

Taras Shevchenko National University of Kyiv

Institute of Geology

Department: **General and Historical Geology**

«APPROVED»

Deputy director on academic work

B.K. Danyuk
« 1 » 09 2025

**WORK PROGRAMME OF THE DISCIPLINE
Modelling of Geological Processes and Structures**

for applicants

Branch of knowledge: **E Natural sciences, mathematics and statistics**
 Training direction (Speciality): **E4 Earth sciences**
 Educational level: **Master**
 Educational program: **Geology**
 Type of discipline: **Obligatory**

Teaching mode	<i>full-time studies</i>
Academic year	<i>2025/2026</i>
Semester	<i>2</i>
Number of credits ECTS	<i>5</i>
Language of teaching, learning and evaluation	<i>English</i>
Form of final control	<i>Final test</i>

Lecturer(s): Dmytro Kravchenko, PhD in Geology, Associate professor, Department of General and Historical Geology. Olena Ivanik, Doctor of science in geology, Professor, Department of General and Historical Geology.

To be continued

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«Approved»

Head of the Department of General and Historical Geology


_____ (Dmitro KRAVCHENKO)

Record of the Department meeting

№ 1 «29. 08. 2025»

Approved by Scientific-Methodical Commission of the Institute of Geology

Record of the meeting № 1 «29.08. 2025»

Head of Scientific-Methodical Commission  (Vsevolod DEMYDOV)

- 1. Aim of the discipline** is to familiarize students with different classes of geological models, principles and methods of modeling of geological processes and structures, review and learn the functionality of the specialized software for solving of the different types of geological tasks.

2. Discipline requirements:

Students must have skills and knowledge in the field of developing of integrated geological and geophysical models using specialized software, and theoretical knowledge related to such subjects as "Earth's evolution", "Modern technologies and methods for studying geological systems".

3. Annotation of teaching discipline / reference:

The discipline discusses the concepts of Models and Modelling, types of Models. The main types of modelling, including physical and symbolic modelling are analysed. The special attention is given to physical and mathematical modelling in geology. This discipline teaches the main principles of algorithms for mathematical modeling of geological processes and structures, analyses and determines the stress-strain state of the natural and technogene systems. This discipline uses real geological objects and situations as examples for modelling based on special software.

4. Object (teaching purposes) – introduction of students with:

- 1) main types of physical and symbolic models;
- 2) main methods of physical and mathematical modelling;
- 3) functional ability of special software for modelling;
- 4) modelling of exogenic geological processes;
- 5) modelling of secondary tectonic structures;
- 6) interpretation of modelling results;
- 7) calculation of stress-strain state of complicated geological systems;
- 8) using results of modelling in different areas of geology.

5. Learning results:

Learning results (1. to know; 2. be able to; 3. communication; 4. autonomy and responsibility)		Form/Methods of teaching and studing	Form / Methods of evaluation	Percentage in the final assessment of the discipline
Code	Learning results			
1.1	Main tasks and objectives of modelling geological processes and structures	lecture, laboratory work	Paperwork	up to 5%
1.2	Classification of models and systems	lecture, laboratory work	Paperwork	up to 5%
1.3	Principles of abstract models development of geological processes and structures	lecture, laboratory work	Paperwork	up to 5%
1.4	Methods and ways of system's imitation with connection of model's conditions;	lecture, practical class, seminar	Paperwork	up to 5%
1.5	Principals and methods of modelling of stress-strain state of geological media	lecture, laboratory work	Paperwork	up to 5%
1.6	Principles and methods of stochastic and deterministic modeling	lecture, laboratory work	Paperwork	up to 5%
1.7	Principles and methods of developing and analysis of physical models	lecture, laboratory work	Paperwork	up to 5%
1.8	Principles and methods of assessment	lecture, laboratory work	Paperwork	up to 5%

	<i>of stress-strain state of geological media</i>			
2.1	<i>Development basic geological models for solving set task</i>	<i>laboratory work, self-study</i>	<i>Paperwork</i>	<i>up to 10%</i>
2.2	<i>Create mathematical models and algorithms for solving set tasks</i>	<i>laboratory work, self-study</i>	<i>Paperwork</i>	<i>up to 10%</i>
2.3	<i>Use specialized software to determine the stress-strain state of natural and man-made systems</i>	<i>laboratory work, self-study</i>	<i>Paperwork</i>	<i>up to 10%</i>
2.4	<i>Use specialized software for modeling geological processes and structures (Subsurface modeling (Jewel Suite™), Reservoir Engineering, Geo Mechanics, 3D-model (Jewel Suite), MFrac, Fault and Fracture Stability Geomechanics, K-MINE etc.)</i>	<i>laboratory work, self-study</i>	<i>Paperwork</i>	<i>up to 10%</i>
2.5	<i>Analyze, interpret and use simulation results</i>	<i>laboratory work, self-study</i>	<i>Paperwork</i>	<i>up to 5%</i>
2.6	<i>Development of database of geological information</i>	<i>laboratory work, self-study</i>	<i>Paperwork</i>	<i>up to 5%</i>
3.1	<i>Be able to organize research and development team for the effective solution of the task</i>	<i>laboratory work</i>	<i>--/</i>	<i>up to 5%</i>
4.1	<i>Understanding personal / personal responsibility for simulation results and recommendations</i>	<i>--/</i>	<i>--/</i>	<i>up to 5%</i>

Structure of the discipline: lectures, laboratory work, self-studying work of students

6. Correlation of discipline learning outcomes with program learning outcomes:

Discipline learning outcomes Program learning outcomes	Program learning outcomes															
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.1	2.2	2.3	2.4	2.5	2.6	3.1	4.1
ПРН12. Моделювати геологічні об'єкти і процеси, застосовуючи картографічні і математичні методи та геоінформаційні технології/ Model geological objects and processes using cartographic and mathematical methods and geoinformation technologies.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

7. Scheme of grading forms:

7.1. Grading forms

1. Semester grading:

- 1) Test on the basics of modelling methods in geology - 10 points (cross-border score of 6 points)
 - 2) Test on the *determine the stress-strain state of natural and man-made systems* - 10 points (passing grade is 6 points)
 - 3) Grading for work at laboratory work - 40 points (passing grade is 24 points)
2. Final examination in the form of the written test: maximum grade is 40 points, passing grade is 24

points.

Results of educational activity of students grading are based on 100 grading scale.

The final grade is based on the results as the sum for the module grades, practical classes grades and the results of the final test.

	<i>Semester grade</i>		Final Test	Final grade
	I	II		
	Module 1	Module 2		
	10	10		
	laboratory work	laboratory work		
	20	20		
Total				
<i>Minimum</i>	<i>18</i>	<i>18</i>	<i>24</i>	<i>60</i>
Maximum	30	30	40	100

A student is not allowed to pass a final test if he graded less than 20 points during two semesters.

7.2.Grading: Control is carried out for compliance with the requirements and involves the successful completion of 11 laboratory works (where students must demonstrate the quality of the acquired knowledge and solve the assigned tasks using the methods outlined by the teacher), and the successful completion of 2 control module works. The final assessment is carried out in the form of a written test.

7.3. Scale of final test

National scale	100 points scale
excellent	90 – 100
good	75 – 89
satisfactorily	60 – 74
Failed	0 – 59

8. PLAN OF LECTURES AND LABORATORY WORK

№ п/п	Theme	Total hours		
		Lectures	Laboratory work	Self-studying work
Modules 1. Principles and methods of modeling of geological processes and structures				
1	Introduction. Theme 1. The concept of model and modeling. The types of models..	8	4	20

2	Theme 2. Mathematical modeling of geological processes.	8	4	20
	Modular work 1		1	
Module 2. Developing of geological models using specialized software				
3	* Theme 3. Basic principles and methods of laboratory simulation in geology.	6	6	30
4	Theme 4 Modelling of the stress-strain state of natural and technogene systems	6	6	29
	Modular work 2		1	
	<i>Final test</i>			
	Total	28	22	99

* according to an individual schedule

Total - 150 hours:

Lectures – 28 hours,

Laboratory work – 22 hours

Consultations – 1 hours

Self-work – 99 hours

References:

Basic:

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- 15) Fookes P.G, E.M. Lee, J.S. Groffiths, (2007). Engeneering geomorphology. Theory and Practice. Whittles Publishing, 279 p.
- 16) *Foster C., Gibson A., Wildman G.* (2008). The new national Landslide Database and Landslide Hazard Assessment of Great Britain. First World Landslide Forum (Tokyo, Japan, 18-21 Nov. 2008) : papers. – Режим доступу до журн. : <http://nora.nerc.ac.uk/4694/>.
- 17) *Garsia_Rodriguez M.J., Malpica J.A., Benito B., Diaz M.* (2008). Susceptibility assessment of earthquake-triggered landslides in El Salvador using logistic regression // *Geomorphology*. Vol. 95. P. 172-191. *Обрії*, 2007. 164 с, розділ 1-2
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