NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Descriptive Geometry, Computer Graphics and Design

APPROVE
Dean of the Design and Engineering Faculty
_____ Ivan ROGOVSKY
" ___ " _____ 2026.

APPROVED
at a meeting of the Department of Descriptive Geometry, computer graphics and design
Protocol No. 10 from "27" May 2026.
Head of the Department
_____ Serhiy PYLYPAKA

CONSIDERED
Program Guarantor "Construction and Civil Engineering"
_____ Yevhen DMYTRENKO

WORK PROGRAM
ACADEMIC DISCIPLINE

OK 09. Mathematical modeling and computer technologies

Field of knowledge: G "Engineering, manufacturing and construction"
Specialty: G19 "Construction and Civil Engineering"
Educational program : "Construction and Civil Engineering"
Faculty: Design and Engineering
Developers:

Professor of the Department of Descriptive Geometry, Computer Graphics and Design, Doctor of Technical Sciences, Professor	_____ Viktor NESVIDOMIN;
Associate Professor of the Department of Descriptive Geometry, Computer Graphics and Design, Candidate of Technical Sciences, Associate Professor	_____Iryna HRYSHCHENKO.

Kyiv – 2026

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Description of the academic discipline

Mathematical modeling and computer technologies is a scientific discipline that studies the principles of construction and functioning of computers, the organization of computing processes on personal computers, their algorithmization, PC software, as well as the effective use of modern information and communication technologies in construction activities. The main focus is on acquiring skills in working with CAD technologies in computer graphics and CAS technologies in computer mathematics.

Field of knowledge, specialty, educational program, educational level		
Educational degree	bachelor	
Specialty	G19 "Construction and Civil Engineering"	
Educational program	educational and professional "Construction and Civil Engineering"	
Characteristics of the academic discipline		
View	mandatory	
Total hours	150	
Number of ECTS credits	5	
Number of content modules	4	
Course project (work)	-	
Control form	exam / test	
Academic discipline indicators for full-time and part-time forms of higher education		
	Form of study	
	daytime	correspondence
Course (year of training)	1	1
Semester	1, 2	1, 2
Lecture classes	30 hours / 15 hours	2 hours / 4 hours
Practical classes	30 hours / 15 hours	0 hours/ 4 hours
Independent work, hours.	90 hours	140
Number of weekly hours	4 hours / 2 hours	

1. Purpose, competencies and program outcomes of the academic discipline

The purpose of the discipline is for students to obtain theoretical knowledge of the basics of computer technologies, and to acquire practical skills in working on personal computers using existing CAS and CAD technologies when solving engineering problems in construction.

Acquisition of competencies :

- integral competence (IC):

IC – The ability to solve complex specialized construction and civil engineering problems in the learning process, which involves the application of a complex of theories and methods for determining the strength, stability, deformability,

modeling, strengthening of building structures; further safe operation, reconstruction, erection and installation of buildings and engineering structures; application of computer-aided design systems in the construction industry.

- *general competencies (GC):*

GC01 – Ability for abstract thinking, analysis and synthesis.

GC02 – Knowledge and understanding of the subject area and professional activity.

GC04 – Ability to communicate in a foreign language.

GC05 – Ability to use information and communication technologies.

GC06 – Ability to search, process and analyze information from various sources.

GC07 – Interpersonal interaction skills.

- *special (professional) competencies (SC):*

SC04 – Ability to select and use appropriate equipment, materials, tools and methods for the design and implementation of technological processes in construction production.

SC05 – Ability to apply computer-aided design systems and specialized application software to solve engineering problems in construction and civil engineering.

SC06 – Ability to perform engineering activities in the field of construction, preparation and use of technical documentation.

SC07 – Ability to take responsibility for making and taking decisions in the field of architecture and construction in unpredictable work contexts.

SC11 – Possess methods of design, modeling and construction using automated design and calculation systems for building structures and engineering structures of industrial, agro-industrial, transport and civil facilities.

Program Learning Outcomes (PLN):

PLN01 – Apply basic theories, methods and principles of mathematical, natural, social and humanities and economic sciences, modern models, methods and software tools for decision support to solve complex construction and civil engineering problems.

PLN03 – Present the results of one's own work and argue one's position on professional issues to specialists and non-specialists, communicating fluently in the state and foreign languages.

PLN06 – Apply modern information technologies to solve engineering and management problems in construction and civil engineering.

PLN07 – Collect, interpret, and apply data, including by searching, processing, and analyzing information from various sources.

2. Program and structure of the academic discipline;

Content names modules and topics	Number of hours											
	Full-time form of study						Correspondence form					
	total	including					total	including				
		l	pr	lab	ind	s.r.		l	pr	lab	ind	s.r.

1	2	3	4	5	6	7	8	9	10	11	12	13
1 semester												
Content Module 1. Computational Mathematics in Civil Engineering: MapleSoft/Mathematica												
Topic 1. Information technologies. Hardware.	6	2	2			2	6	1				5
Topic 2. Software. Windows. MS Office . Information networks.	6	2	2			2	6					6
Topic 3. Mathematical modeling. Algorithms. Computer mathematics systems.	6	2	2			2	6					6
Topic 4. Elements of programming in Maple. Data types. Operands and operations.	6	2	2			2	6					6
Topic 5. Operators. Conditional and loop operators. Sequences.	6	2	2			2	6					6
Topic 6. Functions. Procedures. Extension packages. 2D graphics.	6	2	2			2	6					6
Topic 7. 3D graphics. Animation.	6	2	2			2	6					6
Total for content module 1	42	1 4	14			14	42	1				41
Content module 2. Mathematical models and their programming												
Topic 8. Vector operations in Maple.	6	2	2			2	6	1				5
Topic 9. Matrix operations in Maple. Systems of linear equations.	6	2	2			2	6					6
Topic 10. Interpolation. Parabolic interpolation. Spline interpolation.	6	2	2			2	6					6
Topic 11. Approximation. Linear and quadratic approximations. Spline approximation.	6	2	2			2	6					6
Topic 12. Nonlinear equations with one variable.	6	2	2			2	6					6
Topic 13. Differentiation and integration. Approximate integration methods.	6	2	2			2	6					6
Topic 14. Optimization.	6	2	2			2	6					6
Topic 15. Exam	6	2	2			2	6					6
Total for content module 2	48	16	1 6			16	48	1				4 7

Total hours per semester	90	30	30			30	90	2				88
2nd semester												
Content module 1. Assembly drawings in the Autodesk Inventor												
Topic 1. Sketching. Solid models	11	3	3			5	11	2				9
Topic 2. Assembly operations	9	2	2			5	9		2			7
Topic 3. Associative assembly drawings	9	2	2			5	9					9
Total for content module 1	29	7	7			15	29	2	2			25
Content module 2. Detailing in SolidWorks												
Topic 4. Reading assembly drawings	7	2	2			3	7	2				5
Topic 5. Modeling assembly parts according to the drawing	8	2	2			4	8		2			6
Topic 6. Assembly model	8	2	2			4	8					8
Topic 7. Working drawings of assembly parts. Assembly drawing of an assembly unit	8	2	2			4	8					8
Total for content module 2	31	8	8			15	31	2	2			27
Total hours for 2nd semester	60	15	15			30	60	4	4			52
Total hours per course	150	45	45			60	150	6	4			140

3. Lecture topics

No.	Name	Hour
1 semester		
1.	Information technology. Hardware.	2
2.	Software. Windows. MS Office. Information networks.	2
3.	Mathematical modeling. Algorithms. Computer mathematics systems.	2
4.	Elements of programming in Maple. Data types. Operands and operations.	2
5.	Operators. Conditional and loop operators. Sequences.	2
6.	Functions. Procedures. Extension packages. 2D graphics.	2
7.	3D graphics. Animation.	2
8.	Vector operations in Maple.	2
9.	Matrix operations in Maple. Systems of linear equations.	2
10.	Interpolation. Parabolic interpolation. Spline interpolation.	2
11.	Approximation. Linear and quadratic approximations. Spline approximation.	2
12.	Nonlinear equations with one variable.	2
13.	Differentiation and integration. Approximate integration methods.	2
14.	Optimization.	2
15.	Exam preparation	2

Total hours per semester		30
	2nd semester	
1	Sketching. Solid models	3
2	Assembly operations	2
3	Associative assembly drawings.	2
4	Reading a drawing book	2
5	Modeling assembly parts according to the drawing	2
6	Assembly model	2
7	Working drawings of assembly parts. Assembly drawing of an assembly unit	2
Total hours for 2nd semester		15
Total hours per course		45

4. Topics of practical classes

No.	Name	Hour
1 semester		
1.	Units of measurement of information.	2
2.	MapleSoft. MsVisio.	2
3.	Linear algorithms.	2
4.	Branched algorithms.	2
5.	Cyclic algorithms.	2
6.	Graphs, flat curved lines.	2
7.	Surfaces. 3D animation.	2
8.	Vector operations.	2
9.	Matrix operations. Roots of linear equations.	2
10.	Linear and parabolic interpolation.	2
11.	Approximation. Data processing in Excel.	2
12.	Nonlinear equations with one variable.	2
13.	Differentiation and integration.	2
14.	Optimization.	2
15.	Exam preparation.	2
Total hours per semester		30
2nd semester		
1	Building models based on completed sketches	3
2	Construction of the assembly unit	2
3	Execution of assembly drawing	2
4	Reading a drawing book	2
5	Modeling assembly parts according to the drawing	2
6	Executing the assembly model	2
7	Working drawings of assembly parts and assembly drawing of the assembly unit	2
Total hours for 2nd semester		15

Total hours per course	45

5. Independent work topics

No.	Name	Hour
1 semester		
1.	Hardware and software. Algorithms. Curves and surfaces.	15
2.	Vectors and Matrices. Systems of Linear Equations. Interpolation and Approximation. Data Processing in Excel. Functions. Roots of equations. Antiderivative. Integral. Optimization.	15
Total for 1 semester		30
2nd semester		
1.	Execution of assembly drawing of assembly unit	15
2.	Performing assembly drawing detailing	15
Total for 2 semesters		30
Total hours		60

6. Methods and means of diagnosing learning outcomes:

– oral or written survey;
– interview;
– testing;
– defense of practical, graphic works, and projects.

The level of mastery of the material and the ability to independently perform the work is checked by completing tests for a separate module. Test work can be test tasks and a practical task that must be completed in a limited time during a practical lesson. Students who have missed a test can retake it at a time specified by the teacher.

7. Teaching methods

- problem-based learning method;
- practice-oriented learning method;
- project-based learning method;
- flipped classroom, blended learning method;
- method of educational discussions and debates.

8. Assessment of learning outcomes

The knowledge of a higher education applicant is assessed on a 100-point scale, which is translated into a national assessment in accordance with the current "Regulations on Examinations and Tests at the NUBiP of Ukraine"

8.1. Distribution of points by types of educational activities (1st semester)

Type of educational activity	Learning outcomes	Evaluation

Module 1. Computational Mathematics in Civil Engineering: MapleSoft/Mathematica		
Practical work 1. Units of information measurement.	PRN 01, 03, 06, 07. Be able to write programs for linear, branched, and cyclic algorithms, build graphs, construct curved lines and surfaces, and create three-dimensional animation in the MapleSoft and MsVisio software environments.	**6**
Practical work 2. MapleSoft. MsVisio.		**9**
Practical work 3. Linear algorithms.		**9**
Practical work 4. Branched algorithms.		**9**
Practical work 5. Cyclic algorithms.		**9**
Practical work 6. Graphs, flat curved lines.		**9**
Practical work 7. Surfaces. 3D animation.		**9**
Independent work 1. Hardware and software. Algorithms. Curves and surfaces.		**30**
Module test 1	Testing the acquired skills in the discipline in the first module.	**10**
Total by module 1		**100**
Module 2. Mathematical models and their programming		
Practical work 8. Vector operations.	PRN 01, 03, 06, 07. Be able to perform vector and matrix operations, linear and parabolic interpolation, approximation, differentiation, integration and optimization of data in the MapleSoft, MsVisio software environments. Be able to process information in Excel.	**9**
Practical work 9. Matrix operations. Roots of linear equations.		**9**
Practical work 10. Linear and parabolic interpolation.		**9**
Practical work 11. Approximation. Data processing in Excel.		**9**
Practical work 12. Nonlinear equations with one variable.		**9**
Practical work 13. Differentiation and integration.		**9**
Practical work 14. Optimization.		**6**
Independent work 2. Vectors and matrices. Systems of linear equations Interpolation and approximation. Data processing in Excel. Functions. Roots of equations. Antiderivative. Integral. Optimization.		**30**
Module test 2	Testing the acquired skills in the discipline in the second module.	**10**
Total by module 2		**100**
Educational work	**(M1 + M2)/2*0.7 ≤ 70**	
Test	**30**	

Total per course	**(Coursework + test) ≤ 100**

Distribution of points by types of educational activities (2nd semester)

Type of educational activity	Learning outcomes	Evaluation
Module 1. Assembly drawings in the Autodesk Inventor		
Practical work 1 Building models based on completed sketches	PRN 01, 03, 06, 07	**10**
Practical work 2 Construction of assembly unit		**10**
Practical work 3 Execution of assembly drawing		**10**
Independent work 1. Execution of an assembly drawing of an assembly unit		**40**
Test 1	Testing the acquired skills in the discipline in the first module.	**20**
Module test 1		**10**
Total by module 1		**100**

Module 2. Detailing in SolidWorks		
Practical work 4 Reading assembly drawings	PRN 01, 03, 06, 07	**10**
Practical work 5 Modeling of assembly parts according to the drawing		**10**
Practical work 6 Assembly model execution		**10**
Practical work 7 Working drawings of assembly parts and assembly drawing of the assembly unit		**10**
Independent work 2. Performing detailing of the assembly drawing		**30**
Modular test 2	Testing the acquired skills in the discipline in the second module.	**20**
Module test 2		**10**
Total by module 2		**100**
Educational work	**(M1 + M2)/2*0.7 ≤ 70**	
Exam	**30**	
Total per course	**(Coursework + test) ≤ 100**	

8.2. Scale for assessing knowledge of a higher education applicant

Higher education applicant rating, points	Assessment according to the national system (exams/credits)
90-100	perfectly
74-89	good
60-73	satisfactorily
0-59	unsatisfactorily

8.3. Evaluation Policy

Deadline and resubmission policy:	Works submitted after the deadline without good reason will be given a lower grade. Modules can be retaken with the permission of the lecturer if there is a good reason (for example, sick leave).
Academic Integrity Policy:	Cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct text references to the literature used.
Visitation Policy:	Attendance at classes is mandatory. For objective reasons (e.g. illness, international internship), studies may be conducted individually (online, with the approval of the dean of the faculty).

9. Educational and methodological support;

Training is conducted using information and communication technologies in education. A certified electronic training course on the ELearn platform "Mathematical Modeling and Computer Technologies" is used.

https://elearn.nubip.edu.ua/course/view.php?id=2882
https://elearn.nubip.edu.ua/course/view.php?id=2464

Classes are held in the following sequence:

- presentation of new material (lecture, classroom lesson);
- consolidation of new material (independent work outside the classroom, using literature and electronic resources);
- consolidation of acquired skills and abilities (classroom lesson);
- improving skills acquired in previous classes (performing work outside of class time with the study of lecture material, using literature, and Internet resources).

10. Recommended sources of information

Founded

1. https://www.maplesoft.com
2. https://www.autodesk.com/
3. https://www.solidworks.com/
4. Informatics and computer technology. / Tkach T. B. - Odesa, 2022. - 100 p.

5. Numerical methods: Textbook. / Volontyr L. Oh, Zelinska O. V., Potapova N. A., Chikov I. A. – Vinnytsia: VNAU, 2023. – 322 p.
6. Algorithms and methods of calculations [Electronic resource]: teaching aid / M. A. Novotarsky. – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 407 p.
7. Numerical methods: a textbook / O. I. Yaroshenko, M. V. Hryhorkiv. – Chernivtsi: Chernivtsi National University, 2022. – 172 p.
8. Information technologies: teaching aids / R. O. Tarasenko, S. M. Garina, T. P. Worker; K.: " Alefa " LLC , 2022. - 332 p.
9. Gindis, E. J., Kaebisch, R. C. (2020). Up and Running with AutoCAD 202 2 : 2D and 3D Drawing, Design and Modeling. The Netherlands: Elsevier Science.

Auxiliary

10. Sytnyk V. F. Fundamentals of information systems: Textbook. – 2nd ed., revised and supplemented. / Ed. IN. F. Sytnyk . – K.: KNEU, 2001. – 420 p.
11. Information systems and technologies: a textbook for students / O. V. Gritsunov; Kharkiv National Academician of Urban Economics. – Kh.: KhNAMG, 2010. – 222 p.
12. Nelyubov V. O., Kurutsa O. S. Fundamentals of Informatics. Microsoft Excel 2016: a textbook. Uzhgorod: State Higher Educational Institution "UzhNU", 2018. – 58 p.
13. Computer graphics: textbook: book 1. for students of specialty 151 "Automation and computer-integrated technologies" / Compiled by: Totosko O. V., Mykytyshyn A. G., Stukhlyak P. D. – Ternopil: Ivan Pulyuy Ternopil National Technical University, 2017. – 304 p.
14. Lyashenko B. M., Kryvonos O. M., Vakalyuk T. A. Methods of calculations: a teaching and methodological manual for students of the Faculty of Physics and Mathematics. – Zhytomyr: Publishing House of ZhDU, 2014. – 228 p.

Recommended regulatory documents

15. Higher education standard for specialty 122 "Computer Science" for the first (bachelor's) level of higher education. URL: https://mon.gov.ua/ storage/app/media/vishcha-osvita/zatverdzeni%20standarty/2019/07/12/122-kompyut. nauk.bakalavr-1.pdf.
16. New information technologies, Electronic manual . Access mode http://www.eduforme.org/mod/page/view.php?id=13
17. Gnidenko I. G., Sokolovska S. A. Informatics. Google Books website / 10.06.2007. http://www.books.google.com.ua/books?isbn=5765429521