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

APPROVED BY
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7M06114

Artificial Intelligence

CATALOGUE OF ELECTIVE DISCIPLINES

2025 year of admission

2025 y.

The catalogue of elective disciplines for the EP of the MCM department is developed on the basis of the working curriculum of the EP "7M06114 Artificial Intelligence".

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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

No.	Cycle of discipline	Code of discipline	Name of the discipline	Semester	Number of credits	Prerequisites
1 year						
1	CD	SFT7504	Optimization Methods and Game Theory	2	5	
	CD	MAT7572	Deep Reinforcement Learning	2	5	
2	BD	SFT7501	Data Mining and Machine Learning	1	5	
3	BD	SFT7503	Robotics and Intelligent Machines	1	5	
4	BD	RM7502	Fundamentals of research work	2	5	
5	CD	SFT7506	Computational Intelligence and Deep Learning	2	5	
2 year						
6	CD	SFT7511	Cognitive Technologies for Knowledge Accumulation	3	5	
	CD	SFT7512	Cognitive Technologies for Sustainable Development Management	3	5	
7	BD	MAT7543	Artificial Intelligence for Social Good	3	5	
8	BD	SFT7508	Multimedia Information Retrieval and Computer Vision	3	5	
9	CD	SFT7509	Symbolic and Evolutionary AI	3	5	

3 DESCRIPTION OF ELECTIVE DISCIPLINES

Description of discipline	
Code of discipline	SFT7501
Name of discipline	Data Mining and Machine Learning
Number of credits (ECTS)	5 ECTS
Course and semester	1st course 1st semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline Data Mining and Machine Learning is to equip students with theoretical knowledge and practical skills for extracting meaningful patterns from large datasets and building predictive models. The course focuses on core data mining techniques and machine learning algorithms, enabling students to analyze complex data and make data-driven decisions across various application domains.
Brief course description (main sections)	The course introduces fundamental concepts and techniques in data mining and machine learning. It covers data preprocessing, feature selection, and dimensionality reduction, followed by supervised and unsupervised learning methods such as classification, regression, clustering, and association rule mining. Students will study key algorithms including decision trees, k-means, support vector machines, and neural networks. The course also addresses model evaluation, overfitting, and cross-validation techniques. Practical sessions involve applying algorithms to real-world datasets using modern tools and libraries.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon successful completion of the course *Data Mining and Machine Learning*, students will: • Know the fundamental concepts and methods of data mining and machine learning. • Understand the processes of data preprocessing, feature engineering, and model selection. • Be able to apply supervised and unsupervised learning algorithms to real-world data. • Be able to evaluate model performance using appropriate metrics and validation techniques. • Have the skills to implement machine learning solutions using tools such as Python, scikit-learn, and relevant libraries. • Be competent in interpreting results and making data-driven decisions. • Be prepared to apply data mining and machine learning techniques in research and industry projects.

Description of discipline	
Code of discipline	SFT7503
Name of discipline	Robotics and Intelligent Machines
Number of credits (ECTS)	5 ECTS
Course and semester	1st course 1st semester
Department	Mathematical and Computer Modeling

Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline Robotics and Intelligent Machines is to provide students with foundational knowledge and practical skills in the design, control, and programming of robotic systems and intelligent machines. The course also aims to develop an understanding of how robotics integrates with artificial intelligence to enable perception, decision-making, and autonomous behavior.
Brief course description (main sections)	The course covers the fundamental principles of robotics and intelligent machines, including kinematics, dynamics, and control of robotic systems. It introduces sensors, actuators, and embedded systems used in modern robotics. Students will study basic algorithms for perception, localization, path planning, and decision-making. The course also explores the integration of artificial intelligence techniques, such as machine learning and computer vision, to enable autonomy in robots. Practical exercises and projects will provide hands-on experience in programming and controlling robotic platforms.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon successful completion of the course Robotics and Intelligent Machines, students will: • Know the fundamental concepts of robotics, including kinematics, dynamics, and control. • Understand the roles of sensors, actuators, and embedded systems in robotic platforms. • Be able to develop and implement basic algorithms for perception, localization, and motion planning. • Be able to apply artificial intelligence techniques to enhance robotic autonomy and decision-making. • Have the skills to program and control robotic systems in simulation and real environments. • Be competent in integrating hardware and software components for intelligent machine applications. • Be prepared to engage in interdisciplinary research and development in the field of robotics and intelligent systems.

Description of discipline	
Code of discipline	RM7502
Name of discipline	Fundamentals of research work
Number of credits (ECTS)	5 ECTS
Course and semester	1st course 2nd semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline Fundamentals of Research Work is to provide students with a comprehensive understanding of the principles, methodologies, and stages of scientific research. The course aims to develop skills in formulating research problems, conducting literature reviews, designing studies, analyzing results, and presenting findings

	in both written and oral forms. It also emphasizes academic ethics and critical thinking essential for independent research.
Brief course description (main sections)	The course provides an overview of the key stages of scientific research, including the identification of research problems, formulation of hypotheses, and selection of appropriate research methods. It covers techniques for conducting literature reviews, designing research plans, and collecting and analyzing data. Students will learn the structure of scientific papers, how to write research reports, and how to present findings effectively. The course also addresses research ethics, academic integrity, and proper citation practices, preparing students for independent academic or applied research.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon successful completion of the course Fundamentals of Research Work, students will gain knowledge of the key principles and methodologies of scientific research, develop the ability to formulate research questions and hypotheses, and design appropriate research strategies. They will acquire skills in conducting literature reviews, analyzing data, and presenting research findings in both written and oral formats. Students will also demonstrate competencies in academic writing, critical thinking, proper citation, and adherence to research ethics and academic integrity standards.

Description of discipline	
Code of discipline	SFT7506
Name of discipline	Computational Intelligence and Deep Learning
Number of credits (ECTS)	5 ECTS
Course and semester	1st course 2nd semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline Computational Intelligence and Deep Learning is to provide students with a solid foundation in modern intelligent computing techniques, including neural networks, evolutionary algorithms, fuzzy systems, and deep learning architectures. The course aims to equip students with the knowledge and practical skills necessary to design, implement, and apply computational intelligence methods to solve complex, real-world problems.
Brief course description (main sections)	The course explores the fundamental concepts and techniques of computational intelligence and deep learning. It covers key methods such as artificial neural networks, fuzzy logic systems, genetic algorithms, and swarm intelligence. The deep learning component includes topics like feedforward neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs), and deep generative models. Students will learn about model training, optimization, evaluation, and practical applications in areas such as image recognition, natural language processing, and decision support systems. Hands-on projects and programming assignments will reinforce theoretical knowledge through practical implementation.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon successful completion of the course Computational Intelligence and Deep Learning, students will possess a solid understanding of computational intelligence techniques and deep learning architectures. They will be able to design, implement, and evaluate models using

	neural networks, fuzzy systems, and evolutionary algorithms. Students will acquire practical skills in training deep learning models such as CNNs and RNNs for tasks like image and text analysis. They will be capable of applying intelligent computing methods to solve complex real-world problems, interpret results critically, and use modern tools and frameworks such as TensorFlow or PyTorch effectively in research and applied projects.

Description of discipline	
Code of discipline	MAT7543
Name of discipline	Artificial Intelligence for Social Good
Number of credits (ECTS)	5 ECTS
Course and semester	2nd course 3rd semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline Artificial Intelligence for Social Good is to introduce students to the principles, methodologies, and applications of AI aimed at addressing societal challenges. The course focuses on how AI technologies can be designed and applied ethically and responsibly to promote positive social impact in areas such as healthcare, education, environment, public policy, and humanitarian efforts.
Brief course description (main sections)	The course explores the role of artificial intelligence in solving pressing social challenges and creating positive societal impact. It covers fundamental AI concepts alongside real-world applications in domains such as healthcare, education, environmental sustainability, disaster response, and public services. Students will examine case studies, ethical considerations, bias and fairness in AI systems, and the importance of transparency and accountability. The course also introduces frameworks for designing human-centered and socially responsible AI solutions. Through projects and discussions, students will gain practical experience in applying AI tools to real-world problems for the benefit of communities and society.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon successful completion of the course Artificial Intelligence for Social Good, students will understand the core principles and applications of AI in addressing social and humanitarian challenges. They will be able to identify opportunities for applying AI to real-world problems in areas such as healthcare, education, and the environment. Students will gain the ability to design ethical and socially responsible AI solutions, critically evaluate issues related to bias, fairness, and accountability, and apply appropriate AI tools and techniques in socially impactful projects. They will develop interdisciplinary thinking, teamwork, and communication skills necessary for collaborative, community-oriented AI initiatives.

Description of discipline	
Code of discipline	SFT7508
Name of discipline	Multimedia Information Retrieval and Computer Vision
Number of credits (ECTS)	5 ECTS
Course and semester	2nd course 3rd semester

Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline Multimedia Information Retrieval and Computer Vision is to provide students with theoretical knowledge and practical skills in processing, analyzing, and retrieving information from multimedia data such as images, video, and audio. The course focuses on techniques from computer vision and machine learning that enable the understanding and indexing of visual content for applications in search, recognition, and interpretation.
Brief course description (main sections)	The course introduces key concepts and techniques in multimedia information retrieval and computer vision. It covers fundamental topics such as image and video processing, feature extraction, object detection, image classification, and content-based retrieval. Students will learn about descriptors, similarity measures, and indexing methods for efficient retrieval of multimedia content. The course also includes machine learning approaches for visual recognition and deep learning methods such as convolutional neural networks (CNNs). Practical assignments and projects involve implementing retrieval systems and vision algorithms using modern libraries and tools, with applications in areas such as surveillance, media, and human-computer interaction.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon successful completion of the course Multimedia Information Retrieval and Computer Vision, students will have a solid understanding of the principles and algorithms used to analyze and retrieve multimedia content. They will be able to process images and videos, extract relevant features, and apply techniques for object detection, classification, and content-based retrieval. Students will gain practical skills in using machine learning and deep learning methods, particularly convolutional neural networks (CNNs), for visual recognition tasks. They will be competent in developing and evaluating multimedia retrieval systems, interpreting results, and applying these technologies to real-world applications in various domains such as media, healthcare, and security.

Description of discipline	
Code of discipline	SFT7509
Name of discipline	Symbolic and Evolutionary AI
Number of credits (ECTS)	5 ECTS
Course and semester	2nd course 3rd semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline Symbolic and Evolutionary AI is to introduce students to two foundational approaches in artificial intelligence: symbolic reasoning and evolutionary computation. The course aims to develop an understanding of how knowledge representation, logic-based reasoning, and rule-based systems can be combined with biologically inspired algorithms such as genetic algorithms and evolutionary strategies to solve complex, dynamic, and non-linear problems across various domains.
Brief course description (main sections)	The course covers the theoretical foundations and practical applications of symbolic and evolutionary approaches in artificial intelligence. It begins with symbolic AI, focusing on knowledge

	representation, logical reasoning, expert systems, and rule-based inference engines. The course then explores evolutionary AI, including genetic algorithms, genetic programming, evolutionary strategies, and swarm intelligence. Students will examine how these techniques can be applied to optimization, learning, and problem-solving tasks. Emphasis is placed on the integration of symbolic and evolutionary methods, as well as ethical considerations and real-world applications. Hands-on projects and programming assignments will reinforce key concepts through practical implementation.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon successful completion of the course Symbolic and Evolutionary AI, students will understand the core principles of symbolic reasoning and evolutionary computation. They will be able to represent knowledge using formal languages, develop rule-based systems, and implement logical inference mechanisms. Students will also gain skills in designing and applying evolutionary algorithms such as genetic algorithms and genetic programming to solve complex optimization and search problems. They will be competent in integrating symbolic and evolutionary approaches to create intelligent systems and will develop the ability to critically evaluate the strengths and limitations of these methods in real-world applications.

Description of discipline	
Code of discipline	SFT7504
Name of discipline	Optimization Methods and Game Theory
Number of credits (ECTS)	5 ECTS
Course and semester	1st course 2nd semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline "Optimization Methods and Game Theory" for master's students is to deepen their understanding of advanced optimization techniques and strategic decision-making models, equipping them with the analytical and computational tools necessary to formulate and solve complex problems in engineering, economics, and management, including those involving interactions between multiple decision-makers.
Brief course description (main sections)	The course "Optimization Methods and Game Theory" for master's students provides an in-depth study of advanced optimization techniques and strategic interactions among decision-makers. Key sections include: • Advanced optimization methods: linear, nonlinear, convex, and combinatorial optimization; • Duality theory and sensitivity analysis; • Numerical methods and algorithms for large-scale optimization; • Classical and evolutionary game theory: strategic-form and extensive-form games, Nash and subgame-perfect equilibria; • Cooperative games and bargaining solutions;

	• Applications in economics, engineering, operations research, and multi-agent systems. The course balances theoretical foundations with real-world problem-solving using modern computational tools.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon completing the course "Optimization Methods and Game Theory", master's students will: Gain advanced knowledge of optimization theory and game-theoretic models, including linear, nonlinear, and combinatorial methods, as well as equilibrium concepts and solution techniques for strategic interactions. Develop the **ability to model and analyze** complex decision-making problems involving multiple objectives or agents, under constraints and uncertainty. Acquire **practical skills** in applying analytical and numerical methods to real-world optimization and game-theoretic problems using appropriate software tools. Demonstrate **competence** in selecting and implementing suitable mathematical and algorithmic approaches for problem-solving in interdisciplinary contexts such as engineering, economics, and data science.

Description of discipline	
Code of discipline	MAT7572
Name of discipline	Deep Reinforcement Learning
Number of credits (ECTS)	5 ECTS
Course and semester	1^{st} course 2^{nd} semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline "Deep Reinforcement Learning" for master's students is to provide a deep understanding of the theoretical foundations and practical methodologies of reinforcement learning enhanced with deep neural networks, enabling students to design, implement, and analyze intelligent agents capable of learning optimal behaviors in complex, high-dimensional, and uncertain environments.
Brief course description (main sections)	The course "Deep Reinforcement Learning" provides master's students with a comprehensive understanding of how reinforcement learning principles can be combined with deep learning to build intelligent agents that learn from interaction with complex environments. The course covers both theoretical foundations and practical implementations, enabling students to develop scalable algorithms for sequential decision-making problems. Emphasis is placed on real-world applications in areas such as robotics, game playing, and autonomous systems.

Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon completing the course **"Deep Reinforcement Learning"**, master's students will: Acquire **deep theoretical knowledge** of reinforcement learning concepts, including value-based and policy-based methods, as well as the integration of deep neural networks for function approximation. Develop the **ability to model and analyze** complex sequential decision-making problems in high-dimensional and uncertain environments. Gain **practical skills** in designing, implementing, and debugging deep reinforcement learning algorithms using modern frameworks such as TensorFlow or PyTorch. Demonstrate **competence** in applying deep RL techniques to real-world tasks in areas like robotics, autonomous systems, and game AI, along with the ability to critically evaluate and improve algorithmic performance.

Description of discipline	
Code of discipline	SFT7511
Name of discipline	Cognitive Technologies for Knowledge Accumulation
Number of credits (ECTS)	5 ECTS
Course and semester	2nd course 3rd semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master's thesis
The aim of study of a discipline	The aim of the discipline "Cognitive Technologies for Knowledge Accumulation" is to equip master's students with the theoretical foundations and practical tools for developing systems that support intelligent knowledge acquisition, representation, and reasoning. The course focuses on cognitive approaches and AI technologies that enable machines to learn from data and human interaction, accumulate structured knowledge over time, and support decision-making and problem-solving in complex domains.
Brief course description (main sections)	The course "Cognitive Technologies for Knowledge Accumulation" explores the principles and methods of cognitive computing and artificial intelligence aimed at enabling machines to acquire, represent, and organize knowledge effectively. It covers topics such as knowledge representation models, ontologies, natural language processing, machine learning for knowledge extraction, reasoning mechanisms, and knowledge management systems. The course emphasizes practical approaches to building intelligent systems that support continuous learning and decision-making in dynamic and complex environments.

Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon completing the course "Cognitive Technologies for Knowledge Accumulation", students will gain a solid understanding of knowledge representation and reasoning techniques, as well as cognitive approaches to intelligent systems. They will develop the ability to design and implement systems for automated knowledge extraction, organization, and management using AI tools. Students will acquire practical skills in applying natural language processing and machine learning methods for knowledge accumulation and will be competent in developing solutions that support decision-making and learning in complex, dynamic environments.

Description of discipline	
Code of discipline	SFT7512
Name of discipline	Cognitive Technologies for Sustainable Development Management
Number of credits (ECTS)	5 ECTS
Course and semester	2nd course 3rd semester
Department	Mathematical and Computer Modeling
Prerequisites	
Postrequisites	Writing and defense of master’s thesis
The aim of study of a discipline	The aim of the discipline "Cognitive Technologies for Sustainable Development Management" is to provide master’s students with knowledge and skills to apply cognitive computing and artificial intelligence methods for analyzing, modeling, and supporting decision-making processes that promote sustainable development. The course focuses on integrating intelligent technologies to address complex environmental, social, and economic challenges in sustainable management practices.
Brief course description (main sections)	The course "Cognitive Technologies for Sustainable Development Management" introduces master’s students to the application of cognitive computing and AI methods in the context of sustainable development. It covers techniques for data analysis, knowledge modeling, and decision support aimed at addressing environmental, social, and economic challenges. Students learn to develop intelligent systems that facilitate sustainable resource management, policy planning, and monitoring, emphasizing interdisciplinary approaches and real-world applications in sustainable development.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Upon completing the course "Cognitive Technologies for Sustainable Development Management", students will understand the principles of cognitive computing and AI applied to sustainability challenges. They will be able to analyze and model complex systems related to environmental, social, and economic factors using intelligent technologies. Students will develop skills in designing and implementing AI-based decision support systems for sustainable resource management and policy development. They will gain competencies in integrating interdisciplinary data and tools to promote informed, effective, and sustainable management practices.