**«Approved»**
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# GRADUATE MODEL (BACHELOR)
## Educational program

## 6B07310 – Land Management and Cadastre
## (B075 – Cadastre and Land Management)

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# Introduction

The specialist model should have a systematic nature, reflecting the advantages of both the qualification-based and competency-based approaches.

In the competency-based model, the goals of education are linked not only to the performance of specific functions, but also to integrated requirements for the outcomes of the educational process.

The competency-based approach encompasses, along with specific knowledge and skills, such categories as the ability and willingness to learn, social skills, and more.

Modern conditions in the field of geospatial digital technologies, particularly in the area of cadastre and land management, impose new requirements on graduates. Among them, increasing priority is given to the need for systematically organized, intellectual, communicative, and self-organizing qualities.

The quality of professional training of a bachelor in the field of cadastre and land management depends on the degree of justification of three key aspects:

The goals and objectives of the educational program.

The content of the training.

The principles of organizing the educational process.

Taking into account the opinions of potential consumers and the association of graduates of KazNITU named after K.I. Satpayev, in accordance with the University's mission and the requirements of the State Compulsory Educational Standard of the Republic of Kazakhstan, the goals and objectives of the educational program for the specialty 6B07310 – Land Management and Cadastre were formulated

The curriculum must meet the requirements of the modern level of development in the field of cadastre and land management, which the bachelor studies throughout the entire period of education.

The competency matrix is a tool for determining the minimum skills required of a bachelor in the educational program of the specialty 6B07310 – Land Management and Cadastre.

The structure of the matrix allows for the assessment of the minimum level of competence necessary for career development. It serves as a foundation for establishing future industry standards and can be utilized by companies to assess the qualifications required of their personnel.

The specialist model in the field of geospatial digital technologies includes the following provisions:

- competencies determined by the development of modern science and technology;
- competencies dictated by the requirements of the profession and specialty;
- competencies shaped by the socio-political structure of the country and its moral and spiritual system.

The model of a specialist in the field of cadastre and land management has historically been embodied in various forms, ranging from qualification characteristics to professional profiles.

To acquire a set of professional, intercultural, and communicative competencies, a graduate of the educational program 6B07310 – Land Management and Cadastre must master a comprehensive body of knowledge across general education (GE), basic (BE), and specialized (SE) disciplines, including both the mandatory and elective components, as established by the state standard.

In today's world, the ability to navigate the flow of information is of great importance: this includes the ability to find and systematize various sources of information according to specific criteria; to use rational methods of acquiring, transforming, organizing, and storing information; to apply it in relevant situations of intellectual and cognitive activity; as well as computer literacy, proficiency in modern information and multimedia technologies, and the ability to critically evaluate information.

**Objective:** The objective of the educational program is to train graduates as competitive specialists in the field of cadastre and land management, equipped with critical thinking skills and the ability to apply theoretical and practical knowledge to perform land management and cadastral tasks. These include land and real estate monitoring, cadastral and economic valuation of land and other real estate objects, as well as the application of regulatory frameworks in project development.

A graduate in the field of cadastre and land management must be prepared to:

- carry out organizational activities that prevent negative phenomena in professional practice, contribute to the development of spiritual values and moral-ethical standards of the individual as a member of society, and adhere to the legal system of the Republic of Kazakhstan with a high level of professional culture and civic responsibility;
- engage in continuous self-improvement and personal development, mastering new knowledge, skills, and abilities in innovative areas of cadastre and land management;
- acquire competencies necessary for performing land management and cadastral work related to land and real estate monitoring, cadastral and economic valuation of land and other real estate properties, and application of legal and regulatory frameworks in project development;
- achieve competitiveness in the field of cadastre and land management by enhancing their expertise in advanced cadastral and land management technologies.

## 2. List of Qualifications and Positions

A bachelor's degree graduate of the educational program 6B07310 – Land Management and Cadastre is awarded the academic degree of Bachelor in the field of Geospatial Digital Technologies.

Qualifications and positions are defined in accordance with the National Qualifications Framework (NQF), approved by the protocol of March 16, 2016, by the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations.

A graduate who has completed the educational program in this field of study is prepared to perform the following professional tasks in accordance with the types of professional activities:

- Monitor compliance with the land legislation of the Republic of Kazakhstan by government bodies, individuals, legal entities, and officials.
- Interpret the rules for land use, maintenance of the land cadastre and land management, as well as implementation of measures for the rational use and protection of land.
- Apply modern geodetic equipment, including UAVs, ground-based and satellite positioning technologies, in solving cadastral and land management tasks. Apply GIS technologies to address land cadastre and land management tasks, including conducting cadastral registration within GIS environments and spatially anchoring land plots. Use practical skills and analyze methods for the creation and updating of digital topographic bases for cadastral plans and maps, as well as for the automation of cartographic processes using specialized software.
- Provide cartographic support for territorial planning and the management of industrial placement, national defense needs, protection and rational use of natural resources, and the implementation of environmental programs.
- Carry out soil classification and diagnostics, assess major soil types based on morphological, chemical, and physico-mechanical characteristics. Understand the factors contributing to soil fertility decline and the methods for their mitigation, including land reclamation and soil protection. Be proficient in methods of soil evaluation, calculating bonitet scores, and creating soil maps using GIS technologies.
- Compile, edit, and publish cadastral maps.

**Organizational and managerial activities:**

- Organizing, planning, and managing land management and cadastral works;
- Creating current and forecast cadastral maps.

**Design and survey activities:**

- Organizing and standardizing labor in the field of cadastre and land management;
- Preparing project and estimate documentation for the execution of cadastral and land management works.

**Types of Professional Activities**

Bachelors of the educational program 6B07310 – Land Management and Cadastre may engage in the following types of professional activities:

- Organizational and managerial activities;
- Design, calculation, and analytical activities;

**3. Descriptors**

The field of professional activity includes all sectors of the economy related to the effective management of land resources, including: agricultural land; land of settlements (cities, towns, and rural localities); land for industrial, transport, communication, defense, and other non-agricultural purposes; land of specially protected natural areas; land for health, recreational, and historical-cultural purposes; forest fund land;water fund land; reserve land.

**The objects of professional activity include:**

the land resources of the Republic in all categories; all types of land ownership and land use, including those located within the boundaries of cities, towns, and rural settlements, regardless of their classification by category, designated use, or form of ownership.

**The subjects of professional activity include:** geodetic work in land management; theoretical foundations of land management; fundamentals of cadastre; soil science; geoinformatics; landscape science; engineering arrangement of territories; photogrammetric work and digital mapping; land resource management; organization and planning of land and cadastral works; land use monitoring; state registration and accounting of land; forecasting of land resource use; land reclamation; technical inventory of real estate; parcel-level land management; settlement cadastre; state control over land use and protection; land valuation; land and real estate market; land management for peasant (farmer) households; land management design; remote sensing of the Earth.

## Structure of the Bachelor's Program

**4. General Competencies**

**4.1 Socio-humanitarian competencies**

Knowledge of the laws of socio-economic development of society, the history of Kazakhstan, the state language, foreign and Russian languages as means of interethnic communication.

Understanding the importance of one's social functions as a citizen of the country and a member of society, and a stable, positive attitude toward civic duties. Knowledge of the state symbols (coat of arms, flag, anthem).

Knowledge of human and civil rights and freedoms, and the ability to exercise them in various life situations. The ability to align one’s personal interests with those of society. A commitment to the improvement and development of society based on the principles of humanism, freedom, and democracy. Experience in socially beneficial civic activities.Possession of a defined life stance and an internal readiness to act on it. The ability to take responsibility, participate in the functioning and improvement of democratic institutions. A strong need for self-development.

Knowledge and adherence to the principles of a healthy lifestyle, physical culture, freedom and responsibility in making lifestyle choices.

A graduate must possess a culture of thinking, understand its general laws, and be able to present ideas correctly and logically in both written and oral form. Knowledge and observance of traditions, rituals, and etiquette. The ability to engage in constructive communication and maintain its optimal duration; the ability to conduct a civilized dialogue. Knowledge of constructive methods for resolving conflicts and restoring disrupted relationships. A critical attitude toward oneself and one’s interlocutor, as well as the ability to recognize one's own mistakes and acknowledge correctness in others in a timely manner.

Skills in public speaking and written communication, as well as foreign language communication. Experience in interacting with diverse individuals (of different ages, statuses, and professions), the ability to build partnerships, work in a team, organize the work of subordinates, and find and make managerial decisions.

A graduate must be familiar with ethical and legal norms that regulate human relationships with others, society, and the environment.

**4.2 Economic and Organizational-Managerial Competencies**

A graduate must have knowledge of the fundamentals of production relations and management principles, taking into account technical, financial, and human factors. They should possess the basics of economic analysis and be prepared to perform organizational and managerial functions within a team.

**General Scientific Competencies**

The foundation for professional education is ensured through in-depth knowledge in natural and general technical sciences, achieved by studying subjects such as mathematics, physics, engineering, and computer graphics. General scientific competencies also include information literacy: proficiency in modern information and multimedia technologies, the ability to work with large volumes of data using Big Data tools and techniques. The ability to navigate information flows based on GIS technologies: the skill to find and systematize various sources of information according to specific criteria and to classify them; to apply rational methods of acquiring, transforming, organizing, and storing information; and to update and use it in relevant situations of intellectual and cognitive activity with the help of database management systems (DBMS).

**General Technical Competencies**

A bachelor must be competent in all matters related to the stages of land management and the creation of land parcel cadastres.

These competencies are developed through the study of disciplines such as information and communication technologies, ecology and sustainable development, life safety, engineering and computer graphics.

The professional capabilities of a bachelor under modern conditions must meet the requirements of the global international labor market.

A bachelor should be prepared for changes in social, economic, and professional roles, and be geographically and socially mobile in the context of increasing dynamism and uncertainty.

**5. Professional Competencies**

The purpose of the cycle of specialized disciplines (SD) is to develop proficiency in the key theoretical aspects of methodology, techniques, and technologies in the field of cadastre and land management for solving professional tasks related to: production and technological activities, organizational and managerial activities, design and survey activities.

**Research Activities:**

– Carry out soil diagnostics, assess main soil types based on morphological, chemical, and physical-mechanical characteristics. Identify factors contributing to soil fertility degradation. Be proficient in soil evaluation methods, calculating soil quality scores (bonitet scores), and creating soil maps using GIS technologies;

– Apply fundamental patterns of territorial physical-geographical differentiation of the geographical environment, properties of natural landscapes and their structures, as well as natural and anthropogenic factors that determine landscape functioning and development. Classify natural and anthropogenic landscapes, design landscape maps and maps of physical-geographical zoning using data from aerospace remote sensing.

**Production and Technological Activities:**

– Apply methods for land and real estate management. Organize and carry out cadastral and land management works, including the determination of land parcel boundaries using modern geodetic equipment while adhering to safety regulations;

– Use remote sensing data for solving cadastral and land management tasks; perform aerial photography of land plots using unmanned aerial vehicles (UAVs); process geospatial data and apply GIS technologies for creating cadastral and soil maps, digital terrain models, and object models;

– Apply GIS technologies, systems engineering methodology, automated design systems, ICT standards, and modern programming languages in professional activities.

**Organizational and Managerial Activities:**

– Organize and manage land and cadastral operations based on the current and projected state of the land fund;

– Establish land parcel boundaries and ownership to ensure the issuance of legal documents in accordance with the legislation of the Republic of Kazakhstan;

– Monitor the rational use of land being put into operation and ensure compliance with environmental safety standards.

**Design and Survey Activities:**

– Carry out work related to labor organization and standardization in the field of cadastre and land management;

– Prepare design and estimate documentation for the implementation of land and cadastral works.

**Functions of Professional Activity**

A bachelor in their professional activity performs the following functions:

– Preparation of technical documentation and mandatory reporting according to approved forms;

– Conducting training and briefings on safety techniques, labor protection, and environmental protection;

– Monitoring compliance with requirements for the preparation of land and cadastral documentation.

**Typical Tasks of Professional Activity**

Professional competencies and skills are aimed at the ability to solve the following typical professional tasks:

− Use modern geodetic equipment, including UAVs (unmanned aerial vehicles), ground-based and satellite positioning technologies in solving cadastral and land management tasks;

− Apply GIS technologies to solve land cadastre and land management tasks, including performing cadastral registration within a GIS environment and spatial demarcation of land plots. Utilize practical skills and analyze methods for creating and updating digital topographic bases of cadastral plans and maps, as well as automate cartographic work using specialized software.

− Comply with the regulatory and legal framework for cadastral land valuation; apply methods of zoning urban and rural areas; perform state cadastral land valuation. Interpret the cadastral and market value of a land plot and the results of their examination. Determine economic efficiency when preparing estimate documentation;

− Monitor compliance with the land legislation of the Republic of Kazakhstan by government bodies, individuals, legal entities, and officials. Interpret the rules for land use, maintaining the land cadastre and land management, and implementing measures for the rational use and protection of land.

− Conduct classification and diagnostics of soils, assess major soil types based on morphological, chemical, and physical-mechanical characteristics. Understand the factors contributing to soil fertility degradation and methods for their remediation, as well as soil reclamation and protection. Possess skills in soil assessment, calculation of soil quality scores (bonitet scores), and creation of soil maps using GIS technologies;

− Apply the fundamental patterns of territorial physical-geographical differentiation of the Earth's geographical shell, the properties of natural landscapes and their structures, and both natural and anthropogenic factors influencing the functioning and development of landscapes. Classify natural and anthropogenic landscapes, design landscape maps and maps of physical-geographical zoning using remote sensing data.

− Use modern methods of land and real estate management. Organize and carry out cadastral and land management works, including the determination of land parcel boundaries using digital geodetic equipment, in compliance with safety and life protection regulations;

− Process and utilize remote sensing data in solving cadastral and land management tasks; conduct aerial photography of land plots using unmanned aerial vehicles (UAVs); perform photogeometric processing of geodetic data; apply GIS technologies to create cadastral and soil maps, as well as digital terrain and object models.

− Apply GIS technologies, systems engineering methodology, computer-aided design systems, information and communication technology standards, and modern programming languages in professional activities.

**Areas of Professional Activity**

The areas of professional activity, based on the level and specialization of skills in accordance with the type of work performed, include: land and cadastral administrations; land relations departments; GIS centers; RSE on PVC “State Institute of Agricultural Aerial Survey and Geodesy (GISKhAGI)” of the Committee for Land Resources Management of the Ministry of Agriculture of the Republic of Kazakhstan; Technical Inventory Bureaus; Akimats; Public Service Centers (TsON); branches of the NJSC “State Corporation ‘Government for Citizens’,” and others.

**Content of Professional Activity**

The professional activity of a bachelor is defined by a set of specialized theoretical knowledge and practical skills acquired during the course of study and is based on:

- receiving a comprehensive and high-quality professional education in the field of cadastre and land management, confirmed by the level of knowledge, skills, and competencies in accordance with the criteria and evaluation standards set by the State Educational Standard in terms of both content and volume;
- training professional and competitive specialists in the field of cadastre and land management;
- the ability to apply knowledge of fundamental and applied sciences;
- using methods for analyzing and evaluating experimental results;
- the ability to use methods, skills, and modern technical tools necessary for practical engineering activities in the field of cadastre and land management;
- the ability to find and work with relevant literature, computer-based information, databases, and other sources of information to solve assigned tasks;
- developing teamwork skills, professional and ethical responsibility, the ability to understand problems, and collaboratively find solutions through interaction with specialists from various fields, as well as the drive to continually improve knowledge and skills;
- the ability to work in interdisciplinary teams while demonstrating individuality and, when necessary, solving tasks independently;
- readiness for professional activity through courses that provide fundamental knowledge, practical skills, and experience in industries, government agencies, and educational institutions;

- the ability to conduct analysis and monitoring, and to make managerial decisions based on the results;
- possessing broad knowledge, awareness of current social and political issues, proficiency in the state language, Russian, and a foreign language, as well as knowledge of market economy tools, safety, and environmental protection.

**Requirements for Key Competencies of a Bachelor in the Educational Program 6B07310 – Land Management and Cadastre**

A bachelor **should have an understanding of:**

- coordinate systems;
- plans, maps, and profiles;
- methods and measurements of topographic surveys;
- staking out projects in the field;
- area determination;
- the basics of land management;
- land distribution within the Land Fund of the Republic of Kazakhstan;
- the structure of the land resources system;
- land classification according to suitability;
- the fundamentals of land, water, legal, and multifunctional cadastres;
- the system of land accounting, registration, and valuation.

**Should know:**

- the mathematical basis of maps and types of cartographic projections;
- cartographic methods of relief representation;
- methods for creating maps using software products;
- land legislation of the Republic of Kazakhstan;
- theoretical foundations of the state land cadastre;
- principles of territorial organization of production and land distribution by land use types;
- factors, mechanisms, and history of anthropogenic landscape formation, as well as principles of anthropogenic compatibility;
- factors of soil fertility degradation and methods of their elimination, land reclamation, and soil protection;
- basic knowledge for solving theoretical and practical professional tasks in the field of land reclamation and recultivation.

**Should be able to:**

- process results using software products;
- apply knowledge to manage land resources and real estate, as well as to organize and conduct cadastral and land management works;
- analyze natural and socio-economic systems through computer modeling based on Geographic Information Systems (GIS);
- use methods for planning and organizing cadastral works, and perform calculations to optimize land management and cadastral operations;
- use modern automated GIS systems to solve cadastral tasks;

- monitor the use of land plots based on compliance with land protection and rational use measures;
- perform geodetic measurements using modern geodetic instruments.

**Should have skills in:**

- describing cartographic objects and spatial relationships such as combinations, intersections, and adjacency of terrain features;
- using the - basics of computer networks and understanding how they work, as well as analyzing the principles of GIS servers;
- using UAVs (unmanned aerial vehicles) to effectively collect data on the condition of land resources;
- creating orthophotos, digital terrain models (DTM), and digital elevation models (DEM);
- processing UAV data in software such as Agisoft, ArcGIS, and QGIS;
- performing photogrammetric processing of images in ENVI software;
- processing and analyzing satellite imagery data to solve cadastral and land management tasks.

**Should be competent in:**

- the field of cadastre and land management;
- the labor legislation of the Republic of Kazakhstan;
- the land legislation of the Republic of Kazakhstan.

**General National Educational Goals and Hierarchy of Goals (by Course Cycles)**The training of a bachelor under the educational program 6B07310 – Land Management and Cadastre aims to:

- implement democratic principles of managing the educational process in practice, expanding academic freedom and the capabilities of higher education institutions;
- ensure the adaptation of higher education and scientific research in the field to the changing needs of society and advancements in scientific thought;
- ensure the recognition of the level of specialist training in other countries;
- provide greater mobility for graduates in the changing conditions of the labor market.

**Goal of the General Education Disciplines (GED) Cycle**

- To provide socio-humanitarian education based on knowledge of the laws of socio-economic development of society, the history of Kazakhstan, modern information technologies, the state language, as well as foreign and Russian languages as means of interethnic communication.

- Goal of the Basic Disciplines (BD) Cycle
  - To provide in-depth knowledge in the fields of natural sciences, general engineering, and economics as the foundation for professional education.

**Goal of the Professional Disciplines (PD) Cycle**

To study the key theoretical aspects of technologies and technical methods in the field of cadastre and land management in order to solve professional tasks in the following areas: research activities, production and technological activities, **organizational and managerial activities, design and survey activities.**

**Requirements for the Level of Education of Graduates**

**General Educational Requirements**

The main requirement for general education is that the graduate receives a comprehensive and high-quality professional education, confirmed by the level of knowledge, skills, abilities, and competencies, based on the criteria established by the state compulsory education standard, and assessed both in terms of content and volume.

**Requirements for Social and Ethical Competence**

The graduate must possess humanitarian culture, ethical and legal norms in relation to individuals, society, and the environment, as well as a developed culture of thinking.

**Requirements for Economic and Organizational-Managerial Competence**

The graduate must have mastered the basic laws of economic development, the factors affecting the techno-economic efficiency of production, knowledge of sociology and psychology in enterprise management, and the ability to qualitatively and quantitatively substantiate managerial decisions.

**Requirements for Professional Competence**

The graduate must have professional knowledge in their subject area, understand the fundamentals of industrial relations and management principles taking into account technical, financial, and human factors. The graduate must have a strong foundation in the creation and application of modern technologies in their field of study as well as in related areas. According to their chosen educational trajectory and field of activity, the graduate must have sufficient knowledge, skills, abilities, and competencies to properly define and solve cartographic and geodetic problems within their professional domain.

Requirements for Readiness to Adapt to Changing Social, Economic, and Professional Roles, and for Geographic and Social Mobility

In modern conditions, the professional capabilities of a bachelor's degree specialist must meet the demands of the global and international labor market. The graduate must be ready to adapt to changing social, economic, and professional roles and demonstrate geographic and social mobility in a dynamic and uncertain world.

**Requirements for Academic Knowledge in Core Curricula**

The educational requirements for core academic disciplines are determined by the specific content of the working curriculum of the educational program. To acquire a set of professional, intercultural, and communicative competencies, the graduate must master the knowledge of general education (GE), basic (BC), and professional (PC) disciplines, including both mandatory and elective components, in accordance with their chosen educational trajectory, in full (no less than 240 credits) as defined by the current state standard.

Expected Learning Outcomes by Year of Study

**Year 1:**The focus is on the development of personality, and the ethical and legal foundations of behavior. General knowledge of socio-economic development laws and the history of Kazakhstan is firmly established. Knowledge of the state language, foreign and Russian languages is improved to a professional level. Further

development of mathematical analysis and skills in natural sciences continues, along with mastering elements of computer graphics and the logic of descriptive geometry for future use.

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