork strategy, select team members to achieve the goal in practice |
| - to interact with representatives of different cultures in a tolerant manner |
| - apply the theoretical foundations of assessing the resources of the individual, develop strategies for the effective performance of the assigned task |
| - organize and manage the work of the team, manage the processes of group dynamics; analyze the state of the social group, |
| - to use ways of improving activities in various types of activities, to carry out self-analysis. |
| - explain the phenomenon of culture, its role in human life; adequately assess intercultural dialogues in modern society |
| **Possess:** |
| - methods of determining and managing educational needs, skills to improve their activities and self-development based on self-assessment |
| - assessment and management skills of personal, situational, time resources, the ability to improve on the basis of self-assessment |
| - skills of developing leadership qualities and using them in team management, identifying and assessing conflict situations and choosing the optimal way out of them |

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| - the skills of selecting team members and organizing teamwork in order to achieve the set goal. |
| - skills of intercultural interaction taking into account the diversity of cultures |
| - skills of forming a psychologically safe environment in professional activity |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
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| Part: |  | Mandatory part |
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| Total labor intensity: |  | 2 credits (72 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **TECHNOLOGIES FOR MATERIALS ENGINEERING** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Technologies for materials engineering" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **GPC-2** - Capable to apply modern research methods, present and argumentatively defend the results of the work performed  |
| **GPC-3** - Capable to acquire and use new information in its subject area, offer new ideas and approaches to solving engineering problems  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - the main processes of obtaining materials |
| - basic physical laws in the field of electronics, regularities of their physical properties |
| - basic concepts and patterns in the field of materials science |
| **Be able to:** |
| - to set and solve material science problems |
| - to analyze the results of scientific research in the field of electronics |
| - conduct theoretical and experimental research of materials of various nature |
| **Possess:** |
| - skills of using knowledge of physics, mathematics and electronics in solving engineering problems in the field of materials science |
| - skills of working on technological installations |
| - skills in processing experimental data |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
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| Total labor intensity: |  | 4 credits (144 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **PERSONAL GROWTH TECHNOLOGIES** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| Discipline "Personal growth technologies" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **UC-6** - Capable to determine and implement the priorities of his own activities and ways to improve it based on self-assessment  |
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| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - features of the formation of professional interest and educational motivation; the basics of self-reflection and self-knowledge; own professional interests and needs, own professional and personal resources |
| - basic theoretical and methodological approaches and Personal growth technologies; basic theoretical and methodological approaches in professional activity research |
| **Be able to:** |
| - to systematize professional knowledge in order to write a plan-project of professional activity; to determine the priorities of professional growth |
| - conduct self-analysis and self-assessment; determine the priorities of their own professional activities; apply critical thinking to evaluate ways and means of improving their own professional activities |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
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| Total labor intensity: |  | 2 credits (72 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **PHYSICS OF THE SOLID STATE** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Physics of the solid state" aims to promote the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
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| As a result of mastering the discipline, the student must master the competencies: |
| **GPC-1** - Capable to present a modern scientific picture of the world, identify the natural science essence of problems, determine ways to solve them and evaluate the effectiveness of the choice made  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - fundamental laws of nature and basic physical and mathematical laws for evaluating the effectiveness of choice in the field of micro and nanotechnology, nanoelectronics using the apparatus of solid state physics |
| - basic laws and principles of solid state physics |
| **Be able to:** |
| - apply physical and mathematical methods to solve theoretical and applied problems in the field of micro and nanotechnology, nanoelectronics using the apparatus of solid state physics |
| - solve problems in solid state physics |
| **Possess:** |
| - skills of using knowledge of physics and mathematics in solving practical problems in the field of micro and nanotechnology, nanoelectronics using the apparatus of solid state physics |
| - skills in applying general approaches of solid state physics |
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| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
|  |  |
| Total labor intensity: |  | 5 credits (180 academic hour). |
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| **Abstract to the work program of the discipline (module)** |
| **CHEMISTRY FOR MATERIAL ENGINEERING** |
| **Direction of training: 11.04.04 “Electronics and nanoelectronics”** |
| **Profile: Engineering of modern materials for information technology, renewable energy and sensing** |
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| **1. THE OBJECTIVES OF MASTERING THE DISCIPLINE (MODULE)** |
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| The discipline "Chemistry for material engineering" aims to contribute to the formation of students' competencies. provided by this work program in accordance with the requirements of FSES HE in the direction of training 11.04.04 “Electronics and nanoelectronics”, taking into account the specifics of the focus of training - “Engineering of modern materials for information technology, renewable energy and sensing”. |
|  |  |  |
| As a result of mastering the discipline, the student must master the competencies: |
| **GPC-1** - Capable to present a modern scientific picture of the world, identify the natural science essence of problems, determine ways to solve them and evaluate the effectiveness of the choice made  |
|  |  |  |
| As a result of mastering the discipline (module), the student must |
| **To know:** |
| - the main results of the physico-chemical analysis of chemical processes in heterogeneous systems, phase diagrams of one-, two- and three-component systems, surface phenomena; basic concepts and concepts of chemical kinetics and electrochemical processes |
| - basic methods of studying and describing the structure of microelectronics materials: their macrostructure and microstructure, the internal structure of matter (the structure of atoms, ions, molecules and crystals), the structure and properties of crystals of the most important structural types. |
| **Be able to:** |
| - use the results of physico-chemical analysis to determine the optimal methods and modes of synthesis of microelectronics materials, to predict their properties |
| - interpret data on the structure of atoms, ions and molecules, atomic crystal structure, use these data to determine the main features of the properties of atoms, ions, molecules, crystals |
| **Possess:** |
| - skills of using the results of physico-chemical analysis to determine methods and modes of synthesis of microelectronics materials, to predict their properties |
| - skills in determining, describing and interpreting the main features of the structure and properties of atoms, ions, molecules, crystals |
|  |  |  |
| **2. PLACE OF DISCIPLINE (MODULE) IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM** |
| Direction of training: |  | 11.04.04 “Electronics and nanoelectronics” |
|  |  |
| Profile |  | Engineering of modern materials for information technology, renewable energy and sensing |
|  |  |
| Block: |  | Disciplines (modules) |
|  |  |
| Part: |  | Mandatory part |
|  |  |
| Total labor intensity: |  | 5 credits (180 academic hour). |
|  |  |