

Ministry of Science and Higher Education of the Republic of Kazakhstan
Karaganda University of the name of academician E.A. Buketov

«APPROVED BY»

The decision of the Administration of
NLC «Karaganda University of the name of academician E.A. Buketov»

Protocol № 5 21.05.2024

prof. N.O. Dulatbekov

«APPROVED BY»

The decision of the Directory Board of
NLC «Karaganda University of the name of academician E.A. Buketov»

Protocol № 5 21.06.2024

EDUCATIONAL PROGRAM

8D05402- Mechanics

Level: Doctoral studies (PhD)

Karaganda,
2024

APPROVAL SHEET

EDUCATIONAL PROGRAM «8D05402- Mechanics»

«AGREED» by
Director of the Kazakhstan Multidisciplinary
Institute of Reconstruction and Development
(KazMIRP) of Karaganda Technical University
named after Ahykkassaginov»



Nuguzhinov Zh.S.

«AGREED»
President of the Kazakhstan Geotechnical Association

Zhusubekov A.Z.

« 18 » 04



The educational program "8D05402- Mechanics" was developed on the basis of:

- the Law of the Republic of Kazakhstan of July 27, 2007 No. 319-III "About education"
- the Law of the Republic of Kazakhstan of July 11, 1997 No. 151-I. "About languages in the Republic of Kazakhstan" ,
- Order of the Minister of Science and Higher Education and the Republic of Kazakhstan dated July 20, 2022 No. 2 “State compulsory standard of higher and postgraduate education”
- a national frame of qualifications of March 16, 2016 the Republican tripartite commission on social partnership and regulation of the social and labor relations.
- Order of the Ministry of Education and Science of the Republic of Kazakhstan “On approval of the Rules for the organization of the educational process on credit technology of education” dated October 2, 2018 No. 152
- the classifier of areas of training with higher and postgraduate education from October 13, 2018. No. 569.
- professional standard "Teacher" (Addendum to the order of the Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" dated June 8, 2017 No. 133)
- Recommended by the decision of the Academic Council of the University for entry into force on September 1, 2020.

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Passport of the educational program

1. **Code and name of the educational program:** 8D05402 - Mechanics
2. **Code and classification of the field of education, areas of training:** «8D05 Natural sciences, mathematics and statistics », «8D054 Mathematics and statistics»
3. **Group of educational programs:** D093 - Mechanics
4. **Volume of credits:** 180 ECTS
5. **Form of study:** full-time
6. **Language of instruction:** Russian
7. **Degree awarded:** Doctor of Philosophy (PhD) in the educational program «8D05402-Mechanics»
8. **Educational program type:** new
9. **Level according to the ISCE (International Standard Classification of Education) – 8th level**
10. **Level according to the NQF (National Qualifications Framework) – 8th level**
11. **Level according to the SQF (Sectoral Qualifications Framework) – 8th level**
12. **Distinctive features of the EP:** no
13. **Application number to the license for the direction of personnel training:** KZ 83LAA00018495 from 07/28/2020
14. **The name of the accreditation body and the validity period of the accreditation of the EP:**
15. **The purpose of the EP:** Preparation of competitive PhD doctors of the scientific and pedagogical direction, possessing modern competencies and skills, techniques and technologies that contribute to solving issues that arise in industrial enterprises, specialized research and educational organizations, in construction by providing deep theoretical knowledge and practical experience in the field of mechanics and robotics.
16. **Qualification characteristics of the graduate in the EP «8D05402-Mechanics»**
 - a) **List of graduate positions:**
 - scientific researcher in the field of mechanics and robotics;
 - teacher for a number of subjects of the natural-technical cycle of bachelor's, master's, doctoral studies in higher education;
 - engineer in research and production institutions;
 - engineer in production institutions;
 - mechanical engineer;
 - design engineer;
 - individual entrepreneur;
 - head of a construction company, etc.
 - b) **Scope and objects of professional activity for the graduate:** The scope of professional activity for graduates in the educational program «8D05402-Mechanics» are research activities in the field of mechanics and robotics; engineering. The objects of professional activity for graduates are: activities in research and production and production organizations.

c) Types of professional activity of the graduate:

Doctoral students in the educational program "8D05402-Mechanics" can perform the following types of professional activities:

- experimental and research;
- calculated and designed;
- organizational and managerial;
- scientific and research;
- pedagogical (teaching in master's and doctoral studies), etc.

d) Functions of the graduate's professional activity:

- design and construction of new buildings;
- calculation of necessary objects using new engineering programs;
- comprehensive inspection of hydraulic structures;
- проектирование зданий и сооружений;
- research work in areas related to the use of mechanics and robotics;
- creation and use of mechanical and mathematical models for solving applied problems of natural science, technology, economics and management by effective methods;
 - development of the theoretical foundations of the experiment, tools, methods of planning and processing of the experiment; development of software systems, bringing them to the level of practical implementation using modern computer technology;
 - development of algorithmic provision for the processes of collection, presentation, processing and use of information.

17. Formulation of learning outcomes based on competencies

Type of competencies	Code of learning result	Learning Outcome (according to Bloom's Taxonomy)
Behavioral skills and personality traits (Sof skills)	LO1	Prepares scientific articles for publication in peer-reviewed journals, develops skills in using scientific literature on a research topic, translates scientific literature from English, presents scientific achievements in the field of natural sciences.
	LO2	Plans and conducts comprehensive research within the framework of the dissertation work, including interdisciplinary, based on a holistic systematic scientific worldview, illustrates and applies critical analysis, evaluates modern scientific achievements, offers options and evaluates new ideas in solving research and practical problems, including in interdisciplinary fields.
Professional competencies (Hardskills)	LO3	Illustrates the main problems of fundamental areas of mechanics and analyzes, solves issues related to the following sections and concepts: theory of elasticity, creep and plasticity.
	LO4	Synthesizes research and pedagogical experience, forming a rational method of presenting information on complex structural theories of elasticity, theories of plasticity and creep theory, and subsequently presents and reports the results of scientific research on the topic of a doctoral dissertation.
Digital skills	LO5	Fluent in numerical methods for solving problems of mechanics and robotics, modern measurement methods in computational experiment, theoretical foundations of application software packages, basic methods of mathematical modeling of various problems of mechanics provided by the program, information exchange with other application programs.
	LO6	Knows how to substantiate the essence, method of application, advantages and disadvantages of various methods of mechanics and robotics, methods of calculating structural elements under conditions of their durability and economy, advantages and disadvantages of certain structures.
	LO7	Studies and streamlines, and later apply methods for calculating structures, numerical methods in the mechanics of a deformable solid body, techniques for the dynamics of robotic systems, and designs of actuators and manipulators.

18. Determination for modules of disciplines in accordance with the learning outcome

Code of learning result	Module name	Name of disciplines	Volume (ECTS)
LO1, LO2	Methodological basics of research	Academic writing (in English)	5
		Methods of scientific research	5
LO3, LO4	Actual problems of mechanics	Actual problems of the theory of elasticity, plasticity and creep	5
		Teaching practice	10
		Research practice	10
LO4, LO5, LO6, LO7	Applied mechanics	Modern methods for calculating structures Numerical methods in the mechanics of a deformable solid body	5
		Design of executive mechanisms and manipulators Dynamics of robotic systems	5
LO1, LO2, LO3, LO4, LO5, LO6, LO7	Research work by a doctoral candidate	Research work of a doctoral candidate, including internships and doctoral thesis	123
	Final assessment	Writing and defending doctoral thesis	12

19. Achievability matrix of learning outcomes

№.№ п/п	Name of disciplines	Short description of discipline / RWDS	Number of credits	Learning Outcome Codes						
				LO1	LO2	LO3	LO4	LO5	LO6	LO7
Cycle of basic disciplines University component										
D1	Academic writing (in English)	The discipline is studied in order to form competencies related to analytical research and textual activities; skills of analytical-synthetic, critical and pragmatic thinking. In the process of studying the discipline, the types, methods and ethical principles of writing scientific texts, the principles of constructing a scientific text and preparing it for publication, the design of a bibliographic list, the basic rules for quoting scientific literature, the types of annotations and the features of their compilation, reviewing a scientific text are considered.	5	+	+					
D2	Methods of scientific research	The discipline is studied in order to form the skills of doctoral students to carry out independent research activities; the use of scientific research methods to achieve the objectives set in the dissertation research; the use of methods of processing empirical data on the topic of their dissertation research.	5	+	+					
D3	Teaching practice	The purpose of pedagogical practice is the formation of knowledge, professional competencies to prepare for pedagogical activity in higher educational institutions, conducting training sessions in special disciplines and intensifying the work of doctoral students when performing research with the use of innovative educational technologies.	10			+	+			
Cycle of basic disciplines Component of choice										
D4	Modern methods for calculating structures Numerical methods in the mechanics of a deformable solid body	<p>The purpose of mastering the discipline is the formation of knowledge on the calculation and design of building structures of buildings and structures. The course allows you to gain knowledge about the general characteristics of numerical methods: finite difference methods; finite element methods; about triangular finite elements of structures; about quadrangular finite elements of structures; about increasing the order of approximations; about three-dimensional problems; about spline functions; about one-dimensional splines; about the method of splines of the third degree, fifth degree; about the creation of geometric on the comparative analysis of the accuracy of numerical methods; on the finite elements of the complexes LIRA, ANSYS; on solutions of nonlinear problems in the packages LIRA and ANSYS.</p> <p>The purpose of mastering the discipline is the formation of knowledge by doctoral students of the basic numerical methods for studying the stress-strain state of solids. The course is designed to study general equations of solid mechanics: finite difference and finite element methods; boundary element method; numerical solutions of the theory of elasticity and the Flamman and Kelvin equations; the effect of a rigid die on an elastic half-plane; the stress state of an elastic band; numerical modeling of the stress-strain state of a beam and the stress-strain state of frame structures; numerical solutions spatial theory of elasticity, Boussinesq and Cerruti equations; numerical simulation of the stress-strain state of plates and shells.</p>	5				+	+	+	+

Major disciplines University component											
D5	Research practice	The purpose of the research practice is for doctoral students to study the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as to consolidate practical skills in applying modern methods of scientific research, processing and interpretation of experimental data in dissertation research.	10				+	+			
D6	Actual problems of the theory of elasticity, plasticity and creep	The purpose of mastering the discipline is the formation of doctoral students' knowledge in the field of the theory of elasticity, plasticity and creep, mastering the skills of calculations in the field of mechanics of a deformable solid. The course involves the study of basic hypotheses and formulas in the theory of elasticity; variational methods in the theory of elasticity; solutions of the plane and spatial problems of the theory of elasticity by the finite element method; fundamentals of the theory of plasticity and creep; theory of small elastic-plastic deformations; concepts of the theory of plastic flow; formulation of the problem of the theory of plasticity; numerical methods for solving problems of plasticity; basic dependencies of the theory of creep; creep and relaxation in solids; generalized elastic-viscous body model.	5				+	+			
Major disciplines. Component Selectable											
D7	Design of executive mechanisms and manipulators Dynamics of robotic systems	<p>The purpose of mastering the discipline is the formation of knowledge and professional competencies in the design of actuators, manipulators and mathematical descriptions of their work, the ability to design, develop schemes and create designs of actuators and manipulators; prepare design documentation; apply for a patent; study the kinematics of multi-link manipulators; direct and inverse problems about positions, speeds and accelerations matrix methods for solving problems; force and dynamic analysis in the mechanics of manipulators; solving direct and inverse problems of dynamics; determination of generalized forces and reactions in kinematic pairs; compilation of control algorithms for actuators and manipulators; mastering methods for forming the trajectory of the robot in various coordinate systems.</p> <p>The purpose of mastering the discipline is the formation of system knowledge and professional competence in the methods of dynamic control of robotic systems, the development of basic concepts that are used in calculating the dynamics of robotic systems: classification of robotic systems; generalized coordinates and forces; the method of virtual movements and work; the ability to solve equations of motion; direct and inverse problems of dynamics; possession of conservation laws and basic principles; Euler-Lagrange method for a robotic system; Newton-Euler method for multi-link robotic systems; properties of equations of motion of robotic systems and their use in the analysis of their dynamics, trajectory planning and synthesis of control algorithms.</p>	5					+	+	+	+
Research work of a doctoral student											
D8	Research work of a doctoral candidate, including internships and doctoral thesis	The purpose of the research work of a doctoral candidate is to form the level of knowledge, skills and abilities of research activity necessary for the implementation of professional activities and to prepare for the defense of a doctoral dissertation. Includes independent scientific research, foreign scientific internship, preparation of scientific publications, completion of a doctoral dissertation.	123	-	-	-	-	-	-	-	

20. Coordination of the planned learning outcomes with teaching and assessment methods within the module

Learning Outcomes	Planned learning outcomes for the module	Teaching methods	Assessment Methods
PO1	Prepares scientific articles for publication in peer-reviewed journals, develops skills in using scientific literature on a research topic, translates scientific literature from English, presents scientific achievements in the field of natural sciences.	Dialogue Round table Project training oral presentation	Test control Oral questioning Abstract preparation Essay writing
PO2	Plans and conducts comprehensive research within the framework of the dissertation work, including interdisciplinary, based on a holistic systematic scientific worldview, illustrates and applies critical analysis, evaluates modern scientific achievements, offers options and evaluates new ideas in solving research and practical problems, including in interdisciplinary fields.	Discussion Demonstration Interactive lecture Working with scientific materials	Testing Oral questioning Abstract preparation Essay writing
PO3	Illustrates the main problems of fundamental areas of mechanics and analyzes, solves issues related to the following sections and concepts: theory of elasticity, creep and plasticity.	Video lecture Practical work Analysis and problem solving Exercises	Test control Written control Colloquium Settlement and graphic task
PO4	Synthesizes research and pedagogical experience, forming a rational method of presenting information on complex structural theories of elasticity, theories of plasticity and creep theory, and subsequently presents and reports the results of scientific research on the topic of a doctoral dissertation.	Educational discussion Practical work Analysis and problem solving Exercises	Test control Written control Colloquium Settlement and graphic task
PO5	Fluent in numerical methods for solving problems of mechanics and robotics, modern measurement methods in computational experiment, theoretical foundations of application software packages, basic methods of mathematical modeling of various problems of mechanics provided by the program, information exchange with other application programs.	Video lecture Problematic presentation Reproductive Exercises	Test control Written control Colloquium Settlement and graphic task
PO6	Knows how to substantiate the essence, method of application, advantages and disadvantages of various methods of mechanics and robotics, methods of calculating structural elements under conditions of their durability and economy, advantages and disadvantages of certain structures.	Interactive lecture Research Heuristic Analysis and problem solving	Test control Written control Colloquium Settlement and graphic task
PO7	Studies and streamlines, and later apply methods for calculating structures, numerical methods in the mechanics of a deformable solid body, techniques for the dynamics of robotic systems, and designs of actuators and manipulators.	Working with literature Research Explanatory and illustrative Partially-search engine	Test control Written control Colloquium Settlement and graphic task

21. Criteria for assessing the achievability of learning outcomes of EP 8D05402 – Mechanics

LO codes	Criteria
LO1	Knows: The structural features of academic texts of a technical nature, the purpose of scientific achievements in the natural sciences
	Skills: Implementing social strategies, considering ethical standards, organising a professional educational process
	Possesses: English language skills to prepare scientific articles for publication in peer-reviewed journals
LO2	Knows: Complex dissertation research
	Skills: Independent planning and design of research activities
	Possesses: New ideas for solving problems in research and practice
LO3	Knows: Current problems of mechanics: Theory of elasticity, plasticity and creep deformation
	Skills: Analysis and presentation of scientific data from different areas of mechanics and robotics using innovative technology
	Possesses: The ability to assess the consequences of the decision taken and to answer for it to himself, his colleagues and society, taking into account all ethical norms and social strategies
LO4	Knows: Principles for the description and analysis of deformable solid mechanics and the dynamics of robotic systems
	Skills: Designing, developing schemes and creating constructions
	Possesses: Higher education technology, scientific research culture, and the use of modern information and communication technologies in the educational process
LO5	Knows: Methods for solving problems in mechanics and robotics
	Skills: Use of modern application software packages in conducting research
	Possesses: The specifics of presenting the results of scientific activity in domestic and international research teams in the national and foreign languages
LO6	Knows: Methods of calculating construction
	Skills: Demonstrate in-depth knowledge of methods for solving problems in mechanics and robotics
	Possesses: Modern methods for calculating constructions, numerical methods in the mechanics of deformable solid bodies
LO7	Knows: The requirements for research activities
	Skills: Self-improvement in a professional field
	Possesses: The capacity for constant professional growth, self-improvement

22. Graduate model of the educational program «8D05402-Mechanics»

Graduate attributes::

- In-depth subject knowledge in their field of study
- Interest in mastering trends in education and science
- Ability to cooperate in the professional community
- Ability to independently shape their own activities
- Ability to integrate new ideas
- Independence in seeking opportunities for professional and personal development
- Sociability
- Tolerance and courtesy
- Academic honesty

Types of competencies	Description of competencies
Behavioural skills and personality traits (Softskills)	<ul style="list-style-type: none"> • ability to comply with ethical standards in professional activities • ability to plan and solve problems of one's own professional and personal development • willingness to use modern methods and technologies of scientific communication in state and foreign languages
Professional competencies (Hardskills))	<ul style="list-style-type: none"> • ability to design and conduct complex research, including interdisciplinary research, based on a scientific worldview and using knowledge of mechanics and robotics • ability to design and conduct complex research, including interdisciplinary research, based on a scientific worldview using knowledge of higher mathematics • ability to create and apply mechanical and mathematical models to effectively solve problems in mechanics and robotics • ability to apply knowledge of mechanics, robotics and mathematics in the dissertation
Digital skills	<ul style="list-style-type: none"> • ability to develop software systems in conducting research using innovative educational technologies • ability to master modern methods of measuring in a computational experiment • ability to assess the relevance, perspective and significance of the work under study • the ability to critically analyse and evaluate modern scientific achievements, to develop new ideas in solving research and practical problems, also in interdisciplinary fields • willingness to participate in the work of national and international research teams to solve scientific and scientific-educational problems • readiness to teach in the main educational programmes of higher education

Members of the working group:

Head of the Prof. T.G. Mustafin Department "Algebra, Mathematical Logic and Geometry
 PhD, Associate Professor, T.G. Mustafin Department of Algebra, Mathematical Logic and Geometry
 Master, Senior Lecturer, Prof. T.G. Mustafin Department of Algebra, Mathematical Logic and Geometry

Employers:

The educational program was reviewed by the Faculty Council. 19.04.2024 protocol № 7
 The educational program was reviewed at the meeting of the Academic Council 19.04.2024 protocol № 5
 The educational program was reviewed and approved at the meeting of the University Council 24.05.2024 protocol № 8

Member of the Board, Vice-Rector for Academic Affairs
 Director of the Department of Academic Work Department
 Dean of the Faculty of Mathematics and Information Technology

N.K.Medeubaev
 S.B.Akhazhanov
 B.M.Nurlanova
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