NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Soil Science and Soil Conservation Department

APPROVED

Agrobiology Faculty
"10" 06 2025

CURRICULUM OF ACADEMIC DISCIPLINE

Soil Science with the Basics of Geology

Area of knowledge H "Agriculture, forestry, fisheries and veterinary medicine"
Specialty H1 "Agronomy"
Academic programme "Agronomy"
Faculty "Agrobiology"
Developed by: Professor, Doc Hab., Y. Kravchenko
(position, academic degree, academic rank)

Kyiv – 2025

Description of the discipline

this course is an introductory designed course for the Bachelor student, which provides the basic concepts of all aspects of geology and soil science. It encompasses: Earth's origin; internal and external Earth's dynamics; minerals and rocks – formation, composition, diagnostics and properties changes; agronomic ores properties and application; anthropogenic influence on geologic environment. The course presents the soil composition and genesis; physical, chemical, and biological properties; soil water; classification and mapping; soil conservation; management practices; and soil fertility and productivity (soil testing, use of fertilizers and liming), soil quality assessment. The course gives practical experience as an aid in developing understanding of the minerals, rocks and soils as natural bodies, the use of which has an influence on environmental, human society and life in general.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	*Bachelor*	
Specialty	*H1 "Agronomy"*	
Academic programme	*"Agronomy"*	
Characteristics of the discipline		
Type	Compulsory	
Total number of hours	*180*	
Number of ECTS credits	*6*	
Number of modules	*4*	
Course project (work) (if any)	*1*	
Form of assessment	*Exam*	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	**Part-time**
Year of study	*1, 2*	-
Term	*2, 3*	-
Lectures	*60 hours*	-
Practical classes and seminars	-	-
Laboratory classes	*60 hours*	-
Self-study	*60 hours*	-
Number of hours per week for full-time students	*4 hours*	-

1.Aim, competences and expected learning outcomes of the discipline

Aim: demonstrate understanding of the theoretical basis behind geology and its related concepts; diagnose mineral and rock properties; describe fundamental soil physical, chemical, and biological properties and processes as well as the interactions among them that; govern soil formation; determine soil suitability and capacity to perform various essential production and ecological functions; utilize laboratory techniques to determine soil properties; be able to relate those fundamental soil properties and processes to land use and soil management decisions and implications for soil sustainability, function, and degradation.

Competences acquired:

Integral competence (IC): - the ability to solve difficult specialized tasks and practical problems in agronomy, including the application of theories and methods of the relevant science and is characterized by the complexity and uncertainty of conditions.

General competence (GC):

GC 6 – knowledge and understanding of the subject area and understanding of the professional activity;

GC 7 – ability to apply knowledge in practical situations;
GC 11 – striving to sustain the environmental.

Special (professional) competence (SC):

SC 1 – ability to use the basic knowledge of general subdivisions of agrarian sciences (plant growing, farming, plant selection and seed science, agricultural chemistry, horticulture, soil science, fodder production, agrotechniques in plant growing, plant protection);
SC 3 – knowledge and understanding of basic biological and agrotechnological concepts, rules and theories related to the crops and other plants growing;
SC 8 - ability to solve a wide range of problems and tasks in the process during crop growing, by understanding their biological features and using both theoretical and practical methods;
SC 9 - ability to provide complex management of activities and projects, responsibility for decision making under industrial conditions.

Expected learning outcomes (ELO):

ELO 6 – to demonstrate the knowledge and understanding of fundamental disciplines to the extent necessary to possess relevant skills in the field of agronomy;
PLO 10 – to analyze and integrate knowledge from general and special professional training to the extent necessary for specialized professional work in the field of agronomy;
PLO 11 – to initiate the prompt and expedient solutions of the production problems according to zonal conditions;
PLO 14 – to integrate and improve production processes of crop growing according to current requirements.

2. Programme and structure of the discipline

Names of content modules and topics	Number of hours						
	Full time form						
	weeks	total	including				
			l	p	lab	ind	self
Module 1. General Geology							
Topic 1. Introduction to course. What is soil?	1		2	-	-	-	-
Topic 2. Internal and external spheres of the Earth.	2		2	-	-	-	2
Topic 3. Magmatic, metamorphic and sedimentary processes	3		2	-	-	-	2
Topic 4. Endogenic geological processes.	4		2	-	-	-	4
Topic 5. Weathering processes and soil formation	5		2	-	-	-	2
Topic 6. Exogenic geological processes.	6		2	-	-	-	5
Total for module 1		39	12	-	12	-	15
Module 2. General Soil Science 1							
Topic 7. Soil formation and soil processes	7		2	-	-	-	2
Topic 8. Soil classification	8		2	-	-	-	1
Topic 9. Soil taxonomy and morphology	9		2	-	-	-	1
Topic 10. Overview of soil properties and ecosystem functions	10		2				2
Topic 11. Soil physical properties 1. Texture, structure and soil water categories	11		2				2
Topic 12. Soil ecology 1. Soil communities, plants, macro- and microanimals	12		2	-	-	-	2
Topic 13. Soil ecology 2. Fungi, bacteria and archaea, microbial interactions	13		2	-	-	-	1
Topic 14. Soil organic matter 1	14		2	-	-	-	2
Topic 15. Soil organic matter 2	15		2	-	-	-	2
Total for module 2		51	18	-	18	-	15
Module 3. General Soil Science 2							

Topic 16. Soil colloids	16		2	-	-	-	1
Topic 17. Sorption, cation and anion exchange	17		2	-	-	-	2
Topic 18. Soil acidity and alkalinity	18		2	-	-	-	2
Topic 19. Soil salinity	19		2	-	-	-	2
Topic 20. Soil physical properties 2. Soil structure. soil density, pore space, impacts of tillage	20		2	-	-	-	2
Topic 21. Soil water	21		2	-	-	-	2
Topic 22. Soil air and temperature. Soil productivity	22		2	-	-	-	2
Topic 23. Soils of Ukraine.	23		2	-	-	-	2
Total for module 3		47	16		16		15
Module 4. Soil Geography							
Topic 24. Soils of the Forest zone	24		2				2
Topic 25. Soils of the Forest-Steppe zone	25		2				3
Topic 26. Soils of the Steppe zone	26		2				2
Topic 27. Soils of the Arid-Steppe zone	27		2				2
Topic 28. Saline soils	28		2				2
Topic 29. Alluvial and meadow soils	29		2				2
Topic 30. Soil erosion, degradation and productivity management	30		2				2
Total for module 4		43	14	-	14		15
Course project (work) on Soil Science						1	
Total hours		180	60		60	1	60

3.Topics of lectures

No.	Topic	Hours
1.	Introduction to course. What is soil?	2
2.	Internal and external spheres of the Earth.	2
3.	Magmatic, metamorphic and sedimentary processes	2
4.	Endogenic geological processes.	2
5.	Weathering processes and soil formation	2
6.	Exogenic geological processes.	2
7.	Soil formation and soil processes	2
8.	Soil classification	2
9.	Soil taxonomy and morphology	2
10.	Overview of soil properties and ecosystem functions	2
11.	Soil physical properties 1. Texture, structure and soil water categories	2
12.	Soil ecology 1. Soil communities, plants, macro- and microanimals	2
13.	Soil ecology 2. Fungi, bacteria and archaea, microbial interactions	2
14.	Soil organic matter 1	2
15.	Soil organic matter 2	2
16.	Soil colloids	2
17.	Sorption, cation and anion exchange	2
18.	Soil acidity and alkalinity	2
19.	Soil salinity	2
20.	Soil physical properties 2. Soil structure. soil density, pore space, impacts of tillage	2
21.	Soil water	2
22.	Soil air and temperature. Soil productivity.	2
23.	Soils of Ukraine.	2
24.	Soils of the Forest zone	2
25.	Soils of the Forest-Steppe zone	2
26.	Soils of the Steppe zone	2

27.	Soils of the Arid-Steppe zone	2
28.	Saline soils	2
29.	Alluvial and meadow soils	2
30.	Soil erosion, degradation and productivity management	2

4. Topic of laboratory (practical, seminars) classes

No.	Topic	Hours
1.	The general mineral properties and crystallography	2
2.	Soil minerals	2
3.	Silicates	2
4.	The general rock properties and their formation	2
5.	Rocks as natural formations	2
6.	Quaternary deposits and agronomic ores	2
7.	Lab Safety. Soil sampling	2
8.	Forms (categories) of soil water.	2
9.	Soil hygroscopic moisture determination.	2
10.	Soil granulometry and particle size distribution.	2
11.	Methods of soil texture determination.	2
12.	International pipette and hydrometer methods.	2
13.	Soil organic matter determination.	2
14.	Humus balance	2
15.	Cation exchange capacity determination.	2
16.	Soil acidity and its amendment.	2
17.	Active and exchangeable acidity determination.	2
18.	Hydrolytic acidity determination.	2
19.	Soil alkalinity and salinity.	2
20.	Soil extract analysis.	2
21.	Reclamation of saline soil.	2
22.	Soil productivity assessment.	2
23.	Soil distribution in Ukraine	2
24.	Forest zone soils properties and management	2
25.	Forest-Steppe zone soils properties and management	2
26.	Steppe zone soils properties and management	2
27.	Arid-Steppe zone soils properties and management	2
28.	Saline soil properties and management	2
29.	Alluvial and meadow soils properties and management	2
30.	Soil conservation technologies	

5. Topics of self-study

No.	Topic	Hours
1	Working with geological processes	15
2	Soil Solids and Soil Organic matter	15
3	Soil Productivity	15
4	Soil Survey	15

6. Methods of assessing expected learning outcomes:

- oral and written survey;
- interview;
- test;
- defending laboratory works, projects;
- peer-to-peer assessment, self-assessment.

7. Teaching methods*:*

- problem-based method;
- practice oriented studying method;
- case method;
- project education method;
- flipped classroom, mixed education method;
- research based method;
- learning discussions and debates method;
- team work, brainstorm method.

8. Results assessment.

The student's knowledge is assessed by means of a 100-point scale converted into the national grades according to the "Exam and Credit Regulations at NULES of Ukraine" in force.

8.1. Distribution of points by types of educational activities

Educational activity	Results	Assessment
Module 1. **General Geology**		
Lecture 1. Introduction to course. What is soil?	ELO 6, 10. Understand Earth's landforms, shape, and structure; study the properties of Earth's inner and outer geospheres; develop the ability to identify endogenous and exogenous processes and their resulting landforms, recognize minerals and rocks, and characterize Quaternary deposits (soil-forming rocks) and their role in soil formation.	-
Laboratory work 1. The general mineral properties and crystallography.		10
Lecture 2. Internal and external spheres of the Earth.		-
Laboratory work 2. Soil minerals.		8
Lecture 3. Magmatic, metamorphic and sedimentary processes.		-
Laboratory work 3. Silicates.		8
Lecture 4. Endogenic geological processes.		-
Laboratory work 4. The general rock properties and their formation.		8
Lecture 5. Weathering processes and soil formation.		-
Laboratory work 5. Rocks as natural formations.		8
Lecture 6. Exogenic geological processes.		-
Laboratory work 6. Quaternary deposits and agronomic ores.		8
Self-study 1. Working with geological processes.		20
Module control work 1.		30
Total for module 1		**100**
Lecture 7. Soil formation and soil processes.	ELO 10, 11, 14. Understand soil forming factors and	-
Laboratory work 7. Lab Safety. Soil sampling.		4

Lecture 8. Soil classification.	processes; know laboratory and field safety protocols; learn proper soil sampling techniques; master the classification of water categories in soil; assess plant-available water content; determine hygroscopic moisture, soil texture, and organic matter; comprehend the role of living organisms in soil organic matter accumulation; and predict soil organic carbon content using balance calculations.	-
Laboratory work 8. Forms (categories) of soil water.		4
Lecture 9. Soil taxonomy and morphology.		-
Laboratory work 9. Soil hygroscopic moisture determination.		6
Lecture 10. Overview of soil properties and ecosystem functions.		-
Laboratory work 10. Soil granulometry and particle size distribution.		6
Lecture 11. Soil physical properties 1. Texture, structure and soil water categories.		-
Laboratory work 11. Methods of soil texture determination.		6
Lecture 12. Soil ecology 1. Soil communities, plants, macro- and microanimals.		-
Laboratory work 12. International pipette and hydrometer methods 1.		6
Lecture 13. Soil ecology 2. Fungi, bacteria and archaea, microbial interactions.		-
Laboratory work 13. International pipette and hydrometer methods 2.		6
Lecture 14. Soil organic matter 1.		-
Laboratory work 14. Soil organic matter determination.		6
Lecture 15. Soil organic matter 2.		-
Laboratory work 15. Humus balance.		6
Self-study 2. Working with geological processes.		20
Module control work 2.		30
Total for module 2		**100**
Lecture 16. Soil colloids	ELO 6, 10, 11, 14. Be able to determine soil chemical composition and apply chemical reclamation methods; calculate lime and gypsum application rates for acidic and alkaline soils; assess soil salinity type and degree, as well as leaching water requirements; understand agrotechnological measures for regulating soil air, water, and thermal regimes; and evaluate soil quality and fertility.	-
Laboratory work 16. Soil acidity and its amendment.		7
Lecture 17. Sorption, cation and anion exchange		-
Laboratory work 17. Active and exchangeable acidity determination.		7
Lecture 18. Soil acidity and alkalinity		-
Laboratory work 18. Hydrolytic acidity determination.		7
Lecture 19. Soil salinity		-
Laboratory work 19. Soil alkalinity and salinity.		7
Lecture 20. Soil physical properties 2. Soil structure. soil density, pore space, impacts of tillage		-
Laboratory work 20. Soil extract analysis.		7
Lecture 21. Soil water.		-
Laboratory work 21. Reclamation of saline soil.		7
Lecture 22. Soil air and temperature. Soil productivity.		-
Laboratory work 22. Soil productivity assessment.		8
Self-study 3.		20
Module control work 3.		30
Total for module 3		**100**
Lecture 23. Soils of Ukraine.	ELO 10, 11, 14. Be able to	-

Laboratory work 23. Soil distribution in Ukraine.	classify Ukrainian soils according to their taxonomic units; understand the genesis of soils in different climatic zones of Ukraine; master techniques for morphological description of soil profiles and soil-forming factors; assess soil properties in relation to various agricultural crops; and manage soil fertility at the profile level using modern agrotechnical methods.	6
Lecture 24. Soils of the Forest zone.		-
Laboratory work 24. Forest zone soils properties and management.		6
Lecture 25. Soils of the Forest-Steppe zone.		-
Laboratory work 25. Forest-Steppe zone soils properties and management.		6
Lecture 26. Soils of the Steppe zone.		-
Steppe zone soils properties and management.		6
Lecture 27. Soils of the Arid-Steppe zone.		-
Laboratory work 27. Arid-Steppe zone soils properties and management.		6
Lecture 28. Saline soils.		-
Laboratory work 28. Saline soil properties and management.		6
Lecture 29. Alluvial and meadow soils.		-
Laboratory work 29. Alluvial and meadow soils properties and management.		6
Lecture 30. Soil erosion, degradation and productivity management.		-
Laboratory work 30. Soil conservation technologies.		8
Self-study 4.		20
Module control work 4.		30
Total for module 4		**100**
Class work	**(M1 + M2 + M3 + M4)/4 · 0,7 ≤ 70**	
Exam/credit	**30**	
Total for year	**(Class work + exam) ≤ 100**	
Course project/work		**100**

8.2. Scale for assessing student's knowledge

Student's rating, points	National grading (exam/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Assessment policy

Deadlines and exam retaking rules	works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave).
Academic integrity rules	cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance rules	Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

9. Teaching and learning aids:

- e-learning course of the discipline: https://elearn.nubip.edu.ua/course/view.php?id=2702 and https://elearn.nubip.edu.ua/course/view.php?id=3304;
- lecture notes and presentations (in electronic form);
- textbooks, manuals, lab notes;
- methodological materials for the study of the discipline;
- summer training programme of the discipline.

10. Recommended sources of information

Textbooks:

1. Petrenko L., Berezhniak M., Kravchenko Y., Kozak V., Berezhniak E. Soil Science with Elements of Geology. K.: ЦП ‘’Komprint”, 2020. 702 p.
2. Kravchenko Y.S. Geology with the principles of Geomorphology. Part 1. Dynamic Geology. Київ, ТОВ “Центр ІТ». 2019. 142 p.
3. Brady, N.C. and R.R. Weil. 2021. Elements of the Nature and Properties of Soils, 15th Edition. Pearson Prentice Hall.
4. Бережняк М. Ф., Якубенко Б. Є., Тонха О. Л., Чурілов А. М., Сендзюк Р. В., Бережняк Є. М. Ґрунтознавство з основами геоботаніки. Навчальний посібник. Київ: Вид-во "Ліра". 2019. 636 с.

Laboratory books:

1. Petrenko L., Berezhniak M., Kravchenko Yu., Tonkha O., Berezhniak Ie., Bykova O. Soil Science: Practical Methods Manual. NUBIPU Publishing Center, Kyiv, 2023. 429 p.
2. Tomaizeh S. Soil Science Manual Lab. Hebron University, Soil and Irrigation Department, 2020, 56 p.