Appx 2
to the Order of March 23, 2023 № 244

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
"____"_____2024

"APPROVED"
Soil Science & Soil Conservation Department,
Minutes of Meeting
Protocol № 9 dated 10. 04. 2023
Head of Department
_____ V. Zabaluiev

"REVIEWED"
Program Coordinator of 101 "Ecology"
Program Coordinator
_____ V. Boholiubov

PROGRAM OF THE COURSE

"Soil Conservation with the Basics of Soil Science"

Specialization: **101 "Ecology"**
Educational Programm: **10 "Natural Sciences"**
Faculty: **Plant Protection, Biotechnology and Ecology**
Developer: **Associate Professor, PhD, Yuriy Kravchenko**

Kyiv – 2024

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	10 "Natural Sciences "
Specialization	101 "Ecology"
Characteristics of the course	
Type	Compulsory
Total number of hours	120
Number of ECTS credits	4
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	30 hours
Practical work	-
Lab work	30 hours
Self-work	60 hours
Individual work	-
Weekly contact hours loading for a full-time student	4

2. Purpose, objectives, and competencies of the course

Purpose : this course is an introductory designed for the Bachelor students and provides the basic concepts of all aspects of geology, soil science and soil conservation. It encompasses: Earth's composition and dynamics, pedosphere, anthropogenic influence on pedosphere. The course also presents the soil composition and genesis; physical, chemical, and biological properties; soil water; soil productivity, soil quality assessment, soil degradation and erosion, soil conservation; management practices. The course gives practical experience for sustainable use of soils, the use of which has an influence on environmental, human society and life in general.

Objectives:

- demonstrate understanding of the theoretical basis behind geology and its related concepts;
- describe the generation and use of natural resources;
- 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;
- utilize laboratory techniques to determine soil properties;
- describe different types of soil degradation;
- 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 complex specialized tasks and solve practical problems in the field of ecology, environmental conservation and sustainable nature use or the application of basic theories and methods of environmental sciences under complex and uncertain conditions – during the learning process.

General Competencies (GC):

- GC 1 - knowledge and understanding of the subject area and understanding of the professional activity;
- GC 2 - ability to use information and communication resources;
- GC 5 - ability to use foreign language;
- GC 7 - ability to provide research at adequate level;

Professional Competencies (PC):

- PC 14 – knowledge and understanding of theoretical basics of ecology, environmental and sustainable nature use;
- PC 18 - ability to estimate the influence of technogenic processes at environmental and finding the ecological risks are caused with industry.
- PC 20 – ability to provide ecological monitoring and estimate the current situation of environmental.

Program learning outcomes (PLO):

- PLO 2 - understand the basic environmental laws, rules and principles of environmental protection and nature management;
- PLO 5 - identify the factors determining the formation of landscape and biological diversity;
- PLO 21 - be able to choose optimal methods and tools for research, data collection and processing.

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

3.1. Course program

Module1. Soil Science

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, genious, spieses, soil texture, lithologic seria. Climatic, hydrological and biological principles of soil diagnostics. Morphologic-genetic, chemical and other indexes of soil diagnostics.

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.

Module2. Soil Conservation.

8. Theoretical basics of soil conservation. General conception of a soil conservation as a science. The structure of the land fund of Ukraine. The state of fertility in Ukrainian soils. Scientific approaches of evaluation degraded soils.
9. Mechanical degradation. Soil erosion and degradation. Classification of erosion processes. Water erosion. Deflation. Soil mechanical disturbance. Runoff.
10. Physical degradation. Reduction of soil physical properties. Plowing pan. Changes in soil texture and soil aggregates. Changes in soil water and thermal regimes of degraded soils.
11. Chemical degradation. Humus stocks and quality decreasing. Soil salinization. Soil contamination.
12. Physico - chemical degradation. Acidification, alkalinization, secondary salinization, decalcination, reduction of oxy-redocks potential and loosing a soil buffer capacity.
13. Biological degradation. Problems with a biodiversity on arable lands. NDVI index. Reduction of soil biological activity and phytosanitation state. Soil toxicity.
14. Reclamation of technogenic degraded soils. Soil cover destruction due to geological exploration, mining and road construction. Types of soil disturbances effected by mining. Reclamation of disturbed lands.
15. Soil conservational management. Conservation tillage, crop rotation, fertilization, strip cropping, contour bunds, terracing. Conservational policy and legislation in Ukraine.

3.2. Course structure.

Names of content modules and topics	Number of hours				
	Week	Total	Including		
			Lec	Lab	Self
Module1. Soil Science.					
1. The Earth and geological processes.	1	6	2	-	4
2. Soil formation and soil processes.	2	6	2	-	4
3. Soil classification, taxonomy and morphology.	3	6	2	-	4
4. Soil physics.	4	6	2	-	4
5. Soil chemistry.	5	6	2	-	4
6. Zonal soils of Ukraine.	6	6	2	-	4
7. Azonal and intrazonal soils of Ukraine.	7	6	2	-	4
Mid-term exam 1					
Total for Module 1	7	56	14	*14*	*28*
Module2. Soil Conservation.					
8. Theoretical basics of soil conservation.	8	6	2	-	4
9. Mechanical degradation.	9	6	2	-	4
10. Physical degradation.	10	6	2	-	4
11. Chemical degradation.	11	6	2	-	4
12. Physico - chemical degradation.	12	6	2	-	4
13. Biological degradation.	13	6	2	-	4
14. Reclamation of technogenic degraded soils.	14	6	2	-	4
15. Soil conservational management.	15	6	2	-	4
Mid-term exam 2	8				
Total for Module 2	15	64	16	16	32
Total		120	30	30	60

6. Laboratory class topics

Type of work	Week	Hours
Module 1. Soil Science.		
Lab 1. Diagnostics of Physical Properties of Minerals.	1	2
Lab 2. Forms (categories) of soil water. Soil hygroscopic moisture determination.	2	2
Lab 3. International pipette method of soil texture determination.	3-4	4
Lab 4. Soil organic matter determination.	5	2
Lab 5. Soil acidity and cations determination.	6	2
Lab 6. Soils of Ukraine.	7	2
Module2. Soil Conservation.		
Lab 7. Land degradation and its evaluation.	8	2
Lab 8. Water erosion evaluation.	9-10	4
Lab 9. Wind erosion evaluation.	11	2
Lab 10. Contour – ameliorative land management.	12-13	4
Lab 10. Calculations of CO_2 emission and humus balance.	14-15	4
Total	15	30

7. Independent work topics

№	Topic title	Number of hours
1.	Earth as space and physical body. Internal and external spheres.	3
2.	Magmatic, metamorphic and sedimentary processes.	3
3.	Plate tectonics and crust deformations. Volcanism. Earthquakes.	3
4.	Weathering. Wind movement. Mass wasting. Rivers. Lakes and bogs. Oceans and seas. Glaciers. Ground waters.	3
5.	Soil genesis.	3
6.	Soil texture.	3
7.	Soil organic matter.	3
8.	Soil colloids and retention capacity.	3
9.	Soil water and water-related properties.	3
10.	Soil acidity and alkalinity.	3
11.	Soil physical properties.	3
12.	Soil solution. Redox potential.	3
13.	Soil aggregates. Physical and mechanical characteristics of soils.	3
14.	Soil productivity and its evaluation.	3
15.	Soil erosion and degradation.	3
16.	Physical degradation.	3
17.	Biodiversity problem on arable lands.	3
18.	Types of soil disturbances effected by geological exploration, mining and road construction.	3
19.	Reclamation of disturbed lands.	3
20.	Soil conservational practices.	3
Total for self-work		60

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**. The Earth in Universe, its structure, composition, age, development. Forms and sizes of the Earth. Figure of the Earth, mass, density. Internal and external the Earth layers, its properties (lithosphere, mantle, core, atmosphere, hydrosphere, biosphere). Gravitation, magnetic, thermal and other geophysical fields. Continental and oceanic types of the Earth's crust. Asthenosphere. Continents and oceans, its relief and structure. Old and young platforms. Geosynclinals.

2. **Weathering**. Weathering types and factors, that cause its. Agents of physical weathering. Oxidation, reduction, hydration, dehydration, hydrolysis, kaolinitization, montmorilonitization. Weathering influence on relief. Core of weathering as a natural complex of mountains, relief, climate which was made historically. Formation of weathering core, its types, structure and depth in different climatic areas. Geographical distribution of the cores of weathering in Ukraine. Young and old layers of weathering. Eluvium as a mother of sedimentary rocks, including parent materials of soils.

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	$(CaNa)_m (Mg,Fe^{2+},Al,Fe^{3+})_n (OH) [Si_4O_{11}]$
2	**(**$CaNa) (Mg,Fe^{2+},Al,Fe^{3+}) [Si_2O_6]$
3	$(Mg,Ca,K,Na)_3Al_2(OH)_4 [Si_4O_8(OH)_2] \cdot nH_2O$
4	$(Mg,Fe^{2+},Fe^{3+})_3 [AlSi_3O_{10}] (OH)_2 \cdot 4H_2O$

3. Match the igneous rocks with the corresponding groups:			
1	Granite	A	Medium
2	Peridotite	B	Acid
3	Sienite	C	Ultra basic
4	Bazalt	D	Basic

4. Which rocks formed paragneisses as a result of metamorphism?	
1	Granites
2	Sandstones
3	Marbles
4	Loess

5. The shape of the Earth is ……

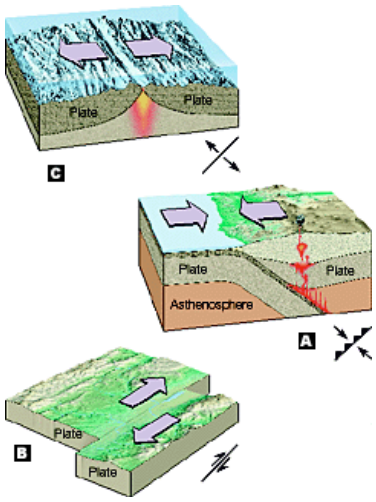
6. Name the type of primary magma:	
1	Schistic
2	Basaltic
3	Sedimentary
4	Biochemic

7. Name folding deformations:	
1	Fault
2	Syncline
3	Grabben
4	Covers (domes)

8. Geologic activity of swamps results in the formation of:	
1	Peat
2	Limnoabrasion
3	Clastic sediments
4	Coal

9. Rifts are a component of:	
1	Plain platform areas
2	Mountain areas
3	Zones of island bows
4	Ocean floor

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	Phisical 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 AI^{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 x 100
3	BSP=S-Hh
4	BSP= S/Hh x 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 were 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” planform. 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 двухпроменевий Libra S-70, pH-метр :Thermo Orion STAR A SERIES, Thermo Orion STAR A SERIES, Дозатор піпетковий з регульованим об'ємом дози Termo Fisher Scientific Oy, 500-5000мкл, Finnpipette F2, 100-1000мкл, Finnpipette F2, 1000-10000мкл, шафа сушильна: Thermconcept KTL 400/02/A, СНОЛ 100/350, Вага лабораторна електронна: OHAUS PA513, OHAUS PA513C, Ваги аналітичні: OHAUS PA214C, Сито лабораторне: СЛ-200 (0,25мм), СЛ-200 (0,25мм), Термогігрометр: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]. K.: ЦП ''Komprint", 2020. 702 p
3. Булигін С.Ю., Вітвіцький С.В. Охорона грунтів в агроландшафтах . Навчальний посібник . К.: Видавництво, 2017.- 442 с.

Laboratory books Recommended:

4. [ГОМ] Тихоненко Д.Г. Геологія з основами мінералогії : навч.; 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 / [L. Petrenko, M. Berezhniak, Yu. Kravchenko та ін.]. 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.

Internet sources.

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