TARAS SHEVCHENKO NATIONAL UNIVERSITY OF KYIV
Institute of Geology

Department ***of Geophysics***

Department ***of Geoinformatics***

«APPROVED»
Deputy Director of the Institute
academic work

Vsevolod DEMYDOV

«29» August 2025

WORK PROGRAM OF THE DISCIPLINE

Nearsurface Geophysics (Приповерхнева геофізика)

for students

Branch of knowledge	**E Natural Sciences, Mathematics and Statistics**
Training direction	**E4 Earth Sciences**
Educational level	**Master**
Educational program	**Geoinformatics**
Type of discipline	**Obligatory**

Teaching mode	**Full-time study**
Academic year	**2025/2026**
Semester	**1**
Number of ECTS credits	**7**
Language of teaching, learning and evaluation	**English, Ukrainian**
Form of final control	**Exam**

Lecturers: *Viktor Onyshchuk, Candidate of Geological Sciences, Associate Professor, Head of the Department of Geophysics*

Oleksandr Shabatura, Doctor of Geological Sciences, Associate Professor of the Department of Geophysics, Associate Professor

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KYIV – 2025

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Approved

Head of the Department of Geophysics

_____ Viktor ONYSHCHUK

Protocol No. 1 of " 26 " August 2025

Approved by the Scientific and Methodological Commission of the Institute of Geology

Protocol No. 1 of " 29 " August 2025

Head of the Scientific and

Methodological Commission _____ Vsevolod DEMYDOV

The discipline aims to provide students with a comprehensive understanding of geophysical methods for mapping and monitoring the physical properties of soil at shallow depths, with a particular emphasis on environmental, geolocation, water, and engineering applications. The emphasis will be on seismic, ground penetrating radar (GPR), and electrical methods, while other methods (laser scanning and electromagnetics) will be presented briefly.

Discipline requirements:

1. Knowledge of the theoretical foundations of physics, mathematics, geophysics, and computational methods.

Annotation of teaching discipline/reference:

The program of the discipline focuses on applied geophysics and methods of performing measurement work. Approaches to solving direct and inverse problems are considered. Methods of qualitative and quantitative interpretation, along with areas of application, are explained through individual field examples. The consideration includes general principles for addressing geophysical problems, an overview of methods for their implementation, and an assessment of their effectiveness. The cycle of calculation problems consolidates theoretical skills.

Object (teaching purposes):

- *Familiarization with the most common geophysical methods used in environmental, geolocation, water, and engineering research.*
- *Find out what physical parameters are measured by each method and how they can be related to the properties of the geological environment that interest you in each application area.*
- *understand the principles of key data acquisition, processing, and interpretation techniques, especially for seismic refraction, GPR, and resistivity;*
- *performing elementary processing steps for each of the above methods using standard software, and interpreting the final results, taking into account possible geophysical limitations.*

Learning results:

Learning outcome (1. to know; 2. be able to; 3. communication; 4. autonomy and responsibility)		*Form/Methods of teaching and studying*	*Form/ Method of evaluation*	*The percentage in the final assessment in the discipline*
Code	Learning outcome			
1.1	*Basic concepts and terms of surface geophysics, classification of geophysical methods, and their studied parameters*	*lecture*	*Paperwork*	*up to 5%*
1.2	*Complex of geophysical methods for engineering and environment*	*lecture, laboratory class*	*Paperwork*	*up to 15%*
1.3	*Complex of geophysical methods for shallow resources*	*lecture, laboratory class*	*Paperwork*	*up to 15%*
1.4	*A set of geophysical methods for archaeology, forensics, and military affairs*	*lecture, laboratory class*	*Paperwork*	*up to 15%*
1.5	*Complex of geophysical methods for groundwater*	*lecture, laboratory class*	*Paperwork*	*up to 15%*
2.1	*Measure, process geophysical observation data, and conduct their geological interpretation*	*lecture, laboratory class*	*Paperwork*	*up to 20%*
2.2	*Be able to organize field and laboratory geophysical measurements*	*lecture, laboratory class*	*Paperwork*	*up to 5%*
3.1	*Be able to organize teamwork to solve the assigned task effectively*	*lecture, laboratory class*	*Paperwork*	*up to 5%*

4.1	*Understanding personal responsibility for professional decisions that may inform the geological environment*	*lecture, laboratory class*	*Paperwork*	*up to 5%*

Correlation between the learning outcomes of the course and the program learning outcomes

Course learning outcomes / Program learning outcomes	1.1	1.2	1.3	1.4	1.5	2.1	2.2	3.1	4.1
To analyze the characteristics of natural and anthropogenic systems and objects of the upper part of the Earth's crust and, in particular, its sedimentary cover.	+	+	+	+	+	+			
To plan and conduct scientific experiments and to write scientific papers in the field of geoinformatics.						+	+	+	+

Discipline structure*: lectures, laboratory classes, and self-studying work of students.*

Scheme of grading forms:

Grading forms

1. Semester grading:

1) Test paper on electromagnetic and penetration methods – 8 points (cut-off mark 5 points)

2) Test paper on magnetic, seismic, and margin technologies – 8 points (cut-off score 5 points).

3) Test paper on processing and analysis of geophysical data – 8 points (cut-off score 5 points).

4) The score for the performance and defense of work in laboratory classes is 36 points (the cut-off score is 22 points).

2. Final examination *in the form of an exam* [1]: *maximum score 40 points, cut-off score 24 points.*

The results of students' academic activities are evaluated on a 100-point scale.

Content modules (CM) form scores that are assigned based on the results of the student's work throughout the semester, *as the sum (weighted or straightforward) of scores for systematic work throughout the semester. The final grade is calculated as the sum of the scores for content modules and the exam scores.*

	Part 1	Part 2	Part 3	exam	Total grade
Min	*12*	*12*	*12*	*24*	*60*
Max	**20**	**20**	**20**	**40**	**100**

*A student is not allowed **to take the exam if he/she have scored less than** 20 points during the semester. [2]The exam score must be at least **24 points** to receive an overall positive grade for the course.*

[1]The semester number of points is formed by the points received by the student in the process of theoretical mastery of the material from all sections of the discipline, seminar classes, performance of practical, laboratory, individual, final control works, creative works during the semester, provided for by the working curriculum (**100** points - *for credit disciplines, if the discipline ends with an exam, then the distribution is carried out according to the following algorithm: **60 points (60%) - semester control** and **40 points (40%) - exam**).*

[2] *In cases where the discipline ends with an exam, the minimum score must be at least **20** points. The recommended minimum **is not less than 36 points**, as students who score less than **24 points on the exam** (which accounts for 60% of the 40 points allocated for the exam) will not be included in the semester grade, regardless of the number of points received during the semester. In the examination report, only the number of points received during the semester is transferred to the "resulting score" column.*

Grading: *Control is carried out according to the modular rating system and involves: performing 10 laboratory works (where students must demonstrate the quality of the acquired knowledge and solve the assigned tasks using the methods and tools outlined by the teacher) and conducting 3 written modular control works. The final assessment is conducted in the form of a written examination.*

Compliance scale

Excellent	90-100
Good	75-89
Satisfactory	60-74
Failed	0 -59

PLAN OF LECTURES AND PRACTICAL CLASSES

No. s/n	Topic name	Hours		
		lectures	Practical	Self-studying work
Part 1. *Electromagnetic and Penetration Methods*				
1	**Topic 1.** Introduction (Application of Surface Geophysics: Overcoming Uncertainty)	2		10
2	**Topic 2.** Resistance method	2	2	10
	Topic 3. Induced and spontaneous polarization method	2	2	10
3	**Topic 4.** Electromagnetic methods	2	2	10
4	**Topic 5.** Penetration methods	2	2	10
	Test 1		2	
Part 2. *Magnetic, seismic, and margin technologies*				
5	**Topic 6.** Magnetic methods	2	2	10
6	**Topic 7.** Seismic methods of reflected and refracted waves	2	4	10
7	**Topic 8.** Seismic surface wave method	2	4	10
8	**Topic 9.** Latest technologies	2	4	10
	Test 2		2	
Part 3. *Data processing and analysis*				
5	**Topic 10.** Data Analysis	2	4	10
6	**Topic 11.** Linear inversion	2	4	10
7	**Topic 12.** Nonlinear inversion. Local methods	2	4	14
	Topic 13. Nonlinear inversion. Global methods	2	4	15
	Test 3	2		
	Examination paper on the discipline			
	TOTAL	**28**	**42**	**120**

Note: Topics assigned for independent study should be noted.

Total volume ***210*** *hours.*[3]**,** including:
Lectures **–** ***28*** *hours.*
Practical training **–** ***42*** *hours.*
Consultations **–** ***1*** *hour.*
Self-studying work **–** ***139*** *hours.*

[3]The total number of hours allocated to this discipline is outlined in the curriculum.

RECOMMENDED SOURCES:[4]

Main:

1. Vyzhva, S.A., Onyshchuk, V.I., Onyshchuk, I.I., Reva, M.V. (2018). *Engineering Geophysics*. Textbook. Kyiv: VPC "Kyiv University", 592 p. (In Ukrainian)
2. Vyzhva, S.A., Reva, M.V., Onyshchuk, I.I., Onyshchuk, V.I. (2014). *Electrometry*. Manual for educational geophysical practice. Kyiv: VPC "Kyiv University", 303 p. (In Ukrainian)
3. Borzyak, O.S., Lyuty V.A., Romanenko, O.V. et al. (2022). *Engineering and geological research for construction*. Textbook. Kharkiv: UkrDUZT. (In Ukrainian)
4. Tolstoy, M.I., Gozhyk, A.P., Reva M.V. et al. (2006). *Fundamentals of Geophysics*. Kyiv: VPC "Kyiv University", 416 p. (In Ukrainian)

Additional:

5. Al-Khafaji, W. (2020). Lectures in Engineering Geophysics.
6. McClymont, A., Martin, Lee, Hildahl, Tom, Niederleithinger, Ernst, Fechner, Thomas, Mackens, Sonja, Galindo Guerreros, Julio Cesar, Mooney, Michael, Bearce, Richard, Carnevale, Mario, Wodajo, Leti, Hickey, Craig, Abera, Liya, DeMarco, Matthew, Tinkey, Yajai, Sack, Dennis, Karaoulis, Marios, Kleine, M., Werf, M., & Chahr, S. (2016). Engineering Geophysics. https://www.doi.org/ 10.4133/SAGEEP.29-028
7. Sharma, P.V. (1997). Environmental and engineering geophysics. Cambridge University Press
8. Everett, M.E. (2013). Near-surface applied geophysics. Cambridge University Press
9. Kirsch, R. (editor). (2009). Groundwater Geophysics - A Tool for Hydrogeology. Springer
10. Butler, D.K. (2005). Near-surface geophysics. SEG
11. Scientific journals: Near-surface geophysics, Journal of Engineering and Geophysics, etc.

[4] *Main: (Basic)* up to 10 fundamental, basic sources. *Additional:* as a rule, up to 20 sources, *including Internet resources*

QUESTIONS FOR SELF-STUDYING WORK

General characteristics of electrical profiling methods: classification, survey methodology, presentation of results, and data interpretation.
Symmetrical electrical profiling.
Combined electrical profiling.
Profiling using the mid-point gradient method.
The anisotropy paradox and its application in electrical prospecting.
Circular profiling surveys.
Vertical Electrical Sounding (VES).
Typification of geoelectrical sections. Types of VES curves.
Self-potential (SP) method: physical principles, survey methodology, presentation of results, and fields of application.
Induced polarization (IP) method: principles, survey methodology, presentation of results, and applications.
Charged-body method: conditions and field of application.
Use of ground-penetrating radar (GPR) for solving near-surface geophysics problems.
Ground-penetrating radar method.
GPR stratigraphy of the upper part of the geological section.
Electrical tomography.
Application of near-surface geophysical methods for landmine clearance tasks.
Application of near-surface geophysical methods for monitoring karst development.
Application of near-surface geophysical methods for detecting areas contaminated with petroleum products.
Uncertainties in geophysics
Sensors in geophysics
Signal filtering
Signal sampling
Signal convolution
Geomagnetic field
Magnetometers
Highlighting anomalies
Magnetic properties of rocks, ores, and minerals
Electrical properties of rocks, ores, and minerals
Multilayer models in electrometry
Natural electric fields
Stress and strain
Wave motion
Seismic waves and modules
Skin effect
Induction of electromagnetic waves in the time domain
Anisotropy
Dielectric permittivity and electrical conductivity
Correlation and covariance
Regularization
Least squares method
Quasi-Newtonian methods