

**NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL
SCIENCES OF UKRAINE**

Department of Soil Science and Soil Conservation


"CONFIRMED"

Dean Faculty of Plant Protection,
Biotechnology and Ecology

_____ Y. Kolomiets
" _____ " _____ 2023

"APPROVED"

Soil Science & Soil Conservation Department,
Minutes of Meeting
Protocol № 9 dated 10. 04. 2023

Head of Department
_____  V. Zabaluiev

"REVIEWED"

Program Coordinator of 202 "Plant
Protection & Phyto-Sanitary Control"
Program Coordinator

_____ M. Pikovskyi

PROGRAM OF THE COURSE

"Soil Science with the Basics of Geology"

Specialization:	<u>202 "Plant Protection & Phyto-Sanitary Control"</u>
Educational Programm:	<u>20 "Agriculture and Food Products"</u>
Faculty:	<u>Plant Protection, Biotechnology and Ecology</u>
Developer:	<u>Associate Professor, PhD, Yuriy Kravchenko</u>

Kyiv – 2023

1. Description of the course “Soil Science with the Basics of Geology”

Field of knowledge, specialization, educational program, educational degree	
Educational degree	Bachelor
Educational program	20 “Agriculture and Food Products”
Specialization	202 “Plant Protection & Phyto-Sanitary Control”
Characteristics of the course	
Type	Compulsory
Total number of hours	75
Number of ECTS credits	2,5
Number of content modules	2
Course project (work)	-
Form of assessment	Exam
Indicators of the course for full-time and part-time forms of study	
	Full time
Year of study	2
Semester	3
Lectures	15 hours
Practical work	-
Lab work	30 hours
Self-work	30 hours
Individual work	-
Weekly contact hours loading for full-time students:	3

2. Purpose, objectives, and competencies of the course

Purpose : 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.

Objectives:

1. demonstrate understanding of the theoretical basis behind geology and its related concepts;
2. observe and record geologic features and processes;
3. diagnose mineral and rock properties;
4. describe the generation and use of natural resources;
5. describe fundamental soil physical, chemical, and biological properties and processes as well as the interactions among them that:
 - govern soil formation, development and differentiation,
 - determine soil suitability and capacity to perform various essential production and ecological functions, and
 - allow for sustained use, conservation, and productivity of soil;
6. use laboratory techniques to determine soil properties;
7. 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.

Acquisition of competencies:

Integrated competency (IC):

- the ability to solve the difficult specialized tasks and practical problems of professional activity in the protection and quarantine of plants or the application of basic theories and methods of biology and agrarian sciences under the complex and uncertain conditions.

General Competencies (GC):

- GC 5 - ability to use foreign language;
- 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 8 - safe skills;
- GC 9 - ability to search, process and analyze information from various sources;
- GC 11 - the desire to preserve the environment.

Professional Competencies (PC):

- PC 1 - ability to use basic knowledge of the main subdivisions of agricultural science (crop growing, agriculture, plant breeding and seed production, agrochemistry, fruit growing, vegetable growing, soil science, fodder production, mechanization in crop production, plant protection);
- PC 3 - knowledge and understanding of basic biological and agro-technological concepts, rules and theories related to the plant growing;
- PC 5 - ability to evaluate, interpret and synthesize theoretical and practical information, industrial and research data in the fields of agricultural production.

Program learning outcomes (PLO):

- PLO 3 - communicate freely orally and in writing in Ukrainian and foreign languages on professional issues related to the specialty “Plant Protection and Quarantine”;
- PLO 5 - correctly use appropriate methods of observation, description, identification, classification, cultivation of objects of agrobiocenoses and maintenance of their stability in order to preserve natural diversity.

3. Program and structure of the course for full time students

3.1. Course program

Module1. Soil Genesis

1. The Earth and geological processes. The Earth internal and external layers and their properties. Gravitation, magnetic, thermal and other geophysical fields. Endogenic and exogenic geological processes. Weathering and soil formation

2. Soil formation and soil processes. Soil forming factors, regimes and processes. Parent materials and quaternary deposits. General diagram of soil formation. A concept about the soil horizons. Types of soil profiles. Soils evolution and degradation.

3. Soil classification, taxonomy and morphology. A concept about soil classification, nomenclature and diagnostics. Classification problems in soil science. Principles, goals and values of soils classification. History of soils classification development. Taxonomy units of genetic classification: type, subtype, genus, species, soil texture, lithologic series. Climatic, hydrological and biological principles of soil diagnostics. Morphologic-genetic, chemical and other indexes of soil diagnostics.

Module2. General Soil Science and Soil Geography.

4. Soil physics. Classification of soil texture, particles and their properties. Mechanical analysis. Soil aggregates classification. Particle density, bulk density, determination and analytical procedure. Soil porosity. Soil hardness. State, forms of connection and category of water in soil. Field, capillary, maximum adsorbing, full, available water capacity of soils. Non-available water. Soil water potential. Gaseous phase of the soil. CO₂ dynamics. Convection, diffusion. Air regime and its regulation. Radiation, convection, conduction. Heat adsorbing capacity, albedo, heat capacity, specific heat capacity. Thermal regimes.

5. Soil chemistry. A classification scheme for soil organic matter. Specific and non-specific organic/humus substances. Structure and properties of humus. Interactions of humic substances with mineral components. Types of humus. SOM status. Humification. Structure, composition, origin, classification and properties of soil colloids. Mechanical, physical, exchangeable, chemical, biological retention. Cation exchange capacity. Active and reserve acidity and methods its determination. Base exchange capacity. Active and potential alkalinity. Soil solution. Extent and type of soil salinity. Salt-affected soils. Chemical amendment of soils.
6. Zonal soils of Ukraine. Soddy-Podzolic, Grey forest, Chernozem and Chestnut soils. Classification, genesis, properties, management.
7. Azonal and intrazonal soils of Ukraine. Soddy, bog, meadow, swampy, alluvial soils. Classification, genesis, properties, management.

3.2. Course structure.

12. Course structure:

Names of content modules and topics	Number of hours					Reading Assignments for Quizzes	Homework Assignments
	Full time						
	Week	Total	Including				
Lec			Lab	Self			
<i>Module1. Soil Genesis.</i>							
1. The Earth and geological processes.	1	7	2	-	5	GPG, P.7-86 ГОМ, P.9-90	
2. Soil formation and soil processes.	3	7	2	-	5	FSS, P. 50-66, FSS, P. 226-246	
3. Soil classification, taxonomy and morphology.	5	6	2		4	FSS, P.226-228	Homework 1. Assigned the geo and pedosphere
<i>Mid-term exam 1</i>			-	-	-		
Total for Module 1		34	6	14	14		
<i>Module2. General Soil Science and Soil Geography.</i>							
4. Soil physics.	7	6	2		4	FSS, P.39-50 FSS, P.148-208	
5. Soil chemistry.	9	6	2		4	FSS, P.91-109	Homework 2. Assigned the soil properties
6. Zonal soils of Ukraine.	11-13	7	3		4	FSS, P.246-381	
7. Azonal and intrazonal soils of Ukraine.	15	6	2		4	FSS, P.355-381 FSS, P.271-281	Homework 3. Assigned the soil geography
<i>Mid-term exam 2</i>			-		-		
Total for Module 2		45	9	16	16		
Total	15	75	15	30	30		

6. Laboratory class topics

Type of work	Week	Hours
<i>Module 1. General Geology</i>		
Lab 1. Diagnostics of Physical Properties of Minerals.	1-2	6
Lab 2. Forms (categories) of soil water. Soil hygroscopic moisture determination.	3-4	4
Lab 3. International pipette method of soil texture determination.	5-6	4
<i>Module 2. General Soil Science 2</i>		
Lab 4. Soil organic matter determination.	7-8	4
Lab 5. Soil acidity determination.	9-10	4
Lab 6. Cation exchange capacity determination.	11-12	4
Lab 7. Soils of Ukraine.	13-15	4
Total for course	15	30

7. Independent work topics

№	Topic title	Number of hours
1.	Earth as space and physical body. Internal and external spheres.	1
2.	Magmatic, metamorphic and sedimentary processes.	1
3.	Plate tectonics and crust deformations. Volcanism. Earthquakes.	1
4.	Weathering. Wind movement. Mass wasting. Rivers. Lakes and bogs. Oceans and seas. Glaciers. Ground waters.	2
5.	The quaternary period and soil parent materials.	1
6.	Soil genesis.	2
7.	Soil texture.	2
8.	Soil organic matter.	2
9.	Soil colloids and retention capacity.	1
10.	Soil water and water-related properties.	2
11.	Soil acidity and alkalinity.	2
12.	Soil physical properties.	2
13.	Soil solution. Redox potential.	1
14.	Soil aggregates. Physical and mechanical characteristics of soils.	1
15.	Soil productivity and its evaluation.	1
16.	Soils of the Forest, Forest-Steppe and Steppe zones of Ukraine. Classification, genesis, properties, management.	2
17.	Salt-affected soils (solonchak, solonez, solod). Classification, genesis, properties, management.	2
18.	Meadow-chnozems and meadow soils. Classification, genesis, properties, management.	2
19.	Flooding plain soils (soddy, swampy, alluvial). Classification, genesis, properties, management.	2
Total for self-work		30

8. Samples of control questions, tests for assessing the level of knowledge acquisition by students

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE			
ECL «Bachelor» Specialties: Ecology, Land management, Agrobiology	Soil Science and Soil Conservation department 201__–201__ yr.	Exam paper № 1	Approved Head of department _____ _____ 20__ p.
MID TERM EXAM 1			
1. Common information about the Earth and its structure.			
2. Weathering.			

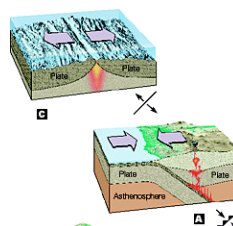
Test block

1. Distribute the minerals according the groups:			
1	Native elements	A	Quartz
2	Sulphides	B	Graphite
3	Silicon oxides	C	Pyrite
4	Iron oxides	D	Magnetite

2. Find the chemical formula of augite:	
1	$(\text{CaNa})_m (\text{Mg}, \text{Fe}^{2+}, \text{Al}, \text{Fe}^{3+})_n (\text{OH}) [\text{Si}_4\text{O}_{11}]$
2	$(\text{CaNa}) (\text{Mg}, \text{Fe}^{2+}, \text{Al}, \text{Fe}^{3+}) [\text{Si}_2\text{O}_6]$
3	$(\text{Mg}, \text{Ca}, \text{K}, \text{Na})_3 \text{Al}_2 (\text{OH})_4 [\text{Si}_4\text{O}_8 (\text{OH})_2] \cdot n\text{H}_2\text{O}$
4	$(\text{Mg}, \text{Fe}^{2+}, \text{Fe}^{3+})_3 [\text{AlSi}_3\text{O}_{10}] (\text{OH})_2 \cdot 4\text{H}_2\text{O}$

5. The shape of the Earth is

10. Identify each of the indicated types of plate boundaries by selecting the correct response.



- 1 convergent boundary
- 2 transform fault boundary
- 3 divergent boundary

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE			
ECL «Bachelor» Specialties: Agrobiology Ecology, Plant Protection, Land management	Soil Science and Soil Conservation department 201__–201__ yr.	Exam paper № 1	Approved Head of department _____. _____ 20 __ p.
FINAL EXAM			
1. Soil texture. Classification of soil texture, particles and their properties. Mechanical analysis. Texture of Ukrainian soils. Extent of soil profile differentiation by texture, granulometric factor of soil aggregation.			
2. Soils of the Forest zone of Ukraine. Classification, genesis, properties, management.			

Test block

1. How many processes are in general scheme of soil formation?	
1	3
2	12
3	8
4	5

2. The content of which fractions are needed to determine:			
a	Group after Kachinsky classification	1	Physical clay
		2	Gravel
		3	Clay
b	Full (Group and Subgroup) after Kachinsky classification	4	Coarse silt
		5	Sand
		6	Fine sand
c	Group and Subgroup after Godlyn classification	7	Medium silt
		8	Fine silt
		9	Colloids

3. Point into specific humic substances:	
1	Fulvic acids
2	Humic acids
3	Proteins
4	Tannins

4. Put in missed words in the sentences:	
1	They define..... soil acidity which is determined by pH of soil solution
2	It is defined.....acidity in soils caused by exchangeable ions H^+ and Al^{3+} located in soil adsorbing complex
3	Reserved soil acidity is divided into..... and

5. Base saturation percent (BSP) is computed by the formula:	
1	$BSP = S * 100 / S + Hh$
2	$BSP = S + Hh / S \times 100$
3	$BSP = S - Hh$
4	$BSP = S / Hh \times 100$

6. Which infiltration rate (mm/hr) is the best for the mineral soils?	
1	500-100
2	Over 500
3	Over 1000
4	60-30

7. By the energy of cation adsorption sequence is:	
1	Na^+
2	F_e^{3+}
3	Ca^{2+}
4	K^+

8. Match soil parameters and productivity characteristics according to the scale A.I.Siry (1974)			
1	SOM stores in 0-100 cm	a	Essential criteria
2	Salinity		
3	Extent of erosion		
4	Active soil moisture (AMD) in 0-100 cm	b	Correction coefficient
5	Bulk density		
6	Climate		

9. Soddy – podzolic soils of sub Ukrainian Polissya may have the following horizons:	
1	HE + E + I + P
2	Ho + He + Hi + Pi + Pk
3	He + Hi + I + Pi + Pk
4	H + Hp + Ph + Pk

10. Match soil types with the natural zones of Ukraine:			
a	Forest	1	Typical chernozem soil
		2	Gleyed soddy soil
b	Forest-steppe	3	Soddy-podzolic soil
		4	Ordinary chernozem soil
c	Steppe	5	Dark chestnut soil
d	Arid steppe	6	Grey forest soil

9. Teaching methods

Teaching methods include: - “Authority lecturing” method with the teacher-centered approach (including ppt presentations, audio & video tools); - “Demonstrator” method, is used to acquire a full understanding of the theoretical and practical knowledge of the subject (soil museum, lab equipment, tools and techniques available by which we investigate soils); - “Real learning” method is used for demonstrating real situations in agriculture and land management; - “Facilitator” method or action method is used to develop problem-solving skills, for ex., how to solve the problems related to: soil organic matter declining, soil acidity, soil salinity, soil compaction, etc.; - “Delegator” or group or the student-centered approach method is beneficial for students group work used in soil mapping and chemical lab-based experiments; - “Blended learning” is based on a strategy that encourages the use of personal preferences in studying research or practical soil science along with face-to-face instruction. This is an integrated teaching style incorporates individual extra-curricular knowledge and specific interests into students scientific or diploma work; - “Field-Trip” method entails visits to places where students studying soils in the nature as well as it has been changed under agriculture influence; - “Brainstorming” method is also beneficial for generating ideas or solving problems within a student group; - “Independent Study” method is widely used outside of the campus and combined with “Online learning” by means of usage “Moodle” platform. This method is focused on students’ self-work; - other methods. There are also other enjoyed techniques used in the course teaching: enthusiasm, pictures, and stories that bring soils alive in the classroom, along with laboratory and field experiences that allow students to grow confidence in their ability to understand and work with soils. To adopt the best teacher practices, a module from geology uses a concept of independent students’ testing with a preliminary self-work preparation at

http://wps.prenhall.com/esm_tarbuck_earth_8/19/5071/1298207.cw/index.html web page.

10. Forms of assessment

Lab reports - lab reports will be submitted in the students’ lab book and teacher’s journal. Lab reports submitted after the due date will be assessed a late penalty of 10% of the total lab report point value for each 24-hour period beyond the due date.

Homework assignments will be announced in the class. The homework assignments will consist of short summary or answer questions that are related to the subject matter being covered in lecture. Homework assignments *must* be submitted as additional text in student workbook.

Mid-term Exams. All mid-term exams dates and themes are shown in the course schedule. At least one week prior to each exam students will receive requesting them to be prepared to examination. Students also will be provided with Study Guide/Learning Objectives for exam. Mid-term exam could be based on oral, writing, quizzing, project or computer-testing procedure. Students who have documented course conflicts with these exam dates and times must contact Dr. Yuriy Kravchenko at least one week prior to the exam date to arrange an alternate exam time. They should get a dean’s permission for this extra examination.

Final Exam. The final is a comprehensive examination and is a writing-quizzing based exam. Date and location for the final exam will be as indicated on the University final exam schedule. Make-up exams will only be granted to students with an excused absence, must be get a dean’s permission, and scheduled with Dr. Yuriy Kravchenko.

11. Distribution of grades received by students

Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated 26.04.2023, protocol №10)

Student rating, points	National grade based on exam results	
	Exams	Credits
90-100	Excellent	Passed

74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactory	
		Not passed

In order to determine the rating of a student (listener) in the discipline R_{dis} (up to 100 points), the rating from the exam R_{ex} (up to 30 points) is added to the rating of a student's academic work R_{aw} (up to 70 points): $R_{dis} = R_{aw} + R_{ex}$.

12. Educational and methodological support

- Textbooks, laboratory books, additional literature, internet sources.
- Lecture and lab classrooms.
- Soil museum.
- Equipment:
 Фотометр полуменевий: BWB-XP G2b, Спектрофотометр скануючий двохпроменевий Libra S-70, рН-метр :Thermo Orion STAR A SERIES, Thermo Orion STAR A SERIES, Дозатор піпетковий з регульованим об'ємом дози Termo Fisher Scientific Oy, 500-5000мкл, Finnpiptette F2, 100-1000мкл, Finnpiptette F2, 1000-10000мкл, шафа сушильна: Thermconcept KTL 400/02/A, ЧОЛ 100/350, Вага лабораторна електронна: OHAUS PA513, OHAUS PA513C, Ваги аналітичні: OHAUS PA214C, Сито лабораторне: СЛ-200 (0,25мм), СЛ-200 (0,25мм), Термогігrometer: TFA D-97877, TFA D-97877, Термостат: IRMECO ILW 53 STD, Млин лабораторний: MF 10 basic IKA-WORKS, Шейкер: GmbH Since 1880 SM-30 C, Дистилятор: GFL 2012, Мішалка магнітна: IKA C-MAG HS 7 з підігрівом, Електроплитка: LDH HPLP-C-P, Термія ЕП42-2,5/220.

13. Recommended sources of information

Textbooks Required:

1. [GPG] Kravchenko Y.S. Geology with the principles of Geomorphology. Part 1. Dynamic Geology. Київ, ТОВ "Центр ІТ». 2009. 142 с.
2. [FSS] Petrenko L.R., Berezhniak M.F., Kravchenko Yu.S., Kozak V.M., Berezhniak E.M. Soil Science with Elements of Geology: [Textbook]. К.: ЦП "Komprint", 2020. 702 p
3. Булигін С.Ю., Вітвіцький С.В. Охорона ґрунтів в агроландшафтах . Навчальний посібник . К.: Видавництво, 2017. 442 с.

Laboratory books Recommended:

4. [ГОМ] Тихоненко Д.Г. Геологія з основами мінералогії : навч. посібник. За ред. д-ра с. -г. наук, проф. Д. Г. Тихоненка. К.: Вища освіта, 2003. — 287 с.
5. [SPM] Petrenko L., Berezhniak M., Kravchenko Yu., Tonkha O., Berezhniak Ie., Bykova O. Soil Science : Practical Methods Manual. NUBIPU Publishing Center, Kyiv, 2013. 429 pp.

Textbooks Recommended:

6. Brady, N.C. and R.R. Weil. 2019. Elements of the Nature and Properties of Soils, 3rd Edition. Pearson Prentice Hall.
7. Foth H. Fundamentals of soil science [11th ed.]. John Wiley & Sons, New York, 1999. 384 pp.

Електронний курс: <https://elearn.nubip.edu.ua/course/view.php?id=3296>