


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

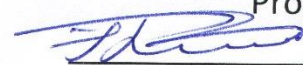
"CONFIRMED"
Dean Land Management Faculty
_____ T. Ievsiukov
" " _____ 2023



"APPROVED"
at the meeting of the department
Soil Science & Soil Conservation
Protocol № 9 dated 10. 04. 2023
Head of Department
_____ V. Zabaluiiev



"REVIEWED"
Program Coordinator of 193 Geodesy
and Land Management
Program Coordinator
_____ I. Kovalchuk



PROGRAM OF THE COURSE
"Soil Science with Basics of Agrochemistry"

Specialization:	<u>193 Geodesy and Land Management</u>
Educational Programm:	<u>19 Architecture and Constructing</u>
Faculty:	<u>Land Management</u>
Developer:	<u>Associate Professor, PhD, Yuriy Kravchenko</u>

Kyiv – 2023

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

Field of knowledge, specialization, educational program, educational degree	
Educational degree	Bachelor
Educational program	Geodesy and land management
Specialization	193 Geodesy and land management
Characteristics of the course	
Type	Obligatory
Total number of hours	90
Number of ECTS credits	3
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
Course (year of study)	1
Semester	2
Lecture classes	30 hours
Practical, seminar classes	-
Lab classes	30 hours
Self-study	30 hours
Individual assignments	-
Number of weekly classroom hours for the full-time form of study	3 hours

2. Purpose, objectives, and competencies of the course

Purpose : students will gain an appreciation of soil as a valuable natural resource and as an integral and essential part of terrestrial ecosystem, and will be able to utilize their knowledge of soil science to solve relevant issues confronted in their academic and professional careers.

Objectives:

1. demonstrate understanding of the theoretical basis of agricultural chemistry and its related concepts;
2. analyze the natural processes of soil formation;
3. 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;
4. use laboratory techniques to determine soil properties;
5. be able to provide soil and land quality assessment.

Acquisition of competencies:

Integrated competency (IC):

- the ability to solve complex specialized problems of geodesy and land management.

General Competencies (GC):

- GC 1 - ability to study and hold of up-to-date knowledge;
- GC 2 – ability to use knowledge at practical situations;
- GC 13 - the ability to predict, multiply of moral, cultural, scientific values and achievements of society based on understanding of history, patterns of development of the subject area, its place in the general system of knowledge about nature and society, as well as in the development of society, techniques and technology, using its for recreation and healthy living.

Professional Competencies (PC):

- PC 1 - the ability to apply fundamental knowledge for the analysis of natural and technogenic phenomena underperforming professional tasks in the field of geodesy and land management.
- PC 3 - ability to apply regulatory and legal acts, regulatory and technical documents, reference materials in professional activities;
- PC 5 - ability to use up-to-date information, technical and technological support to solve difficult issues of geodesy and land management.

Program learning outcomes (PLO):

- PLO 3 - ability to apply normative legal acts, normative technical documents, reference materials in professional activity;
- PLO 5 - apply conceptual knowledge of natural and socio-economic sciences when performing tasks of geodesy and land management;
- PLO 6 – ability to perform remote, ground, field and cameral studies, engineering calculations for processing the results of studies, form the results of studies, prepare reports when solving geodesy and land management tasks;
- PLO 7 – ability to collect, update, process, critically evaluate, interpret, store, publish and use geospatial data and metadata regarding objects of natural and technogenic origin.
- PLO 8 – ability to carry out professional activities in the field of geodesy and land management, taking into account the requirements of professional and civil safety, labour protection, social, ecological, ethical, economic aspects.

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

3.1. Course program

Module 1. General soil science.

1.1. Introduction to Soil Science. Introduction of the course: overview, syllabus, schedule, objectives, grading policy, teaching methods, the module-rating system, grading scale, attendance policy, examination policy, NUBiP principles.

1.2. What is soil? A concept about the soil. Soil as a natural body, medium for plant growth. The soil functions as a component of biogeocenosis, lithosphere. A role of soil properties in ecological stability of landscapes. Soil as a difficult natural structural system. Structural levels of a soil organization. A place, functions and role of soil in nature. Effect of minerals and rocks weathering on soil formation.

1.3. Soil formation and soil processes. Soil forming factors, regimes and processes. Macro-, meso- and micro processes within a solum. General diagram of soil formation. A concept of the primary, medium and mature phases of soil formation. The energy and particles distribution in a soil profile. A concept about the soil horizons. Types of soil profiles. Soils evolution and degradation.

1.4. Soil classification. 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.

1.5. Soil taxonomy and morphology. 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.

1.6. Soil physical properties 1. Texture and structure. Classification of soil texture, particles and their properties. Mechanical analysis. The field and pipet method. Stokes' Law. Texture of Ukrainian soils. Extent of soil profile differentiation by texture, granulometric factor of soil aggregation. Binomial and trinomial, American classifications of soil texture, their principles, differences and characteristic features. General genetic, agronomical and ecological values of soil texture.

1.7. Soil organic matter. Sources of SOM and its composition. OM remains quantity and quality in different ecosystems. SOM Determination. A classification scheme for soil organic matter. Specific and non-specific organic/humus substances. Structure and properties of humus (humic substances). Interactions of humic substances with mineral components. Types of humus. SOM status after L.O. Grishina and D.S. Orlov. Organic matter in different soil types. Humification.

1.8. Soil colloids. A concept about the soil colloids. Structure, composition, origin, classification and properties of soil colloids. Colloidal state, coagulation and peptization. Adsorption, electro kinetics, protective and other properties of soil colloids, their influence on soil formation. A role of soil colloids in the formation of soil fertility. Ecological value of soil colloids.

1.9. Sorption, cation and anion exchange. Mechanical, physical, exchangeable, chemical, biological retention. Saturated and unsaturated soils with bases and its dependence on cations composition. The energy of ions sorption. Cation exchange capacity. Cation composition of Ukrainian soils. Base saturation percent. Influence of mineral fertilizers on the cation adsorbing capacity and properties of soils. Agronomical and ecological essence of soil adsorption.

1.10. Soil acidity and alkalinity. Sources of soil acidity. pH reaction and its ranges. Active and reserve acidity and methods its determination. Base exchange capacity. Chemical amendment of acid soils, liming rate. Active and potential alkalinity. Extent of soil sodicity. Determination of the extent of soil sodicity and calculation of gypsum rates. Resistance of agricultural crops to soil acidity and sodicity.

1.11. Soil salinity. Salt-affected soils. Soil Extract Analysis. The concentration of soil colloids. Toxic salts. Extent and type of soil salinity. The oxidation and reduction processes in Soil solution. Redox potential, T.Clark index. Salt tolerance of plants. Secondary salinity or sodicity. Management of salt-affected soils. Leaching rate.

Module 2. General soil science and soil geography

1.12. Soil physical properties 2. Soil structure, soil density, pore space, impacts of tillage. Soil aggregates classification. Agronomically favorable structural aggregates. Aggregates within different soils, soil horizons. Particle density, bulk density, determination and analytical procedure. Soil porosity. Total, aeration, capillary porosity determination. Soil's resistance to tillage. Soil hardness.

1.13. Soil water. A role of water in plant growing, vital functions of animals and microorganisms. State, forms of connection and category of water in soil. Soil water and water-related properties. States, forms, categories of soil water and its properties. Field, capillary, maximum adsorbing, full, available water capacity of soils. Non-available water. Soil water potential.

1.14. Soil and the hydrologic cycle. Soil Productive water content evaluation. Soil water balance, regimes. Soil water management.

1.15. Soil climate. Soil air and temperature. Gaseous phase of the soil. Composition of soil air. CO₂ dynamics. Convection, diffusion. Air penetrability. Anaerobiosis. Air regime and its regulation. Energy exchange processes. Radiation, convection, conduction. Heat adsorbing capacity, albedo, heat capacity, specific heat capacity. Heat conductivity, heat regime of soil. Thermal regimes.

1.16. Soil ecology. Features of the ecosystem. Factors in soil formation and functioning and their effects at different levels. The functioning of the soil system. Soil as a reservoir of biodiversity. Soil food web: from the tiniest one-celled bacteria, algae, fungi, and protozoa, to the more complex nematodes and micro-arthropods, to the visible earthworms, insects, small vertebrates, and plants. Conceptual organization of soil organisms. Essential functions performed by soil organisms.

1.17. Soil productivity and its evaluation. Essential Criteria. The typical soil grades in points. Etalon of grades. The prices of the grades of soil evaluation. Weighted average grade. Correction coefficients. Soil grade. Soil class. Land Area Evaluation. Bonitation grade of a field. Correction Coefficients for the Technological Properties of Land Areas. Correction Coefficients for the Nonuniformity of Soil Cover. The grade point of land area evaluation.

1.18. Soils of the Forest Zone of Ukraine. Soddy-Podzolic, Sod, Swampy soils. Classification, genesis, properties, management.

1.19. Soils of the Forest-Steppe zone of Ukraine. Grey forest soils, Podzolized, Leached, Typical Chernozems. Classification, genesis, properties, management.

1.20. Soils of the Steppe zone of Ukraine. Ordinary and Southern Chernozems. Classification, genesis, properties, management. Chestnut soils. Classification, genesis, properties, management.

1.21. Alluvial and Meadow Soils. Meadow-chernozems, meadow, soddy, swampy, alluvial soils. Classification, genesis, properties, management.

1.22. Saline soils. Solonchak, solonetz, solod. Classification, genesis, properties, management.

3.2. Course structure for full time students.

Names of content modules and topics	Week	Number of hours			
		Total	Including		
			Lec	Prac	Self
Module 1. General Soil Science					
Lecture topic 1. Introduction to Soil Science.	1	4	1	1	1
Lecture topic 2. What is soil?	1	4	1	1	1
Lecture topic 3. Soil formation and soil processes.	2	4	1	1	1
Lecture topic 4. Soil classification.	2	4	1	1	1
Lecture topic 5. Soil taxonomy and morphology.	3	4	1	1	1
Lecture topic 6. Soil physical properties 1. Texture and structure.	3	6	1	1	2
Lecture topic 7. Soil organic matter.	4	8	2	2	2
Lecture topic 8. Soil colloids.	5	4	1	1	1
Lecture topic 9. Sorption, cation and anion exchange.	5	4	1	1	1
Lecture topic 10. Soil acidity and alkalinity.	6	8	2	2	2
Lecture topic 11. Soil salinity.	7	6	2	2	1
<i>Total for Module 1</i>	7	42	14	14	14
Module 2. General Soil Science and Soil Geography					
Lecture topic 12. Soil physical properties 2. Soil structure, soil density, pore space, impacts of tillage.	8	6	2	2	1
Lecture topic 13. Soil water.	9	6	1	1	2
Lecture topic 14. Soil and the hydrologic cycle.	9	4	1	1	1
Lecture topic 15. Soil climate. Soil air and temperature	10	4	1	1	1
Lecture topic 16. Soil ecology.	10	6	1	1	2
Lecture topic 17. Soil productivity and its evaluation.	11	6	2	2	1
Lecture topic 18. Soils of the Forest Zone of Ukraine.	12	8	2	2	2
Lecture topic 19. Soils of the Forest-Steppe zone of Ukraine.	13	6	2	2	1
Lecture topic 20. Soils of the Steppe zone of Ukraine.	14	6	2	2	1
Lecture topic 21. Alluvial and Meadow Soils.	15	6	1	1	2
Lecture topic 22. Saline soils.	15	6	1	1	2
<i>Total for Module 2</i>	8	48	16	16	12
<i>Total for course</i>	15	90	30	30	30

6. Laboratory class topics

Type of work	Hours
Module 1. General Soil Science 1	
Lab 1. Soil sampling. Lab Safety.	2
Lab 2. Forms (categories) of soil water. Soil hygroscopic moisture determination.	2
Lab 3. Soil granulometry and particle size distribution.	2
Lab 4. International pipette method of soil texture determination.	2
Lab 5-6. Feel and hydrometer methods of soil texture determination.	2
Lab 7. Soil organic matter lab determination.	2
Module 2. General Soil Science and Soil Geography	
Lab 8. Soil organic matter evaluation.	2
Lab 9. Soil acidity determination.	2
Lab 10. Cation exchange capacity determination.	2
Lab 11. Soil alkalinity and salinity.	2
Lab 12. Soils of the Forest and Forest-Steppe zones of Ukraine.	2
Lab 13. Saline Soils and Soils of the Steppe zone of Ukraine.	2
Lab 14. Wet and mountain soils of Ukraine.	2
Lab 15. Soil Productivity Evaluation.	2
Total for course	30

7. Independent work topics

№	Topic title	Number of hours
1.	Soil texture.	2
2.	Soil physical properties.	2
3.	Soil colloids and retention capacity.	2
4.	Soil water and water-related properties.	2
5.	Soil organic matter.	2
6.	Soil acidity and alkalinity.	2
7.	Soil solution.	2
8.	Soil productivity and its evaluation	2
9.	Soil genesis.	2
10.	Soils of the Forest zone of Ukraine. Classification, genesis, properties, management.	2
11.	Soils of the Forest-Steppe zone of Ukraine. Classification, genesis, properties, management.	2
12.	Soils of Steppe zone of Ukraine. Classification, genesis, properties, management.	2
13.	Salt-affected soils (solonchak, solonez, solod). Classification, genesis, properties, management.	1
14.	Soddy-Podzolic, Sod, Swampy, soils. Classification, genesis, properties, management.	0.5
15.	Chernozems. Classification, genesis, properties, management.	1
16.	Grey forest soils. Classification, genesis, properties, management.	0.5
17.	Kastanozems. Solonchak, solonetz, solod. Classification, genesis, properties, management.	0.5
18.	Meadow-chernozems and meadow soils	0.5
19.	Flooding plain soils (soddy, swampy, alluvial). Classification, genesis, properties, management.	1
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: Agrobiological Ecology, Plant Protection, Land management	Soil Science and Soil Conservation department 201__–201__ yr.	Exam paper № 1 from Soil Science	Approved Head of department _____ Balayev A.D. _____ 201__ p.
Test questions			
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

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 ⁺

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 двухпроменевий 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, 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. Petrenko L.R., Berezhnyak M.F., Dudar T.V., Berezhnyak Ye.M. Fundamentals of soil science. Kyiv, NAU-druk, 2010. 457 p.
2. Brady, N.C. and R.R. Weil. 2010. Elements of the Nature and Properties of Soils, 3rd Edition. Pearson Prentice Hall.
3. Foth H. Fundamentals of soil science [8th ed.]. John Wiley & Sons, New York, 1990. 384 pp.
4. Ґрунтознавство: Підручник. Д.Г. Тихоненко, М.О. Горін, М.І. Лактіонов та ін.; за ред. Д.Г. Тихоненка. — К.: Вища освіта, 2005.
5. Назаренко І.І., Польчина С.М., Дмитрук Ю.М. Ґрунтознавство з основами геології: підручник. Чернівці: Книги – XXI, 2006. 504 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, 2013. 429 pp.
2. Гнатенко О.Ф., Петренко Л.Р., Капштик М.В. Ґрунтознавство з основами геології: Метод. рекоменд. до вивчення курсу лекцій і лаборат. занять. К.: НАУ, 1997. 78 с.

Additional literature:

1. Тихоненко Д.Г., Дехтярьов В.В., Горін М.О., Веремеєнко С.І., Фурман В.М., Гавва Д.В. Картографія ґрунтів: підручник [для студ. Агроном., еколог., інженер., спец. Вищих навч. закл. освіти III-IV рівнів акредитації]; за ред. Д.Г.Тихоненка; ред-укл. М.О. Горін. (3-тє вид., допов. і перероб.). Х.:Майдан, 2014. 394с.:іл.

Internet sources

1. Електронний курс:
<https://elearn.nubip.edu.ua/course/view.php?id=2700>