

Matrices of goals and modules of the specialty 7M07103 "Materials Science and Technology of New Materials", based on professionally significant competencies of skills and abilities

Guidance for developing the Objectives and Modules Matrix

The goal matrix allows you to build a specialty in two directions:

1. A simple "Matrix of Objectives and Modules" maps the expected learning outcomes (competency profile) of the program to the modules through which these competencies can be acquired.

2. The "Matrix of goals and modules" based on professionally significant skills and abilities is also a tool for building expected competencies with models of established learning outcomes (as close as possible) similar to ASIIN professionally significant skills and abilities (PSS) from the point of view of the university. They are available for engineering and natural sciences, as well as for typical interdisciplinary programs.

First of all, this method of "matching" helps to determine how the learning outcomes of the specialty are similar to the models of the established learning outcomes of the PSS, or complement them or deviate from them.

Thus, the established learning outcomes of the PSS represent the ideal goals and objectives of the program in the relevant subject area. In case of rejection of program orientation or interdisciplinary educational programs, it would be useful to include additional learning outcomes. Deviations from the PSS depending on the profile and orientation of the program are possible and can be explained by the university.

Secondly, the university must present to what extent each module of the program contributes to the achievement of one or more goals and objectives of the specialty. The stated expected learning outcomes should be reflected in the relevant module descriptions according to the program level. Thus, it is possible to evaluate performance horizontally in two directions. This can be analyzed when all learning objectives are covered by the modules. In addition, it is possible to assess whether the main task of learning at the program level is reflected appropriately in the objectives of the module at the module level.

The matrix of goals and models can also be used by the university as a tool in the development and further development of goals and learning outcomes.

Table 1: Goal Matrix

PSS ASIIN	Expected learning outcomes of the specialty	Relevant Modules
Knowledge and understanding		
graduates, in particular:		
have extensive in-depth knowledge of scientific and engineering principles in the field of materials science / material production process / chemical engineering, and their interdisciplinary integration	<p>The content of EP M101 "Materials Science and Technology of New Materials" based on the development of a multi-level system of training, the fundamentality and quality of education, the continuity and succession of education and science, the unity of education, upbringing, research and innovation, aimed at maximum satisfaction of consumer needs, should ensure:</p> <ul style="list-style-type: none"> - knowledge of the specifics of the socio-cultural development of their country, region of residence; the main philosophical currents and modern concepts of the picture of the world based on the achievements of the natural and social sciences; - the ability to analyze the specifics and modern combination of global, national and regional in the development of the social sphere and management, culture of public, state and personal life; - development and education of the ability and readiness for independent and continuous study of a foreign language, further self-education with its help, the use of a foreign language in other areas of knowledge; - the ability to self-esteem through observation of one's own speech in native and foreign languages. 	Basic disciplines, Historical and social module and multilingual training
have a critical understanding of new research in their discipline.	<p>undergraduate should know:</p> <ul style="list-style-type: none"> - modern technologies in materials science; - structure and properties of functional materials, methods for their improvement and creation of new materials and technological processes for their manufacture; - scientific approaches to controlling the properties of metal and composite materials on a metal basis and scientific principles of creation and methods for controlling the structure and properties of the obtained materials. - a culture of thinking, the ability to generalize, analyze, perceive information, set a goal and choose ways to achieve it. <p>undergraduate must:</p> <ul style="list-style-type: none"> - have experience with research equipment; - to own information means and technologies; - be able to model the behavior of materials, evaluate and predict their performance characteristics; - reasonably choose the technological processes of production, processing and processing of materials; - be able to assess the economic efficiency of technological processes. 	Module Technological assurance material quality
Engineering analysis		
Graduates have special competencies in:		

analyzing and solving problems in a science-based way that are not ordinary and/or not fully defined and have opposite characteristics	<p>undergraduate must:</p> <ul style="list-style-type: none"> - know the basic principles of management and evaluation of the quality level and properties of materials; - be able to conduct theoretical studies of phase equilibria in multicomponent metallic systems, calculation and prediction of state diagrams; - be able to analyze a variety of materials for a scientifically based choice of the appropriate object, the most suitable for solving a specific problem; - be able to formulate goals, objectives and outline ways and measures to achieve and solve them; - apply physical and chemical methods of theoretical and experimental research, methods of mathematical analysis and modeling to set goals for the development, implementation and commercialization of new high-tech technologies in the field of materials science and technologies for obtaining engineering materials. 	Module Physical and Chemical Methods for the Study of Materials
Have the ability to think abstractly and formulate complex problems arising from a new or developing area of their discipline	<ul style="list-style-type: none"> - knowledge of the main types of modern structural and functional inorganic (metal and non-metallic) and organic (polymer and carbon) materials; composites and hybrid materials; superhard materials; intellectual and nanomaterials, films and coatings; - possession of the skills of self-selection of materials for given operating conditions, taking into account the requirements of reliability and durability, efficiency and environmental consequences of their use; - the ability to use methods and tools for testing and diagnostics, research and quality control of materials, films and coatings, semi-finished products, blanks, parts and products, all types of research, control and testing equipment, analytical equipment, computer software for processing the results and analyzing the data obtained. 	Module new functional materials
apply innovative methods to solve problems based on theoretical principles and develop new scientific methods.	<ul style="list-style-type: none"> - knowledge of modern scientific concepts in mechanics and physics of production processes in order to create a material with a set of specified properties; - the ability to use in practice modern concepts of the sciences of materials, the influence of micro- and nanoscale on the properties of materials, the interaction of materials with the environment, electromagnetic radiation and particle flows; - possession of skills in the use of technical means for measuring and controlling the main parameters of technological processes, the properties of materials and products from them. 	Advanced Materials Science Module
Engineering design		
Graduates have special competencies in:		
developing concepts and solutions for fundamentally oriented and partially non-ordinary problems, considering them in relation to a wide coverage of other disciplines	<ul style="list-style-type: none"> - knowledge of traditional methods of surface hardening and coating and modern high-tech methods of surface treatment; - the ability to analyze a variety of coating materials and surface treatment methods for a scientifically based choice of a method for obtaining a surface with specified characteristics; - possession of skills in designing technological processes of surface hardening; - the ability to critically evaluate contemporary problems of surface engineering. 	Surface Structure Engineering Module

use your creativity to develop new and inventive products, processes and methods	<ul style="list-style-type: none"> - know the main scientific and technical problems and prospects for the development of nanotechnology, its relationship with related fields; - to know the main types and properties of nano-objects, nanomaterials, devices and devices based on them, typical technological processes for their production, element base, as well as typical equipment; - gain knowledge on the properties of various types of electronic materials and physical and chemical processes occurring in materials and elements; - be able to navigate among a wide range of materials and elements of electronic equipment; - be able to acquire skills in the analysis of various materials for the scientific substantiation of the choice of the most appropriate material for solving a specific problem. 	Module materials technologies	Advanced processing
apply their investigative decision-making abilities to work with complex, technologically impure or incomplete information.	<p>Apply - the basics of the study of the structural and phase composition and properties of materials;</p> <ul style="list-style-type: none"> - arrangement and operation of instruments and installations for the study of the properties of materials, the operation of technological equipment; - be able to apply the methods of researching materials and developing technologies for obtaining new materials and introducing them into production. 	Research Module	Training
Scientific research and evaluation			
Graduates have special competencies to:			
determine, find and acquire the necessary information	<ul style="list-style-type: none"> - possession of methods of scientific research on the topic of research; - the ability to collect, process, analyze and systematize scientific and technical information on a topic (task); - ability to analyze and systematize modern problems of nanotechnologies and nanoscale structures; - the ability to find and process information; - the ability to interpret, present and apply the results obtained; - the ability to acquire new knowledge; - Skills of presentation with a report at a conference or seminar. 	Research module (R&D)	
critically evaluate data and draw conclusions	<ul style="list-style-type: none"> - possession of technological methods for creating new materials and the use of standards and other regulatory documents in assessing the quality control of products; - the ability to analyze various methods and technological routes for obtaining new materials for solving a specific problem; - the ability to conduct complex research, testing and diagnostics of materials, including standard and certification tests; - the ability to conduct research on nano-objects using scanning tunneling, atomic force and electron transmission microscopes. 	Practice-oriented module	
research and evaluate the application of new and emerging technologies in their discipline.	<ul style="list-style-type: none"> - the ability to identify new areas of research, new problems in the field of nanotechnology and diagnostics of nanomaterials, the possibilities of creating new functional materials with their subsequent use in practice; - the ability to formulate technical specifications, develop and use technical means in carrying out technological processes for obtaining and processing nanomaterials, and compose the necessary set of technical documentation; - skills in the development, commissioning and operation of science-intensive technological and analytical equipment; - the ability to solve applied engineering and technical and economic problems with the help of application software packages. 	Research module Practice-oriented module	
Engineering practice			

Graduates are able to		
Classify and systematically combine knowledge from different fields and solve complex problems;	<ul style="list-style-type: none"> - Have practical skills that are necessary when applying methods for solving problems, obtaining and processing materials for process analysis; - be able to determine a rational combination of the main technical and economic indicators for obtaining materials and equipment. 	Surface Engineering Module Practice-oriented module
Quickly, methodically and systematically familiarize yourself with the new and the unknown;	<ul style="list-style-type: none"> - use information technology to select the necessary materials and equipment in the manufacture of finished products. 	Advanced Materials Science Module
evaluate applicable methods and their scope;	<ul style="list-style-type: none"> - ability to apply modern methods of research, testing and quality control of materials, films and coatings; - possession of experience with research equipment; - the ability to assess the economic efficiency of technological processes; - master the methods of studying nano-objects using scanning tunneling, atomic force and electron transmission microscopes. 	Module of innovative technologies in materials science Practice-oriented module
To be able to reflect the non-technical effects of engineering activities systematically and with full responsibility to integrate them into their actions	<ul style="list-style-type: none"> - be able to apply the methods of researching materials and developing technologies for obtaining new materials and introducing them into production. 	Practice-oriented module
Broad application skills		
Graduates		
meet all the skills requirements for the broad application of the first cycle of the bachelor's program for the more demanding level of the second cycle of the master's degree;	<p>The graduate must show:</p> <ul style="list-style-type: none"> - the ability to logically present acquired knowledge and demonstrate an understanding of systemic relationships within the discipline, as well as interdisciplinary relationships in modern science; - the ability to build technologies for teaching new knowledge; - possession of approaches and methods of critical analysis, the ability to use them in practice in relation to various cultural forms and processes of modern society; 	Final assessment module
function effectively as the leader of a team that may be composed of different disciplines and levels;	<p>Be able to build interpersonal relationships in a team and work in a team</p> <ul style="list-style-type: none"> - have organizational skills, be able to create mobile working groups to achieve their goals and be able to manage such a group, be able to protect their rights and require them to fulfill their duties; 	Final assessment module
work and communicate effectively at the national and international level	<p>have fundamental professional training, organize and conduct research and experimental research activities in the chosen direction, be recognized nationally or internationally. An indicator of recognition is publications in scientific journals with a high impact factor, carried out by international and domestic scientific projects together with foreign partners.</p>	Final assessment module