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

APPROVED BY
Vice-rector for academic affairs
«International Information Technology University» JSC
_____ Umarov T.F.
(Signature) (Full name)
«30» 03 2021 y.

_____ 6B06112 _____
(Code of Academic Program

_____ Data Science _____
(Name of Academic Program)

CATALOGUE OF ELECTIVE DISCIPLINES

2021 year of admission

2021 y.

The catalogue of elective disciplines for the AP 6B06112 Data Science is developed on the basis of the working curriculum of the AP.

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

minutes No. № 8 from «05» March 2021 y.

Head of Department _____ Ydyrys A.Zh.
signature Full name, position, degree

CED compiler _____ Satybaldina A.N.
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The catalogue of elective disciplines was approved at a meeting of the Academic Council of "International Information Technology University" JSC

minutes No. 4 from «30» March 2021 year.

Director of Academic Affairs _____ Mustafina A.K.
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1 TERMS AND ABBREVIATIONS

1. 1 Academic 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 academic 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 academic 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 adviser for each academic year on the basis of the academic 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 academic program) and assists in choosing a learning path (creating an individual curriculum) and mastering the academic 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 academic 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	Code of discipline	Name of discipline	Semester	Number of credits	Prerequisites
			2 year			
1	CD COC	CED6501	Optional discipline No. 1 from CED	4	6	
		SFT6531	Programming in Java			
		SFT6541	Programming in C#			
			3 year			
2	CD COC	CED6506	Optional discipline No. 6 from CED	6	5	
		MAT6536	Methods of nonlinear programming			Introduction to Programming, Algorithms and Data Structures
		MAT6546	Deep Learning for Applied Mathematics			Discrete Mathematics, Computational Mathematics
			4 year			
3	CD COC	CED6502	Optional discipline No. 2 from CED	7	6	
		MAT6532	Methods for Solving Inverse Ill-Posed Problems			Numerical Methods, Nonlinear Programming Methods
		MAT6542	Deep learning of inverse problems			Advanced Mathematics for Machine Learning, Deep Learning for Applied Mathematics
4	CD COC	CED6507	Optional discipline No. 7 from CED	7	6	
		MAT6537	Dynamic programming			Operation Research, Introduction to Programming
		MAT6547	Numerical simulation on MatLab			Numerical Methods
		MAT6513	Integration of business processes (SAP)			Information and communication technology

3 DESCRIPTION OF ELECTIVE DISCIPLINES

Description of discipline	
Code of discipline	SFT6531
Programming in Java	Programming in Java
Number of credits (ESTS)	6
Course, semester	2, 4
Department	MCM
Course author (s)	Olzhayev O.M.
Prerequisites	Introduction to programming
Postrequisites	-
The aim of study of a discipline	The course will introduce students to object-oriented programming using Java. Students are expected to know the basics of scalar types (integers, strings, booleans) and fundamental control structures in procedural programming (loops, assignment statements, conditional expressions). Finally, it will include a short introduction to the Java Framework and Java JDBC.
Brief course description (main sections)	This course was designed to introduce the student to the Java language. Java GUI, Java Database will be studied in this course. Java's unique architecture allows programmers to develop a single application that can run smoothly and reliably across multiple platforms. In this hands-on course, students gain extensive experience with Java and its object-oriented features. Students learn to create robust console and graphical applications, and store and retrieve data from relational databases.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	□ Build robust console and graphical applications. □ Understand the concept of OOP, as well as the purpose and principles of using inheritance, polymorphism, encapsulation, and method overloading. □ Determine the classes, objects, members of the class and the relationship between them, necessary for a specific problem. □ Build Java applications using robust OOP techniques (such as interfaces and APIs) and properly structuring the program (for example, using access control identifiers, automatic documentation via comments, handling error exceptions).

Description of discipline	
Code of discipline	SFT6541
Name of discipline	Programming in C#
Number of credits (ESTS)	6
Course, semester	2, 4
Department	MCM
Course author (s)	Zhanabekov Zh.
Prerequisites	Introduction to programming
Postrequisites	-
The aim of study of a discipline	Create a knowledge system about the .NET Framework class library and the object-oriented C # .NET language. Generate knowledge and skills for developing applications using C # .NET. Develop an understanding and use of the benefits of the .NET platform.
Brief course description (main sections)	The course is designed to develop students' knowledge of some of the tools available in the .NET Framework Class Library. The course will also improve students' knowledge of the C # programming language and teach how to apply object-oriented architecture and design principles to .NET applications written in C # .NET.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	□ • Creation of console / window applications in Visual Studio.NET; □ • Create and use classes and objects in a C # application; □ • Use the concepts of encapsulation, inheritance and polymorphism in console / window applications; □ • Handling process error; □ • Creation of charts and themes. □ • Explain the compiled program documentation.

Description of discipline	
Code of discipline	MAT6536
Name of discipline	Methods of nonlinear programming
Number of credits (ESTS)	5
Course, semester	3, 6
Department	MCM
Course author (s)	Rysbaiuly B.
Prerequisites	Introduction to Programming, Algorithms and Data Structures
Postrequisites	Methods for Solving Inverse Ill-Posed Problems
The aim of study of a discipline	To teach students to apply nonlinear programming methods in solving practical problems.
Brief course description (main sections)	In most problems, the construction of a mathematical model cannot be reduced to a linear programming problem. Mathematical models in the design problems of real objects or technological processes should reflect real physical and, as a rule, nonlinear processes occurring in them. The variables of these objects or processes are interconnected by physical nonlinear laws, such as the laws of conservation of mass or energy. They are limited to the limiting ranges that ensure the physical feasibility of a given object or process. As a result, most of the mathematical programming problems that are encountered in research projects and in design problems are nonlinear programming (NP) problems.
Expected Learning Outcomes (knowledge, abilities, skills, and competencies acquired by students)	Students will master nonlinear programming techniques for solving partial differential equations. They will learn how to draw up algorithms for solving equations, carry out numerical calculations and analyze the results obtained.

Description of discipline	
Code of discipline	MAT6546
Name of discipline	Deep Learning for Applied Mathematics
Number of credits (ESTS)	5
Course, semester	3, 6
Department	MCM
Course author (s)	Nurtas M.
Prerequisites	Discrete Mathematics, Computational Mathematics
Postrequisites	Deep learning inverse problems
The aim of study of a discipline	An introduction to the basic ideas behind deep learning from an applied mathematics perspective.
Brief course description (main sections)	Multilayer artificial neural networks are becoming an increasingly common tool in a variety of applications. At the heart of this deep learning revolution are familiar concepts from applied and computational mathematics, especially from calculus, approximation theory, optimization, and linear algebra. This course focused on four fundamental questions: What is a deep neural network? How is the network trained? What is Stochastic Gradient Method? How to use a deep neural network algorithm to solve problems with partial differential equations. The course illustrates these ideas with a MATLAB shortcode that sets up and trains the network. The course also demonstrates the use of modern software to solve a large-scale image classification problem.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Have an idea of neural networks; be able to train the network; be able to use a neural network algorithm to solve partial differential equations.

Description of discipline	
Code of discipline	MAT6532
Name of discipline	Methods for Solving Inverse Ill-Posed Problems
Number of credits (ESTS)	6
Course, semester	4, 7
Department	MCM
Course author (s)	Rysbaiuly B.
Prerequisites	Numerical methods, methods of nonlinear programming
Postrequisites	-
The aim of study of a discipline	This course was designed to teach students how to solve inverse ill-posed problems of practice.
Brief course description (main sections)	Methods for constructing a mathematical model of oil transportation by pipeline based on the basic laws of physics (the law of conservation of mass) are considered. The initial and boundary conditions are set as close as possible to practice. The inverse problems of oil transportation by pipeline are set. On the basis of the main model of the direct problem, a mathematical model of the inverse problem is developed. Inverse ill-posed problems are considered.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	Students will learn how to build an auxiliary and conjugate problem. Learn to build a functional gradient and build an iterative process. A program is compiled, numerical calculations are carried out and the results are analyzed.

Description of discipline	
Code of discipline	MAT6542
Name of discipline	Deep learning of inverse problems
Number of credits (ESTS)	6
Course, semester	4, 7
Department	MCM
Course author (s)	Nurtas M.
Prerequisites	Advanced Mathematics for Machine Learning, Deep Learning for Applied Mathematics
Postrequisites	-
The aim of study of a discipline	To acquaint students with methods for solving inverse practical problems.
Brief course description (main sections)	Approximate methods for solving inverse problems are being developed, algorithms are being compiled. Predict the solution to a given problem using machine learning. Computational experiments are carried out, the output 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 how to compose solution algorithms, carry out numerical calculations and analyze the results obtained.

Description of discipline	
Code of discipline	MAT6537
Name of discipline	Dynamic programming
Number of credits (ESTS)	6
Course, semester	4, 7
Department	MCM
Course author (s)	Satybaldina A.N.
Prerequisites	Operation Research, Introduction to Programming
Postrequisites	-
The aim of study of a discipline	Introduce students to dynamic (quadratic and convex) programming.
Brief course description (main sections)	Quadratic programming (QP) is the process of solving a special type of mathematical optimization problem a quadratic optimization problem (with a linear constraint), that is, the problem of optimizing (minimizing or maximizing) a quadratic function of several variables subject to a linear constraint on these variables. Quadratic programming is a special type of nonlinear programming. If subproblems can be recursively nested within larger problems so that dynamic programming techniques are applicable, then there is a relationship between the value of the larger problem and the values of the subproblems.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	At the end of this course, students will be ready to apply dynamic programming technologies to solve various optimization problems.

Описание дисциплины	
Code of discipline	MAT6547
Name of discipline	Numerical simulation on MatLab
Number of credits (ESTS)	6
Course, semester	4, 7
Department	MCM
Course author (s)	Nurtas M.
Prerequisites	Numerical methods
Postrequisites	-
The aim of study of a discipline	The course covers the computer and math tools needed to understand math and computer science research in Matlab, and to plan and execute independent research projects. Topics include mathematical modeling, description of applied software packages, description of animation and descriptor visualization of the calculation process, creation of a user interface.
Brief course description (main sections)	Matlab is a high-level programming language and interactive environment for numerical computing, visualization, and programming. Matlab allows matrix manipulation; graphing functions and data; implementation of algorithms; creation of user interfaces; interaction with programs written in other programming languages, including C, C ++, Java and Fortran; data analysis; development of algorithms; creation of models and applications.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	• develop a clear understanding of the fundamental concepts of multidimensional calculus using computer modeling in Matlab. • be able to set and solve optimization problems that include several variables, with or without constraints. • Solve the first-order linear ODE by integrating coefficients or varying parameters. • be skilled in modeling a simple system for obtaining first-order ODEs, 2D and 3D graphical visualization of solutions using directional fields and isoclines and their approximation by various methods.

Описание дисциплины	
Code of discipline	MAT6513
Name of discipline	Integration of business processes (SAP)
Number of credits (ESTS)	6
Course, semester	4, 7
Department	MCM
Course author (s)	Karashbayeva Zh.O.
Prerequisites	ICT
Postrequisites	-
The aim of study of a discipline	To acquaint students with important branches of the ERP system and its applications. Develop your knowledge and skills in SAP ERP systems in a way that encourages confidence and ensures satisfaction and pleasure. Develop an understanding of core principles and a high appreciation for SAP. During the educational process, students should familiarize themselves with and be able to apply methods and tools to solve various problems..
Brief course description (main sections)	An Enterprise Resource Planning (ERP) system is software that manages all business areas of an organization, including Accounting and Finance, Human Resources, Sales and Distribution, Manufacturing, Purchasing and Inventory. It's cross-functional, process-oriented, real-time, and based on industry best practices - from service to manufacturing to nonprofit. It is important that business and systems engineers have a working knowledge of these systems as they will be ERP users, auditors, consultants and / or developers in their careers. This course covers ERP theory and practice. The course content includes the evolution of ERP systems, business process reengineering, process mapping, ERP life cycle, ERP functionality, as well as audit and risk issues.
Expected Learning Outcomes (knowledge, abilities, skills and competencies acquired by students)	• Understanding the technical aspects of ERP systems • Learn the concepts of reengineering and how they relate to the implementation of ERP systems. • Be able to map business processes using process mapping methods in SAP • Understand the activities and activities within the life cycle of a SAP system • Be able to identify and describe the typical functionality of an ERP system • Get hands-on experience with SAP transaction flow and SD, FI, CO, PP, HR, MM configuration.