Faculty of «Computer technology and cybersecurity»
Department of «Mathematical and computer modeling»

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«14» 03 2023

6B06112

Data Science

CATALOGUE OF ELECTIVE DISCIPLINES

2023-2027 year of admission

2023 y.

The catalogue of elective disciplines for the EP pf the MCM department is developed on the basis of the working curriculum of the EP "6B06112 Data Science".

The catalogue of elective disciplines was discussed at a meeting of the department of Mathematical and computer modeling

minutes No. № 8 from « 10 » ___02____2023 y.

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1 TERMS AND ABBREVIATIONS

1. 1 Educational program is a single set of basic characteristics of education, including goals, results and content of training, the organization of educational process, ways and methods for their implementation and criteria for assessing learning outcomes.
The content of educational program of higher education consists of three cycles of disciplines - general education disciplines (hereinafter - GED), basic disciplines (hereinafter - BD) and core disciplines (hereinafter - CD).
The cycle of GED includes disciplines of the compulsory component (hereinafter - CC), the university component (hereinafter - UC) and (or) the component of choice (hereinafter - COC). BD and CD include disciplines of UC and COC.

1. 2 Catalogue of elective disciplines (CED) is a systematic annotated list of all COC disciplines, for the entire training period, containing a brief description indicating the purpose of study, a summary of main sections and expected learning outcomes. CED reflects the prerequisites and postrequisites of each academic discipline. It should provide the students with the possibility of an alternative choice of elective disciplines for the formation of an individual educational trajectory.

On the basis of educational program and CED, the students develop individual curricula with the help of advisers.

1. 3 Individual curriculum (IC) is a curriculum formed by the students independently with the help of an advisor for each academic year on the basis of the educational program, the catalogue of elective disciplines or modules;

IC defines an individual educational trajectory of each student separately. It includes disciplines and types of educational activities (internship, experimental research, forms of final certification) of the compulsory component (CC), the university component (UC) and the component of choice (COC).

1. 4 Advisor is a teacher who performs the functions of an academic mentor of a student (according to the appropriate educational program) and assists in choosing a learning path (creating an individual curriculum) and mastering the educational program during the training period.

1. 5 The university component is a list of compulsory educational disciplines determined by the university independently for the mastering of the educational program.

1. 6 The component of choice is a list of academic disciplines and the corresponding minimum amounts of academic credits offered by the university and independently chosen by students in any academic period, taking into account their prerequisites and postrequisites.

1. 7 Elective disciplines are educational disciplines that are a part of the university component and the component of choice in the framework of established academic credits, introduced by organizations of education reflecting the individual preparation of students and taking into account the specifics of socio-economic development, the needs of a particular region and established scientific schools.

1. 8 Postrequisites are the disciplines and (or) modules and other types of academic work, the study of which requires knowledge, skills and competencies acquired at the end of the study of this discipline and (or) modules;

1. 9 Prerequisites are the disciplines and (or) modules and other types of educational work containing knowledge, abilities, skills and competencies necessary for the mastering of the studied discipline and (or) modules;

1. 10 Competencies are the ability of the practical use of acquired knowledge and skills in professional activities.

2 ELECTIVE DISCIPLINES

№	Cycle of discipline	Name of discipline	Semester	Number of credits	Prerequisites
		3 year			
2	CD COC	Economic theory	5	5	
		Startups and entrepreneurship	5	5	
		Fundamentals of ecology and life safety	5	5	
		Fundamentals of law and anti-corruption culture	5	5	
		Research methodology	5	5	
		4 year			
3	CD COC	Methods of nonlinear programming	7	5	Programming in Python
		Deep Learning for Applied Mathematics	7	5	Programming in Python
4	CD COC	Methods for solving inverse ill-posed problems	8	6	Numerical methods, Methods of nonlinear programming
		Deep learning of inverse problems	8	6	Advanced Mathematics for Machine Learning , Deep Learning for Applied Mathematics

3 DESCRIPTION OF ELECTIVE DISCIPLINES

Description of discipline	
Name of the discipline	Economic Theory
The aim of study of a discipline	To reveal the origin and main stages of the development of economic theory as a science; the subject of economic theory; methods of understanding economic processes and their classification; economic categories, laws, and principles; functions of economic theory; the role of economic theory as the theoretical and methodological foundation for other economic disciplines.
Brief course description (main sections)	The course provides an overview of the principles and patterns of economic relations. This course aims to assist students in studying the precise categorical-conceptual framework of the economic system of society, based on a new technology for organizing the positive process, at a time when the market transformation of the economy has only begun, and the theoretical understanding of what is happening is not yet complete.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Students will gain sufficient knowledge of the economic framework, the ability to understand the theoretical positions of various economic schools, the essence, and the mechanism of the functioning of economic laws.

Description of discipline	
Name of the discipline	Startups and Entrepreneurship
The aim of study of a discipline	To provide students with systematic and practical knowledge about the process of realizing a technological product from idea to market launch.
Brief course description (main sections)	The course is designed to help students develop IT competencies, entrepreneurial skills, teamwork, business skills, and soft skills.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	• Ability to create startup teams and independently exist in the market. • Proficiency in entrepreneurial thinking tools. • Skills in interacting with business mentors. • Skills in determining the optimal model for monetizing their project. • Project management skills. • Knowledge of how technological startups are created and understanding how to apply this knowledge to their own projects • Ability to identify the target audience for their project.

Description of discipline	
Name of the discipline	Fundamentals of law and anti-corruption culture
The aim of study of a discipline	The goal of the course is to establish the foundations of an anti-corruption culture, forming the ability to describe the essence and causes of corruption in society.
Brief course description (main sections)	Within the framework of the course, students will become familiar with concepts such as anti-corruption awareness and anti-corruption culture, gain knowledge about corruption as a phenomenon of modern reality and its historical roots. The course develops skills for working with legislation in the field of combating corruption and fosters a civic stance towards this issue. This course is aimed at improving anti-corruption culture and forming a morally ethical foundation in society.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Acquires knowledge, skills, and abilities in combating corruption.

Description of discipline	
Name of the discipline	Fundamentals of ecology and life safety
The aim of study of a discipline	To provide students with the volume of theoretical knowledge and practical skills necessary to solve the following tasks: • Creating normal conditions in areas of human labor and recreation; • Developing and implementing measures to protect humans and their environment from harmful effects;

	• Designing new technology and technological processes in accordance with modern safety requirements for their operation; • Ensuring the stability of economic facilities and technical systems in normal conditions and emergencies; • Forecasting and assessing the consequences of emergencies; • Making decisions to protect the population, production personnel, and property from the consequences of accidents, disasters, natural and man-made hazards, and applying protective measures in case of emergencies, as well as taking measures for response and liquidation.
Brief course description (main sections)	This higher education course studies methods of safe interaction between humans and their environment (industrial, domestic, urban, natural), sustainable operation of economic facilities (organizations) under emergency conditions, issues of protection from negative factors, prevention and elimination of the consequences of natural and man-made emergencies, and the application of modern protective measures.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	• Ability to create normal conditions in areas of human labor and recreation. • Development and implementation of measures to protect humans and their environment from harmful impacts. • Designing new technology and technological processes in accordance with modern safety requirements for their operation. • Ability to forecast and assess the consequences of emergencies. • □ Making decisions to protect the population, industrial personnel, and property from the consequences of accidents, disasters, natural hazards, and the use of modern protective measures, as well as taking actions for their mitigation.

Description of discipline	
Name of the discipline	Research Methodology
Postrequisites	Writing and defense of a diploma project
The aim of study of a discipline	The course develops an understanding of the evidence-based approach in education. It introduces students to the concept of an information base for decision-making, evaluation of effectiveness of changes, programs, and policies. The course develops knowledge and skills for conducting and interpreting research results using various research designs, as well as qualitative and quantitative data collection methods.
Brief course description (main sections)	The course focuses on activities aimed at developing students' ability to independently formulate theoretical and practical judgments and conclusions, skills in objectively evaluating scientific information, independence in scientific research, and the aspiration to apply scientific knowledge in educational activities, including for the completion of a diploma project (work).

Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	• Able to write a research paper using LaTeX. • Designs research instruments in accordance with research questions and goals. • Able to determine the optimal way to access respondents/informants. • Proficient in techniques of participant observation. • Demonstrates knowledge of research ethics at all stages of conducting qualitative research. • Able to conduct initial data analysis. • Identifies advantages and limitations of different survey data collection methods. • Justifies the relevance of the research question based on practical tasks and real situation analysis, with support from scientific literature.

Description of discipline	
Name of the discipline	Methods of nonlinear programming
Pretrequisites	Programming in Python
The aim of study of a discipline	The course reveals the distinctions and advantages of nonlinear programming tasks over classical tasks of mathematical analysis, classifies the branches of nonlinear programming, formulates tasks, and classifies methods for solving nonlinear programming problems.
Brief course description (main sections)	In most engineering tasks, constructing a mathematical model cannot be reduced to a linear programming problem. Mathematical models in the design of real objects or technological processes must reflect the actual physical processes occurring within them, which are generally nonlinear. The variables of these objects or processes are interconnected by physical nonlinear laws, such as the laws of mass and energy conservation. They are limited by a specific range that ensures the physical realism of the object or process. As a result, most mathematical programming tasks encountered in research projects and design tasks are nonlinear programming (NLP) problems.

Description of discipline	
Name of the discipline	Deep Learning for Applied Mathematics
Pretrequisites	Programming in Python
The aim of study of a discipline	To introduce students to the theory and practice of deep learning.
Brief course description (main sections)	Deep learning is the dark magic of our time, incredibly powerful and practically accessible to almost everyone, not just giants like Google, Amazon, or Tesla. And for companies themselves, it is important when hiring employees in this field that candidates have experience solving realistic cases. The only prerequisite knowledge required for this course is a basic understanding of Python syntax. Deep learning, of course, is based on mathematics, especially in areas such as linear algebra, probability theory, statistics, and mathematical analysis.

Description of discipline	
Name of the discipline	Methods for Solving Inverse Ill-posed Problems
Prerequisites	Numerical Methods, Nonlinear Programming Methods
The aim of study of a discipline	This course is designed to teach students how to solve inverse ill-posed problems in practice.
Brief course description (main sections)	The course covers methods for constructing a mathematical model of oil transportation through pipelines based on fundamental laws of physics (law of mass conservation). Initial and boundary conditions are set to be as close to practical application as possible. Inverse problems of oil transportation through pipelines are posed. Based on the main model of the direct problem, a mathematical model of the inverse problem is developed. Inverse ill-posed problems are examined.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Students will learn to construct auxiliary and conjugate problems. They will learn to build the gradient of the functional and create an iterative process. A program will be developed, numerical calculations will be conducted, and the obtained results will be analyzed.

Description of discipline	
Name of the discipline	Deep Learning for Inverse Problems
Prerequisites	Advanced Mathematics for Machine Learning, Deep Learning for Applied Mathematics
The aim of study of a discipline	To introduce students to methods for solving inverse practical problems.
Brief course description (main sections)	Approximate methods for solving inverse problems are developed, and algorithms are formulated. The course includes predicting solutions to given problems using machine learning. Computational experiments are conducted, and the output data is analyzed.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Students will master methods for solving inverse practical problems using machine learning. They will learn to formulate solution algorithms, conduct numerical calculations, and analyze the obtained results.