**AGREED**
Chairman of the
Educational and Methodological
Council of JSC «International Information
Technology University»

**Mustafina A.K.**

«12» December 2024 Protocol of the EMC № 3

**APPROVED**
By the Chairman of the Board - Rector
of the JSC «International Information
Technology University»

**Issakhov A.A.**

«28» February 2025 Protocol of the AC № 10

# EDUCATIONAL PROGRAM

## 8D06105 Data Science

Code and classification of the field of education: 8D06 – Information and communication technologies

Code and classification of study area: 8D061 Information and communication technologies

Group of educational programs: D094 – Information technologies

ISCED level: 8

NQR level: 8

ORC level: 8

Academic Degree Awarded: Doctor of Philosophy PhD in the educational program "8D06105 Data Science"

Duration of study: 3 years

Number of credits: 180

**AGREED**
by Director REDPRINT LLP
(Digital Agency NIDGE)

M.M. Ryskeldi

«__» _____ 2025.

**AGREED**
Deputy Director for Research of the Institute of Ionosphere

B.A. Iskakov

«__» _____ 2025.

Almaty, 2025

The code and name of the educational program: **8D06105 «Data Science»**

| № | **Developers of the Educational Program (Position, Academic Degree, Scientific Degree, Full Name)** | **Date** | **Signature** | **Note** |
|---|---|---|---|---|
| 1 | Associate Professor of the Department Mathematical and Computer Modeling, PhD Nurtas M. | | | |
| 2 | Associate Professor of the Department Mathematical and Computer Modeling, PhD Ydyrys A.Zh. | | | |
| 3 | Associate Professor of the Department Mathematical and Computer Modeling, PhD Abdikalikova Z.T. | | | |
| 4 | Associate Professor of the Department Mathematical and Computer Modeling, PhD Alpar S. | | | |

**Contents**

**List of abbreviations and acronyms**

| | |
|---|---|
| BD | Cycle of basic disciplines |
| BC | Basic competency |
| BM | Basic module |
| UC | University component |
| HE | Higher education |
| NMS | National Mandatory Standards of Higher and Post-Graduate Education |
| ATT | Additional types of training |
| EQF | European qualifications framework |
| EFE | European foundation for education |
| KSA | Knowledge, Skills and Abilities |
| FA | Final attestation |
| EC | Elective component |
| ISCED | International Standard Classification of Education |
| NQF | National qualifications framework |
| NQS | National qualifications system |
| GHM | General humanitarian module |
| RC | Required component |
| GEM | General education module |
| GED | Cycle of general education disciplines |
| EP | Educational program |
| GPM | General professional module |
| SQF | Sectoral qualifications framework |
| GEC | General education competency |
| MD | Cycle of major disciplines |
| PI | Professional internship |
| PS | Professional standard |
| PE | Postgraduate education |
| PC | Professional competency |
| PM | Professional module |
| LO | Learning outcome |
| QMS | Quality Management System |
| RW | Research work |

## 1. Description of the educational program

Data Science – is the science of methods for analyzing data and extracting valuable information and knowledge from it. It intersects closely with such areas as machine learning (Machine Learning) and the science of thinking (Cognitive Science) and, of course, technologies for working with big data (Big Data Analysis).

Currently, the main players in the economic world are becoming increasingly aware of the potential of operational data. They are constantly looking for ways to use their data and extract from them as much useful information as possible. The role of data researchers is to help companies solve this problem by acquiring, storing, organizing and processing this scope of information in order to benefit. A specialist in the field of data science and artificial intelligence should have multidisciplinary skills, starting from a thorough knowledge of mathematics and statistics up to the development of IT tools and infrastructure that is necessary for data management and processing. In addition, research scientists must be curious and thirsty to understand the area of application in which they are working.

Doctoral student in Data Science should:

• take and pass 1 course of theoretical training;

• pass all the necessary exams to prove the acquainting of theoretical knowledge;

• conduct research work within 3 years.

In the process of training in doctoral studies, PhD students can get all of the opportunities that are necessary for engaging in scientific activities, in particular they have:

• access to library resources and electronic catalogs;

• opportunity to consult with their research supervisors and other professors;

• opportunity to communicate and consult with leading scientists from various foreign universities;

• possibility of undergoing foreign internships.

## 2. Aim and objectives of the educational program

The *purpose* of the educational program "Data Science" is to prepare doctoral students to extract useful information and identify patterns in a large array of information, as well as testing hypotheses by compiling a mathematical model and developing software for a different range of practical tasks.

*Tasks of the educational program:*

- Develop a deep understanding of key technologies in data science and business analytics: data mining, machine learning, visualization methods, predictive modeling and statistics.
- Practice problem analysis and decision making.
- Get hands-on experience with statistical programming languages and big data tools through research.
- Getting skills to work with neural networks.

## 3. Passport of the academic program

| № | Name | Description |
|---|---|---|
| 1. | Education area code and classification | 8D06 Information and communication technology |
| 2. | Training direction code and classification | 8D061 Information and communication technology |
| 3. | Group of academic programs | D094 Information Technology |
| 4. | Name of the educational program | 8D06105 Data Science |
| 5. | Aim of the educational program | The purpose of the educational program "Data Science" is to prepare doctoral students to extract useful information and identify patterns in a large array of information, as well as testing hypotheses by compiling a mathematical model |

| | | |
|---|---|---|
| | | and developing software for a different range of practical tasks. |
| 6. | Type of the educational program | New EP |
| 7. | Level according to the National Classifications Framework | 8 |
| 8. | Level according to the Sectoral Qualifications Framework | 8 |
| 9. | Distinctive features of the program | |
| 10. | Partner University | |
| 11. | Academic degree awarded | Doctor of Philosophy PhD in the educational program "8D06105 Data Science" |
| 12. | Duration of study | 3 years |
| 13. | Volume of credits | 180 |
| 14. | Language of education | Russian, English |
| 15. | Atlas of new professions | Development engineer artificial neural network |
| 16. | Regional standard | |
| 17. | Availability of an attachment to the training license | Yes |
| 18. | License number for the training area | KZ81LAM00001263 |
| 19. | Availability of program accreditation | Yes |
| 20. | Generated learning outcomes | LO1: Conduct a statistical analysis: build a confidence interval, hypothesis testing, regression and analysis of variance.<br>LO2: Substantiate the results obtained during the study<br>LO3: Solve applied data processing and analysis tasks to identify hidden dependencies in them.<br>LO4: Apply research methodology in data science.LO5: Able to analyze data using the Python programming language.<br>LO5: Able to construct a mathematical model of a practical problem and to develop a computer model (software product)<br>LO6: Able to analyze data using the programming language Python.<br>LO7: Conduct a comprehensive analysis and analytically summarize the results of research work using modern scientific and technological achievements, the skills of independent data collection, study, analysis and generalization. |

## 4. Professional Standards (PS), profession cards, labor functions

| № | Name of the PS | Profession card | Labor functions |
|---|---|---|---|
| 1 | Teaching staff (faculty) of higher education and/or postgraduate education institutions | Lecturer, Assistant Professor in the field of education, higher and/or postgraduate education institutions (HEIs). | Implementation of scientific and methodological work |
| | | | Learning |
| | | Lecturer, Associate Professor (Docent), | Learning |
| | | | Conducting scientific research |

| | | | |
|---|---|---|---|
| | | Professor in the field of education, HEIs. | |
| | | Lecturer, Associate Professor (Docent) in the field of education, HEIs | Learning |
| | | | Conducting scientific research |
| 2 | Software testing | ICT Researcher | Defining the goal and objectives, and the scientific apparatus of the study |
| | | | Conducting research, experimentation and collecting evidence on the topic |
| | | | Analyzing problems to develop solutions using computer hardware and software |

## 5. List of the EP competencies

BC1: Knowledge of the basic methods of spectral problems with symmetric matrices and the solution of arbitrary systems of equations used in production, technology and science;
BC2: The ability to interpret the results of computational experiments, identify trends, make forecasts;
BC3: Ability to implement methods of spectral problems with symmetric matrices and solve arbitrary systems of equations using modern software and programming languages.
BC4: The ability to correctly use the grammatical constructions of the scientific style of speech.
BC5: Ability to write annotations, abstracts, research papers.
BC6: Knowledge of the methodological foundations of research conduction and creativity.
BC7: Knowledge in the field of similarity and modeling, computational experiment.
BC8: Possession of the technique of an optimal experiment design and processing measurement results.
BC9: Readiness for teaching activities in the main educational programs of higher education.
BC10: Ability to prepare and conduct research in accordance with the focus of the doctoral program, using knowledge of basic and core disciplines of EP.
PC1: Know the main optimization methods of the inverse and ill-posed problems used in industry, engineering and science.
PC2: To be able to interpret the results of computational experiments, identify trends, make forecasts.
PC3: Have the skills to implement optimization methods of the inverse and ill-posed problems using modern software and programming languages.
PC4: The ability to use the deep neural network algorithm to solve problems with partial derivatives.
PC5: The ability to illustrate ideas with the short MATLAB scripts, which installs and trains the network.
PC6: The ability to demonstrate the use of modern software for the large-scale image classification task.
PC7: Ability to build decision-making models in situations of conflict and cooperation.
PC8: The introduction of the principles of optimality in specified situations, the axiomatic approach to the mathematical formalization of the concepts of justice and rationality.
PC9: The ability to conduct statistical research and to study modern statistical methods.

## 6. List of learning outcomes of the EP

LO1: Conduct a statistical analysis: build a confidence interval, hypothesis testing, regression and analysis of variance.
LO2: Substantiate the results obtained during the study
LO3: Solve applied data processing and analysis tasks to identify hidden dependencies in them.
LO4: Apply research methodology in data science.LO5: Able to analyze data using the Python programming language.
LO5: Able to construct a mathematical model of a practical problem and to develop a computer model (software product)
LO6: Able to analyze data using the programming language Python.
LO7: Conduct a comprehensive analysis and analytically summarize the results of research work using modern scientific and technological achievements, the skills of independent data collection, study, analysis and generalization.

## 7. Matrix for correlating the learning outcomes of the EP with the formed competencies (V)

| | LO1 | LO2 | LO3 | LO4 | LO5 | LO6 | LO7 |
|---|---|---|---|---|---|---|---|
| **BC1** | | V | | | | | |
| **BC2** | | V | | | | | |
| **BC3** | | V | | | | | |
| **BC4** | V | | | | | | |
| **BC5** | V | | | | | V | |
| **BC6** | V | | | | | | |
| **BC7** | V | | | | | | |
| **BC8** | V | | | | | | |
| **BC9** | V | | | | | | |
| **BC10** | V | | | | | V | |
| **PC1** | | V | | | | | |
| **PC2** | | V | | | | V | |
| **PC3** | | | V | | V | | V |
| **PC4** | | | | | V | | |
| **PC5** | | | | | V | | V |
| **PC6** | | | V | | | | V |
| **PC7** | | | V | | | | |
| **PC8** | | | V | | | | |
| **PC9** | | | | V | | V | |

## 8. The relationship of LO with labor functions

| № | LO | Labor functions |
|---|---|---|
| 1. | LO1 | Conducting scientific research<br>Conducting research, experiment and collecting evidence on the topic |
| 2. | LO2 | Conducting scientific research<br>Conducting research, experiment and collecting evidence on the topic |
| 3. | LO3 | Implementing scientific and methodological work<br>Conducting scientific research |
| 4. | LO4 | Conducting scientific research<br>Defining the goal and objective, and scientific apparatus of the study |
| 5. | LO5 | Conducting research, experiment and collecting evidence on the topic<br>Training |

| | | |
|---|---|---|
| 6. | LO6 | Analyzing problems to develop solutions using computer hardware and software<br>Conducting scientific research<br>Training |
| 7. | LO7 | Conducting scientific research<br>Analyzing problems to develop solutions using computer hardware and software |

**9. Table showing interconnection of competencies, learning outcomes, assessment methods and criteria**

| Competencies of an EP graduate | Competencies expressed in expected learning outcomes | Evaluation criteria | Name of assessment method |
|---|---|---|---|
| **General educational competencies** | | | |
| BC1<br>BC6<br>BC7 | LO2<br>LO1 | Knows the basic concepts in the field of study | Summary |
| | | Reproduces and explains basic concepts in the area under study | Report, message |
| | | Knows the basic concepts in the field of study | Test |
| BC2<br>BC3<br>BC5<br>BC8<br>BC9<br>BC10 | LO2<br>LO1<br>LO6 | Uses knowledge in the area under study in practice | Project |
| | | Solve complex problems based on acquired knowledge | Multi-level tasks and assignments |
| BC4 | LO1 | Able to construct oral speech in a reasoned and clear manner | Round table, discussion, controversy, dispute, debate |
| | | Able to construct oral speech logically and clearly | Interview |
| | | Able to construct written speech logically and clearly | Essay |
| **Professional competencies** | | | |
| PC1<br>PC3<br>PC4<br>PC5<br>PC8 | LO2 | Applies acquired knowledge to solve practical problems | Project |
| | LO3 | Applies acquired knowledge to solve practical problems | Project |
| | LO5 | Applies acquired knowledge to solve practical problems | Project |
| | LO7 | Applies acquired knowledge | Laboratory work |
| PC2<br>PC6<br>PC7 | LO2 | Able to present his ideas in a compelling manner | Laboratory work |
| | LO3 | Able to retrieve necessary information | Colloquium |
| | LO5 | Able to present his ideas in a compelling manner | Laboratory work |
| | LO7 | Able to present his ideas in a compelling manner | Laboratory work |
| PC9 | LO13 | Able to apply acquired knowledge in the chosen additional educational program | Project |
| | LO5 | Able to present his ideas in a compelling manner | Laboratory work |
| | LO7 | Able to present his ideas in a compelling manner | Laboratory work |

**10. Information about the modules of the educational program**

| Module code / Module Name | Complexity of module in credits | Learning outcomes | Criteria for assessing learning outcomes | Module-forming disciplines Code / Name |
|---|---|---|---|---|
| **BASIC MODULES** | | | | |
| BM8501 Scientific and pedagogical training module | 19 | Knowledge of the methodological foundations of scientific knowledge and creativity.<br>Knowledge in the field of similarity and modeling, computational experiment.<br>Competencess in optimal experiment design and processing measurement results.<br>To form skills for the correct use of grammatical constructions of the scientific style of speech.<br>Competences in writing abstracts and research papers.<br>Possession of the pedagogical technique of the teacher. | Verbal survey, testing, report, midterm control, computational and graphic works, Presentation, Report | Research methods<br>Academic writing<br>Teaching practice |
| BM8502 Modern methods of optimization and deep learning module | 8 | Possession of professional skills<br>Know: the basic methods of spectral problems with symmetric matrices and the solutions of arbitrary systems of equations used in industry, engineering and science;<br>Be able to: interpret the results of computational experiments, identify trends, make a forecast;<br>Have skills: implementing methods of spectral problems with symmetric matrices and solving arbitrary systems of equations using modern software and programming languages. | Verbal survey, testing, report, midterm control, computational and graphic works, Presentation, Report | Deep learning in applied mathematics / Nonlinear optimization problems of machine learning<br>Advanced deep learning problems / Game simulation and applications |
| **RESEARCH WORK** | | | | |
| Research work | 123 | Ability to identify the main tasks solved by the IAC.<br>Knowledge of the mathematical support of the specified problems (complex of procedures or subsystem) and the software of the specified problems (complex of procedures or subsystem), the organizational and legal support of the selected task (complex of procedures or subsystem). Systematization and analysis of the actual materials necessary for writing a term paper, a scientific report and a practice report. | Presentation, Report | The research work of a PhD student, including an internship and |

| | | | | |
|---|---|---|---|---|
| | | | | implementation of doctoral thesis |
| **PROFILLING MODULES** | | | | |
| PM8501 Methods and models in machine learning module | 18 | Apply research methodologies in the field of data science.<br>Ability to conduct data analysis using the Python programming language<br>Conduct complex analysis and analytically summarize the results of research work using modern achievements of science and technology, skills of independent data collection, study, analysis and generalization<br>Ability to present their ideas in a reasoned manner<br>Ability to identify the main tasks solved by the IAC.<br>Knowledge of the mathematical support of the specified problems (complex of procedures or subsystem) and the software of the specified problems (complex of procedures or subsystem), the organizational and legal support of the selected task (complex of procedures or subsystem). Systematization and analysis of the actual materials necessary for writing a term paper, a scientific report and a practice report. | Verbal survey, testing, report, midterm control, computational and graphic works, Presentation, Report | Enumerative combinatorics / Applied statistical analysis<br>Machine learning methods and algorithms / Conditionality of systems of linear equations<br>Research practice |

## 11. Information about the disciplines of the educational program

| № | Name of module\discipline | Brief description of discipline (30-50 words) | Labor intensity of discipline in credits | Formed learning outcomes (codes) | Prerequisites | Postrequisites |
|---|---|---|---|---|---|---|
| **Basic disciplines University component** | | | | | | |
| 1. | Academic writing | "Academic Writing" is a compulsory component of the Ph.D. program offered to the IITU Ph.D. It is one-semester five-credit practical course that tailors the students' research skills and English language competence to their professional/research needs in academic writing. Students in this course will do a lot of reading activities, explore academic writing strategies and formats required at the graduate level, and get ready for independent academic writing for the Ph.D. program. By the end of the course, students will organize and present research portfolio, and write a research article outline. | 5 | LO2 | - | - |
| 2. | Teaching practice | Practical skills and competencies in teaching at the university; responsibility and creative attitude to scientific and scientific-pedagogical activity. | 10 | | - | - |
| 3. | Research methods | The course presents for PhD students the methodology of research in the field of information systems. Course topics: the importance of research and some information technology research methodologies, ie formal method, prototyping, experiment and evaluation; methods for writing results, such as writing reports, writing articles, and writing abstracts; registration of research results; writing research proposals. | 4 | LO4 LO7 | - | - |
| **Basic disciplines Elective component** | | | | | | |
| 4. | Elective 1 | | 4 | | | |
| | Advanced deep learning problems | The purpose of the course is to study and apply neural network methods in various tasks, the use of deep learning methods in practical tasks, effective management of neural networks, the use of regularization methods for deep learning and gradient descent algorithm for various types of inverse problems and their application in industry and economics. | 4 | LO3 LO6 LO7 | Neural networks | - |
| | Game simulation and applications | The objectives of the discipline "Game simulation and applications" are the development of professional knowledge in the field of mathematical theory of decision-making, the formation of skills in the field of mathematical modeling of conflict situations and cooperation. Tasks of the discipline: building models of decision-making in situations of conflict and cooperation, mastering the principles of optimality in these situations, the axiomatic approach to the mathematical formalization of the concepts of justice and rationality. | 4 | LO3 LO6 | Methods of math. modeling | - |
| 5. | Elective 3 | | 4 | | | |
| | Nonlinear optimization problems | The purpose of teaching the discipline "Nonlinear optimization problems" is to teach PhD students methods for solving inverse and ill- | 4 | LO3 LO5 LO6 | Machine | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| | of machine learning | posed problems used in data science. Tasks of studying the academic discipline: - mastering optimization methods for solving inverse and ill-posed problems used in practice and in science; - mastering the skills of programming and using commercial programs to solve inverse and incorrect problems and interpret the results of numerical calculations. | | LO7 | learning | |
| | Deep learning in applied mathematics | The purpose of the course is the application and training of deep neural network methods in problems with partial differential equations, as well as the use of stochastic gradient methods to solve applied problems using MATLAB, which configures and trains coursework networks, the use of modern software to solve large-scale image classification problems. | 4 | LO3 LO6 LO7 | Neural networks | - |
| **Major disciplines University component** | | | | | | |
| 6. | Research practice | The practice is supervised by the supervisor of the undergraduate and the head of the research unit. The purpose of research practice: systematization, expansion and consolidation of professional knowledge, the formation of graduate skills in independent research work and experiments conduction. | 10 | | - | - |
| **Major disciplines Elective component** | | | | | | |
| 7. | Elective 4 | | 4 | | | |
| | Applied statistical analysis | To provide doctoral students with knowledge of the variety of modern approaches to statistical research, to explore modern statistical methods, to instill a critical approach in the selection of analysis tools and an awareness of the need for careful testing of the statistical adequacy of the resulting models, as well as to develop skills in meaningful interpretation of the results. | 4 | LO1 LO6 | Statistics | - |
| | Enumerative combinatorics | The aim of the course is to acquire skills in applying the methods of enumerative combinatorics to scientific research in various fields. The course covers topics such as binomial coefficients, the inclusion and exclusion formula, nonlinear repetition: the versatility of Catalan numbers, generating functions, generating functions, the Euler generating function for partitions and the pentagonal formula. | 4 | LO1 LO3 | - | - |
| 8. | Elective 2 | | 4 | | | |
| | Conditionality of systems of linear equations | The purpose of teaching the discipline "Conditionality of systems of linear equations" intended for PhD students is to study on computers spectral problems with symmetric matrices and solutions of arbitrary systems of equations. Tasks of studying the academic discipline: - mastering spectral problems with symmetric matrices and solving arbitrary systems of equations used in practice and in science; - mastering the skills of programming and using commercial programs for solving spectral problems with symmetric matrices and solving arbitrary systems of equations and interpreting the results of numerical calculations. | 4 | LO3 LO6 LO7 | Numerical methods | - |
| | Machine learning methods | "To build a machine learning method, mathematical statistics, numerical methods, mathematical analysis, optimization methods | 4 | LO2 LO5 | Numerical | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| | and algorithms | and various techniques for working with data in digital form are used. Therefore, machine learning belongs to the class of artificial intelligence methods. In the proposed course, machine learning methods are implemented on a specific example of the process of heat transfer and in a homogeneous and heterogeneous environment. First, various classes of problems for the equations of moisture and heat transfer are considered. Then mathematical models of the problems under consideration will be constructed. Methods for solving inverse and incorrect problems for each class of problems are being developed. Algorithms for solving the studied problems are being developed. Codes are compiled and computational experiments are carried out based on known experimental data." | | | meth ods | |
| **Research work<br>Required component** | | | | | | |
| | | | | | | |
| 9. | Doctoral research work | The research work of a PhD student, including an internship and implementation of doctoral thesis | 123 | | - | - |

## 12. Curriculum of the educational program (Platonus)

| № | Module code | Module name in three languages (kaz / rus / eng) | Discipline Code | Discipline name in three languages (kaz / rus / eng) | Cycles (RW, BD, PD) | Components (CS, UC, EC) | Total number of credits (ECTS) | Total number of academic hours | Number of classroom hours | | | | Number of SIS hours | | Form of control (Midterm, End-of-term, examination, CP defense, differential test, DP defense) | Prerequisites (Discipline Code) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total number of classroom hours | Including | | | Total number of SIS hours | Including TSIS | | |
| | | | | | | | | | | lectures | practical classes (sem.) | laboratory classes | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| **1 year** | | | | | | | | | | | | | | | | |
| **1 semester** | | | | | | | | | | | | | | | | |
| 1 | RW | Ғылыми зерттеу жұмысы / Научно-исследовательская работа / Scientific research work | RW8008 | Докоранттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және докторлық диссертациясының орындалуы / Научно-исследовательская работа докторанта, включая прохождение стажировки и выполнение докторской диссертации / The research work of a PhD student, including an internship and implementation of doctoral thesis | RW | CS | 17 | 510 | 0 | 0 | 0 | 0 | 0 | 0 | Report Dif.test | - |
| 2 | BM8501 | Ғылыми-педагогикалық дайындық модулі / Модуль Научно-педагогическая подготовка/ Scientific and pedagogical training module | LAN8001A | Академиялық жазылым / Академическое письмо / Academic writing | CD | UC | 5 | 150 | 45 | 0 | 45 | 0 | 105 | 15 | M, E, Exam | - |
| 5 | BM8502 | Оңтайландырудың және терең оқытудың заманауи әдістері модулі / Модуль Современные методы оптимизации и глубокого обучения / Modern methods of optimization and deep learning module | MAT8512 | Ойын үлгілеу және қосымшалар / Игровое моделирование и приложения / Game simulation and applications | CD | EC | 4 | 120 | 45 | 15 | 15 | 15 | 75 | 15 | M, E, Exam | - |
| | | | MAT8502 | Терең оқытудың озық мәселелері / Продвинутые проблемы глубокого обучения / Advanced deep learning problems | | | | | | | | | | | | |
| 7 | PM8501 | Машиналық оқытудағы әдістер мен модельдер модулі / Модуль | MAT8521 | Машиналық оқыту әдістері мен алгоритмдері / Методы и алгоритмы | PD | EC | 4 | 120 | 45 | 15 | 15 | 15 | 75 | 15 | M, E, Exam | - |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Методы и модели в машинном обучении / Methods and models in machine learning module | | машинного обучения / Machine learning methods and algorithms | | | | | | | | | | | | |
| | | | MAT8520 | Сызықтық теңдеулер жүйесінің шарттылығы / Обусловленность систем линейных уравнений / Conditionality of systems of linear equations | | | | | | | | | | | | |
| | | | | **Total number for a 1 semester:** | | | **30** | **900** | **135** | **30** | **75** | **30** | **255** | **45** | | |
| | | | | **2 semester** | | | | | | | | | | | | |
| 8 | RW | Ғылыми зерттеу жұмысы / Научно-исследовательская работа / Scientific research work | RW8009 | Докоранттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және магистрлік диссертациясының орындалуы (NIRD) / Научно-исследовательская работа докторанта, включая прохождение стажировки и выполнение докторской диссертации (НИРД) / The research work of a PhD student, including an internship and implementation of doctoral thesis (NIRD) | RW | CS | 8 | 240 | 0 | 0 | 0 | 0 | | | Report Dif.test | |
| 3 | BM8501 | Ғылыми-педагогикалық дайындық модулі / Модуль Научно-педагогическая подготовка/ Scientific and pedagogical training module | RM8001 | Зерттеу әдістері / Методы научных исследований / Research methods | CD | UC | 4 | 120 | 45 | 15 | 15 | 15 | 75 | 15 | M, E, Exam | - |
| 4 | BM8502 | Оңтайландырудың және терең оқытудың заманауи әдістері модулі / Модуль Современные методы оптимизации и глубокого обучения / Modern methods of optimization and deep learning module | MAT8511 | Қолданбалы математикада терең оқыту / Глубокое обучение в прикладной математике / Deep learning in applied mathematics | CD | EC | 4 | 120 | 45 | 15 | 15 | 15 | 75 | 15 | M, E, Exam | - |
| | | | MAT8501 | Машиналық оқытудың сызықтық емес оңтайландыру мәселелері / Нелинейные оптимизационные проблемы машинного обучения / Nonlinear optimization problems of machine learning | | | | | | | | | | | | |
| 6 | PM8501 | Машиналық оқытудағы әдістер мен модельдер модулі / Модуль Методы и модели в машинном обучении / Methods and models in machine learning module | MAT8513 | Тізімдік комбинаторика / Перечислительная комбинаторика / Enumerative combinatorics | PD | EC | 4 | 120 | 45 | 15 | 15 | 15 | 75 | 15 | M, E, Exam | - |
| | | | MAT8503 | Қолданбалы статистикалық талдау / Прикладной статистический анализ / Applied statistical analysis | | | | | | | | | | | | |
| 9 | BM8501 | Ғылыми-педагогикалық дайындық модулі / Модуль Научно-педагогическая подготовка/ Scientific and pedagogical training module | PP8501 | Педагогикалық тәжірибе / Педагогическая практика / Teaching practice | CD | UC | 10 | 300 | 0 | 0 | 0 | 0 | 0 | 0 | Report Dif.test | |
| | | | | **Total number for a 2 semester:** | | | **30** | **900** | **90** | **135** | **45** | **45** | **225** | **45** | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **TOTAL NUMBER FOR THE 1 YEAR:** | | | **60** | **1800** | **195** | **90** | **105** | **0** | **465** | **90** | | |
| **2 year** | | | | | | | | | | | | | | | | |
| **3 semester** | | | | | | | | | | | | | | | | |
| 11 | RW | Ғылыми зерттеу жұмысы / Научно-исследовательская работа / Scientific research work | RW8003 | Докторанттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және докторлық диссертациясының орындалуы / Научно-исследовательская работа докторанта, включая прохождение стажировки и выполнение докторской диссертации / The research work of a PhD student, including an internship and implementation of doctoral thesis | RW | CS | 30 | 900 | 0 | 0 | 0 | 0 | 0 | 0 | Report Dif.test | |
| | | | | **Total number for a 3 semester:** | | | **30** | **900** | **0** | **0** | **0** | **0** | **0** | **0** | | |
| **4 semester** | | | | | | | | | | | | | | | | |
| 12 | RW | Ғылыми зерттеу жұмысы / Научно-исследовательская работа / Scientific research work | RW8010 | Докторанттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және докторлық диссертациясының орындалуы / Научно-исследовательская работа докторанта, включая прохождение стажировки и выполнение докторской диссертации / The research work of a PhD student, including an internship and implementation of doctoral thesis | RW | CS | 20 | 600 | 0 | 0 | 0 | 0 | 0 | 0 | Report Dif.test | |
| 13 | PM8501 | Машиналық оқытудағы әдістер мен модельдер модулі / Модуль Методы и модели в машинном обучении / Methods and models in machine learning module | PP8504 | Зерттеу тәжірибесі / Исследовательская практика / Research practice | PD | UC | 10 | 300 | 0 | 0 | 0 | 0 | 0 | 0 | Report Dif.test | |
| | | | | **Total number for a 4 semester:** | | | **30** | **900** | **0** | **0** | **0** | **0** | **0** | **0** | | |
| | | | | **TOTAL NUMBER FOR THE 2 YEAR:** | | | **60** | **1800** | **0** | **0** | **0** | **0** | **0** | **0** | | |
| **3 year** | | | | | | | | | | | | | | | | |
| **5 semester** | | | | | | | | | | | | | | | | |
| 14 | RW | Ғылыми зерттеу жұмысы / Научно-исследовательская работа / Scientific research work | RW8005 | Докторанттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және докторлық диссертациясының орындалуы / Научно-исследовательская работа докторанта, включая прохождение стажировки и выполнение докторской диссертации / The research work of a PhD student, including an internship and implementation of doctoral thesis | RW | CS | 30 | 900 | 0 | 0 | 0 | 0 | 0 | 0 | Report Dif.test | |
| | | | | **Total number for a 5 semester:** | | | **30** | **900** | **0** | **0** | **0** | **0** | **0** | **0** | | |
| **6 semester** | | | | | | | | | | | | | | | | |

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| 15 | RW | Ғылыми зерттеу жұмысы / Научно-исследовательская работа / Scientific research work | RW8006 | Докторанттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және докторлық диссертациясының орындалуы / Научно-исследовательская работа докторанта, включая прохождение стажировки и выполнение докторской диссертации / The research work of a PhD student, including an internship and implementation of doctoral thesis | RW | CS | 18 | 540 | 0 | 0 | 0 | 0 | 0 | 0 | Report Dif.test | |
| 16 | | | | Докторлық диссертацияны жазу және қорғау / Написание и защита докторской диссертации / Writing and defending a doctoral dissertation | | | 12 | 360 | 0 | 0 | 0 | 0 | 0 | 0 | Defence PhD thesis | |
| | | | | **Total number for a 6 semester:** | | | **30** | **900** | **0** | **0** | **0** | **0** | **0** | **0** | | |
| | | | | **TOTAL NUMBER FOR THE 3 YEAR:** | | | **60** | **1800** | **0** | **0** | **0** | **0** | **0** | **0** | | |
| | | | | **TOTAL:** | | | **180** | **5400** | **195** | **90** | **105** | **0** | **465** | **90** | | |