

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE
REPUBLIC OF KAZAKHSTAN**



GRADUATE PROFILE (MASTER'S DEGREE)

**Of Educational Program
7M06101 – Software Engineering
(M094 «Information Technologies»)**

Алматы, 2024

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INTRODUCTION

The main concept of the educational program 7M06101 – «Software Engineering» is to implement a continuous process of training scientific, pedagogical and professional personnel capable of creating and researching innovative software solutions and integrated computing systems. The program is aimed at training a new generation of specialists with in-depth knowledge and competencies for scientific and engineering activities in the field of software development.

The peculiarity of the educational program «Software Engineering» consists in the competencies acquired by graduates who have been trained in this program. The planning of the content and organization of the educational process are carried out by the University within the framework of the credit technology of education, which provides flexibility and individualization of the educational trajectory of undergraduates.

The Master's degree in scientific and pedagogical direction implements educational programs of postgraduate education to train specialists capable of teaching and research activities focused on the use of advanced software development technologies, distributed systems architecture and big data. The content of the program includes:

- theoretical training in basic and core disciplines that create the basis for a deep understanding of the principles of software development;
- practical training in the form of professional and research internships;
- research work aimed at completing a master's thesis;
- final certification, which allows to comprehensively assess the achievements of students.

The educational program 7M06101 – «Software Engineering» provides training for competitive specialists capable of developing and implementing high-tech software products, designing complex information systems and solving complex engineering problems. Thus, the content of educational program 7M06101 – «Software Engineering» is aimed at the formation of professional competencies necessary for graduates to work in the modern IT sector and scientific activities.

1 Goals and objectives of the educational program 7M06101 – «Software Engineering»

Purpose: The purpose of the educational program is to prepare masters of technical sciences with specialized competencies in the study of integrated solutions for the development of computer systems software.

To provide practice-oriented training of specialists in engineering and scientific activities in the field of software development who are able to apply various technologies, knowledge and skills of software development and design activities with a focus on in-depth study of aspects of creating complex software systems and applications, the use of modern architectural solutions for software development and a detailed study of hardware and technical capabilities of computer technologies.

Tasks:

- application of advanced programming languages and methodologies for the development of highly reliable and scalable software;
- development and implementation of microservice architecture, the use of containerization and cloud technologies to increase the flexibility and manageability of software systems;
- design and implementation of CI/CD processes to accelerate software deployment and updates;
- optimization of the performance of software solutions, taking into account the requirements of reliability and ease of maintenance.
- planning and management of IT projects using modern methodologies such as Agile, Scrum, Waterfall;
- analysis and optimization of the enterprise architecture using corporate governance tools;
- implementation of information technology management methodologies and evaluation of their effectiveness;
- analysis of the prospects for the development of information management to increase the competitiveness of the organization.
- protection and management of intellectual property in the process of software development and research;
- preparation of patents and scientific publications supporting research and innovation projects;
- development of copyright protection and licensing strategies for products and technologies;
- analysis of legal aspects and protection of research results for their effective implementation.

- design and implementation of highly loaded distributed systems that ensure stability and safety under real loads;
- managing the processing of large amounts of data and optimizing system performance;
- analysis and use of architectural solutions to increase the scalability of systems;
- creation of infrastructure for distributed data processing in real time.
- application of decision theory and quantitative methods to analyze and solve complex management problems;
- the use of forecasting and data analysis to justify management decisions;
- development and application of project analysis and management methods to improve the efficiency of business processes;
- Modeling strategies using game theory to achieve optimal results.
- development and implementation of sustainable development strategies, taking into account international standards and best practices;
- assessment and analysis of the effectiveness of sustainable development strategies in enterprises and organizations;
- implementation of the principles of sustainable development in software design and development processes;
- conducting research on the impact of digital technologies on environmental sustainability and social responsibility of business.
- design and deployment of cloud solutions for data storage, processing and analysis;
- development and optimization of migration processes of legacy systems to the cloud environment;
- ensuring data security and confidentiality in cloud systems;
- analysis and improvement of corporate cloud systems, taking into account the requirements of business and users.
- creation of mathematical and computer models for the analysis and forecasting of changes in ecosystems;
- development and application of modeling methods to support solutions in the field of natural resource management;
- analyzing ecosystem data and building models to assess the sustainability of natural systems;
- designing systems for monitoring and analyzing ecosystems using IoT and machine learning technologies.
- teaching disciplines related to software engineering and information and communication technologies in colleges and universities;
- Project and team management, mentoring, and educational process development in «Software Engineering».

2 List of Qualifications and Positions

A graduate of the specialty 7M06101 – «Software Engineering» is awarded an academic degree of Master of Technical Sciences. The educational program has been developed in accordance with the State Mandatory Standards of Higher and Postgraduate Education, approved by Order No. 2 of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 (registered in the Register of State Registration of Normative Legal Acts under No. 28916) and reflects the learning outcomes on the basis of which curricula are developed (working curricula, individual curricula of students) and working curricula in disciplines (syllabuses).

Graduates of the specialty 7M06101 – «Software Engineering» can hold the following positions:

- software engineer;
- Software developer;
- Specialist in IT project management;
- software systems architect;
- specialist in cloud technologies and high-load systems;
- data analyst;
- Research associate;
- university teacher.

The field of professional activity of the graduate is all sectors of the economy where modern IT solutions are required, including software development, high-load and cloud systems, data management, IT project management, scientific and educational institutions.

The objects of the master's professional activity are:

- information systems and technologies designed for processing, storing and transmitting data;
- software architectures, including microservices and distributed systems;
- computing and analytical systems developed for big data and high-load tasks;
- cloud computing platforms and sustainable development models integrated into IT projects.

3 Descriptors

The requirements for the level of training of a graduate student in the 7M06101 – «Software Engineering» program are determined on the basis of the Dublin descriptors of the second level of higher education (Master's degree) and reflect the acquired competencies expressed in the learning outcomes.

Learning outcomes are formulated both at the level of the entire educational program and at the level of individual modules or disciplines. Descriptors represent the results that characterize the graduate's ability:

- demonstrate developing knowledge and understanding in the field of software development, based on modern achievements and methodologies, and apply the acquired knowledge in a research and practical context;

- to use professional knowledge, skills and approaches to solve complex technical problems in a new environment, including in interdisciplinary areas where IT technology plays a key role;

- to collect, analyze and interpret data to form informed judgments, taking into account the social, ethical and scientific aspects of the application of information technology;

- clearly and accurately convey information, ideas, conclusions and solutions to problems, as well as present the results of their work within the framework of team projects and scientific research;

- to demonstrate self-study skills necessary for continuous professional development and research activities in the field of software system development and management.

4 Competencies upon completion of training

4.1 Requirements for the key competencies of graduates of the scientific and pedagogical Master's degree

Knowledge of:

- The role of science and education in society.
- Contemporary trends in scientific inquiry.
- Current methodological and philosophical challenges in natural, social, humanitarian, and economic sciences.
- Professional competencies of higher education faculty.
- Contradictions and socio-economic consequences of globalization processes.

Understanding of:

- The methodology of scientific research.
- Principles of organizing scientific activities.
- Psychology of students' cognitive processes.
- Psychological methods to enhance learning efficiency.

Skills in:

- Applying knowledge to foster original development and implementation of ideas in research.
- Critically analyzing existing concepts and theories.
- Integrating knowledge from diverse fields to address research challenges.
- Making judgments and decisions under conditions of incomplete information.
- Using psychological and pedagogical knowledge in teaching practices.
- Employing interactive teaching methods.
- Conducting information and analytical work using modern technologies.
- Thinking creatively and solving novel problems.

Competent in:

- Scientific research and solving typical academic challenges.
- Conducting educational activities within a credit-based teaching system.
- Utilizing modern information technologies in the learning process.
- Mastering public speaking and clear communication.
- Self-development and deepening professional knowledge.

Capable of:

- Methodological research work.
- Academic and pedagogical activities in higher education.
- Applying modern educational technologies.
- Conducting scientific research and project management.

Professional Competencies:

- Ability to independently acquire, comprehend, structure, and apply new knowledge and skills in professional activities, fostering innovative capabilities.
- Capacity to independently define research goals and establish a sequence of professional problem-solving steps.
- Practical application of fundamental and applied knowledge in disciplines relevant to the master's program profile.
- Competence in selecting and creatively utilizing modern scientific and technical equipment for addressing scientific and practical tasks.
- Critical analysis, presentation, defense, discussion, and dissemination of professional activity results.
- Proficiency in drafting and formatting scientific and technical documentation, reports, reviews, presentations, and articles.
- Readiness to lead a professional team, embracing social, ethnic, religious, and cultural differences with tolerance.
- Ability to communicate effectively in oral and written form in a foreign language to solve professional tasks.

Universal and Social-Ethical Competencies:

- Capacity for abstract thinking, analysis, and synthesis.
- Use of philosophical knowledge to form a worldview.
- Analysis of the key stages and patterns of historical societal development to shape a civic position.
- Application of basic economic knowledge in various areas of activity.
- Application of legal knowledge for solving tasks across different fields.
- Ability to act in non-standard situations and bear social and ethical responsibility for decisions made.
- Capability for self-development, self-fulfillment, and unlocking creative potential.
- Application of physical culture methods to ensure full social and professional activity.
- Knowledge of first aid techniques and methods for protection in emergencies.

Special and Management Competencies:

- Ability to analyze and evaluate anthropogenic impacts on humans and their environment, including ecological risks, predict negative effects, and assess their consequences.
- Skills in modeling hazardous processes in the technosphere and ensuring the safety of designed systems.
- Proficiency in modern software tools for modeling, forecasting, evaluating, mitigating risks, and managing them.

- Capability to design and calculate safety systems and devices, evaluating their efficiency in specific life activity conditions.
- Ability to identify key environmental hazards based on legal and regulatory acts as well as terminology in life safety and environmental protection.
- Skills in conducting engineering-economic calculations for ensuring technosphere safety, interpreting project documentation, and drafting competent design assignments for safety measures.
- Readiness to lead a professional team while embracing diversity in social, ethnic, religious, and cultural backgrounds.

4.2 Requirements for the research work of a graduate student

- the ability to solve professional problems by integrating fundamental and technical sciences;
- the ability to conduct independent scientific research and analyze experimental data;
- the ability to create and explore models of the studied objects;
- the ability to analyze and apply modern information technologies for scientific tasks.

4.3 Requirements for the organization of practices

The educational program includes teaching and research practices:

- 1) Pedagogical practice is conducted to master teaching methods, attracting undergraduates to undergraduate studies.
- 2) Research practice is aimed at familiarization with the latest research methods, data processing and interpretation, which contributes to the development of professional skills in research work.

5 Requirements for completing studies and obtaining a diploma

To complete the educational program for the preparation of masters of technical sciences in the direction 7M06101 – «Software Engineering», a master's student must master at least 120 credits:

- 88 credits of theoretical training,
- 12 credits for pedagogical and research practice,
- 24 credits of research work of a master's student.

Degree awarded

Graduates of the program are awarded the academic degree «Master of Technical Sciences» in the direction 7M06101 – Software Engineering.

Graduate competencies

A graduate who has completed a master's degree program must have the following competencies:

General professional competencies:

- The ability to independently acquire, comprehend and apply new knowledge and skills in professional activities, and develop an innovative approach.
- Skills in setting research goals and choosing a sequence for solving professional tasks.
- The ability to apply knowledge of fundamental and applied sections of disciplines corresponding to the profile of the master's degree.
- The ability to critically analyze, present and defend the results of professional activity.
- Skills in drawing up technical documentation, writing reports, reviews, reports and scientific articles.
- - Willingness to lead a team, taking into account socio-cultural differences and tolerance.
- Possession of communication skills in a foreign language to solve professional problems.

Professional competencies by type of activity

Engineering, design and research activities:

- The ability to perform complex technical developments in the field of software engineering.
- Ability to analyze and develop distributed systems and architectures.
- Skills in applying machine learning and data analysis methods to solve applied problems.
- The ability to use modeling and analysis methods to design secure software solutions.
- Software optimization and integration skills in complex OT systems.

Production and technological activities

- Skills of independent execution of design and scientific and production works.

- Knowledge of the methods of operation of modern equipment and development tools.
- The ability to apply modern methods of data and information processing for production tasks.
- Software testing and quality assurance skills.
- The ability to manage the software lifecycle, plan and coordinate the development and operation of software solutions.
- Organizational and managerial activities
- Readiness to organize and manage research and production projects.
- The ability to apply regulatory and methodological documents for software development planning.
- The ability to interact with clients and partners using the standards of project and process documentation.
- The ability to evaluate and choose approaches to software development and integration, taking into account risk management.
- Knowledge of decision-making and data analysis methods to optimize the software development process.

Scientific and pedagogical activity

- Skills in conducting seminars, laboratory and practical classes.
- Participation in the development of educational and methodological documentation and educational materials.
- The ability to lead the scientific and educational activities of students in the field of software engineering.

The results of mastering the Master's degree program

The Master's degree program includes the necessary general cultural and professional competencies, ensuring the readiness of graduates for successful professional activity and research work in the field of development and implementation of software systems.

CONCLUSION

The Master's degree program in the direction 7M06101 – «Software Engineering» is aimed at training highly qualified specialists who are able to effectively solve problems in the field of development, implementation and maintenance of software solutions. Graduates of the program will acquire the necessary competencies, including both general professional and specific skills that meet modern requirements of the software industry.

Providing in-depth theoretical knowledge combined with practical skills will allow undergraduates to successfully adapt to rapidly changing labor market conditions and develop in their professional activities. Readiness for critical analysis, innovative approach and effective communication will contribute to the creation of competitive specialists who will be able to make a significant contribution to the development of information technology.

In the learning process, attention is focused on an individual approach to each student, which allows you to develop not only professional, but also personal qualities. The program provides opportunities for scientific and research activities, which helps prepare graduates for further study and development in graduate school or other scientific programs.

Thus, the Software Engineering program is aimed at the formation of not only highly qualified engineers, but also leaders capable of creative thinking and responsible decision-making in the modern technological world.

**Head of the Department of
«Software Engineering»**



Abdoldina F.N.