BORYS GRINCHENKO KYIV UNIVERSITY

«APPROVED»

Decision of the Academic Council,
Borys Grinchenko Kyiv University

23 March 2017, Protocol No.3

The Head of the Academic Council, Rector
Victor Ogneviuk
_____

**Programme of Study (Vocational)
111.00.02 Mathematical modeling**

Level Two (Master) of higher education

Field of Knowledge: **11 Mathematics and Statistics**
Specialty: **111 Mathematics**
Qualifications: **Master of Mathematics**

Enacted since 01 September 2017
(Order No 348, 26.05.2017)

Kyiv – 2017

LETTER OF APPROVAL
Programme of Study (Vocational)

The Chair of information technology and mathematical disciplines
Protocol No 1, 10 January 2017
The Head of the Chair _____ Oksana Lytvyn
                                              (signature)

The Academic Council of the Faculty of Information Technologies and Management
Protocol No 6, 15 March 2017
The Head of the Academic Council _____Alla Mykhatska
                                                        (signature)

The Head of the SMC of Standardization
and Quality Education _____ Olha Leontieva
 23 March 2017

Vice-Rector on Academic Affairs _____ Oleksii Zhyltsov
23 March 2017

PREAMBLE

The programme of study (vocational) complies with the Law of Ukraine "On Higher Education" and the Draft of the Standard for Higher Education of Ukraine in the field of knowledge 111 Mathematics for Level Two (Master) of higher education by the project group:

The head of the project group – Proshkin, Volodymyr, Ph.D. in Pedagogics, Associate Professor, Professor of the Chair of information technology and mathematical disciplines in Borys Grinchenko Kyiv University.

The members of the project group:
Astafieva, Maria, Candidate of physical and mathematical sciences, Associate Professor, Associate Professor of the Chair of information technology and mathematical disciplines in Borys Grinchenko Kyiv University.

Molchanov, Ihor, Ph.D. in physical and mathematical sciences, Professor, Professor of the Chair of information technology and mathematical disciplines

External Reviewers:
Liashko, Serhii, Corresponding Member of the National Academy of Sciences of Ukraine, Ph.D. in physical and mathematical sciences, Professor, the Head of the Chair of Computational Mathematics, Taras Shevchenko National University of Kyiv

Chernei, Ruslan, Candidate of physical and mathematical sciences, Associate Professor, Associate Professor of the Chair of Mathematics, National University of Kyiv-Mohyla Academy

Programme of Study (Vocational) was introduced on 1 September 2017

The term of Vocational revision ____time for____ years

Actualized:

Date of Review of the PS/Amendments to PS	**25.04.2019**		
Signature:			
PS Guarantor			

I. Profile of the Programme of study (Vocational)
111 Mathematics

<table>
<tr><td colspan="2" align="center">1 – General information</td></tr>
<tr><td>The full name of the higher education institution and the structural unit</td><td>Borys Grinchenko Kyiv University
Faculty of Information Technologies and Management</td></tr>
<tr><td>Degree of higher education and name of qualification</td><td>Degree: Master
Qualification: Master in mathematics</td></tr>
<tr><td>Official name of the programme of study</td><td>111.00.02 – Mathematical modeling</td></tr>
<tr><td>Type of diploma and term of study according to the programme</td><td>90 credits ECTS Master degree, unitary
term of study: 1 year 4 months</td></tr>
<tr><td>Availability of accreditation</td><td>Accredited in 2017 (the decision of Accreditation Commission of Ukraine from 27 December 2018, Protocol No 133)</td></tr>
<tr><td>Cycle / Level</td><td>Level Two (Master) /
FQ-EHEA – cycle two, EQF LLL – level 7, HPK – level 7</td></tr>
<tr><td>The education level required to commence study under the programme</td><td>Level One (Bachelor) of higher education</td></tr>
<tr><td>Language (s) of teaching</td><td>Ukrainian</td></tr>
<tr><td>Validity of the programme of study</td><td>2022</td></tr>
<tr><td>Internet address of the permanent placement of the description of the programme of study</td><td>http://kubg.edu.ua</td></tr>
<tr><td colspan="2" align="center">2 – The purpose of the programme of study (vocational)</td></tr>
<tr><td colspan="2">To provide students with profound training in the field of Mathematics, emphasised on modern mathematical theories and methods that have wide application in different fields of science and practice, mastering the basics and methods of mathematical modeling; to provide knowledge and form the appropriate competencies for further education, development of research skills, independent pedagogical work on the corresponding profile</td></tr>
<tr><td colspan="2" align="center">3 - Characteristics of the programme of study</td></tr>
<tr><td>Subject area</td><td>- Objects of study and /or activity: mathematical structures, concepts, and ideas for modeling and development of theory in</td></tr>
</table>

	order to explain and/or optimize natural-technological or socio-economic phenomenons.
	- *Learning objectives:* formation of complex knowledge and skills for use in professional activities in the field of mathematics, development of mathematical theories, mathematical modeling, analysis and solution of applied problems.
	- *The theoretical content of the subject area:* mathematical models allow analyzing and processing the data of scientific, natural, technical, economic, sociological research, build the basis of scientific and educational activities in the field of mathematics and statistics and contribute to the development and creation of new information technologies.
	- *Methods, techniques, and technologies:* the applicant of higher education must master the methods of mathematical modeling, information, software and communication technologies; the skills of scientific and production, design, organizational and management activities; the ability to pedagogical and educational activities in the field of mathematics and statistics.
	- *Instruments and equipment:* computer and network programmable devices.
	The proportion of the volumes of the general and professional components and optional parts: 3:1
	Field practice share: 13.5 ECTS credits (15%)
Orientation of the programme of study	Vocational
The main focus of the programme of study	Educational and professional program aimed at mathematical modeling
Specific features of the programme	- the program provides for the study of mathematical modeling in applied areas to choose from Economics, Finance; - the program provides the theoretical and practical study of the main disciplines in the field of teaching methods in higher education (mathematical disciplines), including productive assistant practice.
4 – Eligibility of graduates to employment and further studying	
Employment	2310 – teacher (higher education institutions – assistant, teacher) 2121.2 – mathematician: actuary, mathematician-analyst of operations research (sectoral research institutes, departments of mathematical modeling in positions related to analytics,

	mathematical modeling, forecasting; financial institutions, insurance companies, statistical offices, IT companies, audit firms, industrial enterprises, public service institutions in positions related to analysis and forecasting, optimization and rationalization, operations research)
Further training	The possibility of obtaining an education at the third (educational and scientific) level in the field of mathematics, applied mathematics, computer science, and related sciences
5 – Teaching and assessment	
Teaching and learning	Based on the principles of student-centered and personal approach; implemented through training based on research, strengthening of practical and creative orientation in the form of a combination of lectures, practical training, self-study and research using elements of distance learning, the solution of applied problems, the implementation of projects, industrial practices, training and protection of qualification master's work
Assessment	Cumulative score-rating system, which provides for the evaluation of students for all types of classroom and extracurricular educational activity (current, modular, final control); modular control works, individual calculation and design works, testing, tests, practice reports, exams, certification
6 – Programme competencies	
Integral competence	The ability to solve complex mathematical problems and practical problems in professional activities or in the learning process, which involves research and/or innovation and is characterized by the complexity and/or uncertainty of the conditions
General competencies (GC)	**GC-1** *The ability to solve the problem comprehensively.* The ability to identify the scientific crux of the problems in the professional field, to find adequate ways to solve them; to master the systematic, holistic approach of the analysis and assessment of the situation. **GC-2** *Critical thinking.* The ability to analyze, verify, and evaluate the completeness and reliability of information in the course of the professional activity, if necessary, to supplement and synthesize the missing information. **GC-3** *Creativity.* Producing new ideas, creative approach to their implementation; ability to innovate. **GC-4** *Human resorces management.* The ability to take initiative and exercise leadership functions in the team to achieve a common goal; the ability to manage projects, organize teamwork, set goals, make and implement decisions; evaluate and ensure the effectiveness of teamwork; the ability to manage the strategic

	development of the team in the process of the professional activity.
	GC-5 *Coordination with others.* Ability and willingness to carry out collective projects, to take responsibility for the work of a particular group; ability to lead a discussion, defending one's point of view.
	GC-6 *Communication.* Ability to written and oral communication in Ukrainian language and at least in one of the common European languages; ability to speak clearly, to be convincing; skills of interpersonal relations; skills of effective use of modern communication technologies.
	GC-7 *Emotional intelligence.* Awareness of one's own emotional state, self-control, and self-regulation; self-respect and confidence; ability to overcome difficulties, stress resistance; optimistic attitude, initiative, being determined to obtain positive result.
	GC-8 *Cognitive flexibility.* The ability to acquire new knowledge, skills and to integrate them with possessed ones; the ability to analyze the phenomenon, situation, problem, taking into account different options, factors, and causes; the ability to adapt thinking for solving problems in changed conditions or unusual situations.
	GC-9 *Focus on high results.* The need to deliver quality work; ability to plan the stages and progress of work, to assess and ensure the quality of work performed, to present the results and justify the proposed solution in a modern technical, scientific and professional level.
	GC-10 *The judgments wording and decision-making.* Ability to orient in various views of the problem and its solutions, to form own opinion; to be able to formulate the problem, to choose the optimal solutions, to analyze and comprehend the optimal decision, and to present it convincingly.
	GC-11 *Information and ICT literacy.* The ability to search, process and analyse necessary information from various sources, in order to find the solution for educational, scientific and professional tasks, in compliance with ethical and legal standards; skills in the use of information and communication, computer technologies as a tool for knowledge and skills acquisition, as well as the presentation of problems, challenges, and results, etc.
Professional competence (PC)	**PC-1** *Knowledge and understanding.* Specialized conceptual knowledge acquired in the learning process at the level of the latest achievements, which are the basis for original thinking, research and/or innovation; the ability to use the acquired knowledge in practical professional activities.

	PC-2 *Research skills.* Ability to understand the essence of the problem, the task statement, to choose and use appropriate methods and organizational procedures for its solution (resolution), research or innovative activity, to evaluate the results critically, to determine the prospects for further development of the studied and related topics.
	PC-3 *Solution to the problems.* Ability to think critically and to solve complex tasks and problems that require interdisciplinary approaches, updating, and integration of knowledge, often in the context of incomplete/insufficient information and conflicting requirements.
	PC-4 *Modeling.* The ability to transfer mathematical knowledge in non-mathematical contexts, to develop adequate mathematical models of real processes and phenomenons, to study them by choosing appropriate methods, including computer, and interpret the results of the study in terms of the researched process (phenomenon).
	PC-5 *Information competence.* Ability and willingness for the effective use of knowledge and skills and application of modern means of information and computer technologies applied programmes and programme packages for the solution of mathematical and applied problems and other professional purposes.
	PC-6 *Creativity and innovation.* Ability to independently develop projects through creative application of existing and/or generation of new mathematical ideas; ability to develop new and/or improve existing mathematical methods of analysis, modeling, forecasting, solving new problems in new fields of knowledge.
	PC-7 *Communication.* The ability to submit mathematical reasonings and conclusions in a form suitable for the target audience, both orally and in writing, as well as to understand the mathematical considerations of other persons involved in solving the same problem.
	PC-8 *Self-education and further training.* Ability to self-education and professional development in the field of mathematics, didactics, educational technologies based on innovative approaches.
	PC-9 *Teaching skills.* The possession of the didactic knowledge of the processes and methods of teaching and learning mathematics, awareness of the latest educational technologies and the ability to use them in practical teaching.

7 – Programme learning outcomes (PLO)

	Knowledge and understanding
	PLO-K-1 Demonstrate at the level of application a thorough knowledge of the basic conceptions and facts of linear algebra and

matrix theory, analytical and differential geometry, differential and integral calculus of the function of real and complex variables, real variables, series theory, differentials, logic and set theory, discrete mathematics, probability theory and mathematical statistics, as well as reproduce the knowledge of certain special sections of higher and applied mathematics (applied functional analysis, theory of dynamic systems, algebraic topology) in the volume, necessary for the possession of the mathematical apparatus of the relevant field of knowledge and the use of mathematical methods in the chosen profession.

PLO-K-2 Know the basics of mathematical disciplines and theories that study models of natural, economic, and social processes.

PLO-K-3 Know and understand mathematical methods of analysis, forecasting, and evaluation of model parameters, basic approaches of transforming a mathematical model into a computer one, qualitative and quantitative study of a constructed model, analysis and interpretation of the results received during modeling.

PLO-K-4 Demonstrate the knowledge and understanding of the connections of some parts of theoretical and applied mathematics with economic processes and theories for constructing effective economic models.

PLO-K-5 Understand and explain the place of mathematics in science in general and in the philosophical systems of philosophers (Plato, Aristotle, Descartes, Leibniz, Kant), the nature of mathematical knowledge, the structure of mathematical knowledge, the reason for its effectiveness in other fields; know and understand the fundamental and applied aspects of science in mathematics.

PLO-K-6 Know and understand the limits of applicability of various mathematical theories, methods, tools.

PLO-K-7 Possess the basics of psychological and pedagogical disciplines, the knowledge of didactics and methods of teaching mathematics to the extent necessary for professional teaching in high school.

PLO-K-8 Have knowledge of building competent communication in the educational and scientific process, professional activity.

Skills

PLO-S-1 Carry out logical reasoning, build a proof of mathematical facts competently by using classical methods of proving (from the opposite, mathematical induction, constructive method, etc.).

	PLO-S-2 Read and understand the fundamental sections of mathematical literature and demonstrate mastery of their reproduction in a reasoned oral and/or written report.
	PLO-S-3 Demonstrate the ability to use fundamental mathematical laws in solving theoretical and applied mathematical problems and problems that require, in particular, the integration of acquired knowledge, methods from various branches of mathematics, including multi-criteria problems and problems with incomplete data.
	PLO-S-4 Recognize mathematical structures in other (non-mathematical) theories; translate problems from other fields into the language of mathematics and solve them by methods of mathematical modeling.
	PLO-S-5 Communicate professional knowledge, own justifications, and conclusions to experts and the general public; orally and in writing to communicate in native and foreign languages in scientific, industrial and social spheres of activity with professional issues.
	PLO-S-6 Demonstrate certain research skills, the ability to solve a task/problem, to perform an innovative task (work planning, research, finding solutions/obtaining results, formulation of conclusions, and presentation of results) independently or under the guidance of a specialist (teacher, researcher or professional practitioner).
	PLO-S-7 Apply computer technologies, applied mathematical packages, other software products, information resources for the solution of mathematical problems, modeling, analysis of models, for other professional purposes.
	PLO-S-8 Apply new approaches to develop a strategy for decision-making in complex unpredictable conditions.
	PLO-S-9 Have the ability to organize collective activities and implement complex projects, taking into account available resources and time constraints.
	PLO-S-10 Be aware of the limitations of one's own knowledge and the need for continuous training, to demonstrate the ability of rational ways to independently search for sources of information on a certain range of issues, including foreign languages, to analyze the found information, to replenish their knowledge and acquire skills.
	PLO-S-11 Demonstrate the ability to apply the latest educational technologies in professional activities, willingness, and ability to learn from positive experience, to improve teaching skills through self-education.
	PLO-S-12 Demonstrate the ability to work in a team, acting ethically and responsibly.

	PLO-S-13 Be able to formulate a mathematical / pedagogical problem, to find and analyze the correspondence between the task and the existing models, to choose the optimal solutions, to analyze and comprehend the obtained solution, to present the results of the work and to justify the proposed solutions at the modern scientific, technical and professional level

8 – Resource support for the implementation of the programme	
Personnel support	The head of the project group and the teaching staff, which ensures its implementation, meets the requirements defined by the License conditions for the implementation of educational activities of educational institutions. Personnel support of the educational program consists of the faculty of the Department of computer scince and mathematics of the Faculty of information technology and management. The practice-oriented nature of the educational program involves wide participation of practitioners, corresponding to the direction of the program.
Material and technical support	Specially equipped with hardware and software, visual and methodological materials, computer classes and competence - development centers, namely: center for living mathematics, laboratory of embedded systems and 3D-modeling, the center for modeling and programming, the center for educational technologies
Information and educational-methodological support	Library electronic resources, electronic scientific publications, e-learning courses with the possibility of distance learning and independent study, cloud services.

9 – Academic mobility	
National Credit Mobility	
International Credit Mobility	The regulation on the procedure of realization of the right to academic mobility of participants of the educational process of the University was put into effect by the order of 30.09.2016. The signing of agreements on student mobility with universities of European countries in the framework of the Erasmus + programme KA1. Among them: the University of Vilnius (Lithuania), University of Constantine the Philosopher in Nitra (Slovakia), University of Extremadura (Spain), University of Silesia in Katowice (Poland), Academy of Jan Dlugosz in Czestochowa (Poland), University of Ostrava (Czech Republic), University of Lisbon (Portugal) and others.
Studying of foreign higher education learners	According to the license, training of foreigners and stateless persons is provided

II. The List of the Components of the Programme of Study (vocational) and Their Logical Coherence

2.1. The List of the Components of PS

Component Code	Components of the Programme of Study (academic discipline, practice, degree paper)	Credits ECTS	The Form of the Final Control
1	2	3	4
Formation of professional competencies			
I. Compulsory components of PS			
1. Educational disciplines			
ОДФ.01	History and philosophy of mathematics	4	Exam
ОДФ.02	Foreign language of professional direction	5	Credit
ОДФ.03	Applied functional analysis	4	Exam
ОДФ.04	Dynamic systems	5	Exam
ОДФ.05	Mathematical modeling	8	Exam
	1. Fundamentals of mathematical modeling	*2*	Exam
	2. System analysis	*3*	
	3. Forecasting	*3*	
ОДФ.6	Applied mathematics and computer modeling	14	Exam
	1. Economic and mathematical modeling	4	*Exam*
	2. Computer modeling of systems and processes	6	*Exam*
	3. Systems of computer mathematics	4	
ОДФ.7	Teaching in Higher education	8	Exam
	1. Pedagogy and psychology of higher education	*4*	
	2. Methods of teaching mathematical disciplines	*4*	
The total amount of the theoretical components		*48*	-
2. Practice			
ОП.1	Internship (assistant)	6	Credit
ОП.2	Undergraduate (in mathematics)	7,5	Credit
The total amount of practice		*13,5*	-
3. Attestation			
ОА.1	Qualification degree paper	6	
	1. Preparation of the degree paper	*4,5*	
	2. Degree paper defense	*1,5*	
The total amount of certification		*6*	-
The total amount of the compulsory components		**67,5**	
II. Optional components			
ВД 1.01	free choice academic disciplines from the course catalogue	22,5	Credits
The total amount of the optional components		**22,5**	
THE TOTAL AMOUNT OF THE PROGRAMME OF STUDY		**90**	

2.2. Structural-logical scheme of PS

Semester 1 30 credits ECTS	Semester 2 34,5 credits ECTS	Semester 3 22,5 credits ECTS
History and philosophy of mathematics 4 credits ECTS	Applied mathematics and computer modelling 14 credits ECTS	Free choice academic disciplines from the course catalogue 10,5 credits ECTS
Foreign language of professional direction 5 credits ECTS	Economic and mathematical modelling 4 credits ECTS	Internship (assistant) 6 credits ECTS
Applied functional analysis 4 credits ECTS	Computer modeling of systems and processes 6 credits ECTS	Undergraduate practice (in mathematics) 7,5 credits ECTS
Dynamic systems 5 credits ECTS	Systems of computer mathematics 4 credits ECTS	**Attestation (1,5 credits ECTS):** Degree paper defense
Mathematical modeling 8 credits ECTS	Teaching in Higher education 7 credits ECTS	
Fundamentals of mathematical modeling 2 credits ECTS	Pedagogy and psychology of higher education 3 credits ECTS	
System analysis 3 credits ECTS	Methods of teaching mathematical disciplines 4 credits ECTS	
Forecasting 3 credits ECTS	Free choice academic disciplines from the course catalogue 12 credits ECTS	
	Preparation of the degree paper 4,5 credits ECTS	

III. Form of Attestation of Higher Educational Learners

The graduate students majoring in 111 Mathematics get attestation in the form of degree paper defense, and they are given the document of the state standard issued to confirm that they are awarded the degree and educational qualification of Master of Mathematics.

The attestation is performed openly and publicly.

IV. Matrix of the Programme Competence Compliance with the Programme Components

	ОДФ.0 1	ОДФ.0 2	ОДФ.0 3	ОДФ.0 4	ОДФ.0 5	ОДФ.0 6	ОДФ.0 7	ОП.1	ОП.2	ОА.1	ВД 1.01
GC1			●	●	●	●	●	●	●	●	
GC2	●		●	●	●	●	●	●	●	●	●
GC3	●		●	●	●	●	●	●	●	●	●
GC4						●	●	●	●		
GC5							●	●	●		
GC6		●					●	●	●		
GC7							●	●			
GC8			●	●	●	●					●
GC9							●	●	●	●	
GC10					●			●	●	●	
GC11						●				●	
PC1			●	●	●		●			●	
PC2					●				●	●	●
PC3			●	●	●		●	●	●	●	
PC4			●	●	●	●			●	●	
PC5						●			●	●	
PC6					●			●	●	●	
PC7	●	●					●	●	●		
PC8			●	●	●	●	●	●	●	●	●
PC9							●	●			

V. Matrix of Providing Programme Learning Outcomes with the Relevant Programme Components

	ОДФ.01	ОДФ.02	ОДФ.03	ОДФ.04	ОДФ.05	ОДФ.06	ОДФ.07	ОП.1	ОП.2	ОА.1	ВД 1.01
PLO-K-1			●	●	●						
PLO-K-2				●	●	●				●	●
PLO-K-3			●	●	●	●			●	●	
PLO-K-4					●	●			●	●	●
PLO-K-5	●						●	●			
PLO-K-6			●	●		●			●	●	
PLO-K-7							●	●		●	
PLO-K-8		●					●	●			
PLO-S-1	●		●	●	●						●
PLO-S-2			●	●			●	●		●	
PLO-S-3			●	●	●				●	●	●
PLO-S-4					●	●			●	●	
PLO-S-5		●					●	●			
PLO-S-6										●	
PLO-S-7						●			●	●	
PLO-S-8						●	●	●	●	●	
PLO-S-9							●	●	●		
PLO-S-10	●	●								●	
PLO-S-11							●	●			
PLO-S-12							●	●	●		
PLO-S-13		●	●	●		●	●	●	●	●	●